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Abstracts Oral

LIPID HUMIFICATION BY SOIL MINERALS

Presenter: A.R. Adams (15358445@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A.R.	Adams	Department of soil science, Stellenbosch University, Private Bag X1, Matieland, 7602.
C.E.	Clarke	Department of soil science, Stellenbosch University, Private Bag X1, Matieland, 7602.
A.G.	Hardie	Department of soil science, Stellenbosch University, Private Bag X1, Matieland, 7602.

Introduction

Humification processes generate various recalcitrant forms of carbon in soils. This carbon pool plays a crucial role in mitigating climate change and overall soil health. Soil minerals catalyze the humification of biomolecules such as sugars, amino acids and polyphenols (e.g. Hardie et al., 2007). However, it is unknown whether these soil minerals catalyze the humification of lipids (fats), a group of biomolecules whose structures are found in some of the most recalcitrant forms of soil carbon. This study undertook to determine whether soil minerals humify lipids, characterize the products formed, and investigate the rates and mechanisms of these reactions.

Materials and Methods

Several oxides and clay minerals were reacted with fatty acids and triglycerides. Reactions were monitored, and products analyzed, with GC-MS, FTIR, NMR, UV-VIS and ESR spectroscopy. Product recalcitrance was studied using TGA and DSC techniques.

Results and Discussion

Significant polymerization (humification) of the lipids were observed. Oxidation and coupling of both free fatty acids and triglycerides occurred as well as significant breaking of the triglyceride glycerol-fatty acid ester bonds also occurred (e.g. Gomez et al. 2011). Mn-oxides polymerized lipids to the greatest degree, catalyzing humification through various radical reactions. Highly recalcitrant products were formed as a result of the reactions.

Conclusions

Minerals catalyze lipid humification, generating highly recalcitrant forms of carbon. These formerly unknown reactions thus contribute a significant portion to the global soil carbon pool.

References

Hardie AG, Dynes JJ, Kozak LM, Huang PM. 2007. Influence of polyphenols on the integrated polyphenol-Maillard reaction humification pathway as catalyzed by birnessite. *Annals of Environmental Science* 1: 91-110. Gomez NA, Abonia R, Cadavid H, Vargas IH. 2011. Chemical and spectroscopic characterization of a vegetable oil used as dielectric coolant in distribution transformers. *Journal of the Brazilian Chemical Society* 22: 2292-2303.

TAILORING TRIPLE CROPS OF RICE-RICE-VEGETABLE SEQUENCES IN RAINFED SAWAH RICE BASED TECHNOLOGY TO FARMERS' FIELD CONDITION.

Presenter: SO Adigbo (sundayadigbo@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
SO	Adigbo	Institute of Food Security, Environmental Resources and Agricultural Research
IO	Vaughan	Institute of Food Security, Environmental Resources and Agricultural Research
CI	Alarima	Department of Agricultural Extension & Rural Development
CG	Afolabi	Department of Crop Protection
CA	Onifade	General Study unit
JN	Odedina	Department of Plant Physiology & Crop Production, Federal University of Agriculture Abeokuta, Nigeria
TO	Fabunmi	Department of Plant Physiology & Crop Production, Federal University of Agriculture Abeokuta, Nigeria

Introduction

Farmers in Ogun State, Nigeria have the potential to grow 3 crops in a Sawah rice based technology but lack the technical know-how. A field trial on a triple crop of rice-rice-fluted pumpkin was carried out in the 2016/2017 cropping season to (1) evaluate the sowing methods of rice-rice in rice-rice-vegetable sequences (2) determine economic optimum sowing method.

Materials and Methods

Field trials were conducted on farmers' field at Sowumi village, Nigeria. The inland valley was designed into Sawah. Bunds were manually done while power tiller was used for tilling, puddling and leveling of the soil. The 2 x 2 x 3 factorial experiment had 2 rice (*Oryza sativa* L) varieties (main plot) and two sowing methods (sub plot). The first crop was established in April and harvested in August. The succeeding rice crops had 3 sowing methods (ratooned rice, transplants and broadcasting as the sub sub-plots) and were established in September and harvested in December. Fluted pumpkin (*Telfairia occidentalis*) was planted on the entire field during the dry season. The treatments were replicated three times. The data collected were plant height, number of days to 50% heading, panicle length, panicle weight and grains panicle⁻¹, panicle m⁻¹, and grain yield ha⁻¹ for 2 rice crops and fresh leaf weight of pumpkin.

Results and Discussion

Transplanted (4.38 t ha⁻¹) and broadcasted (2.75 t ha⁻¹) yields of rice for the first rice crop were higher than that of the farmers' variety at 2.22 and 2.58 t ha⁻¹ respectively. Partial budgeting revealed that net benefit obtained from transplanting and broadcasting the improved variety were N593 300 and N453 100 ha⁻¹, respectively while transplanted and broadcasted local variety were N536,000.00 and N313, 500 ha⁻¹, respectively. The second crop of rice had similar grain yield of 2.19, 1.91 and 2.27 t ha⁻¹ for ratooned, transplanted and broadcasted rice, respectively. However, the cost of land preparation, seeds, transplants and broadcasting of the second upland rice crop gave ratooned rice an edge. The fresh leaf weight of fluted pumpkin were similar. The combined yield of broadcast 'Ofada' rice-ratooned rice-pumpkin were comparable to the transplanted WITA 4-ratooned rice-pumpkin in terms of economically viability. These appealed to the farmers because labour needed for land preparation, seeding for transplanted and broadcast of second crop competed with postharvest handling.

Conclusions

The trial shows that transplanted WITA 4-ratooned rice-pumpkin and broadcast 'Ofada'-ratooned rice-pumpkin were best among the twelve combinations. It further revealed that farmers preferred Ofada rice-ratooned rice-pumpkin sequence.

References

GAMETOCLONAL VARIATION IN EGYPTIAN BREAD WHEAT (TRITICUM AESTIVUM L.)

Presenter: KZ Ahmed (k.z.ahmed@mu.edu.eg)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
KZ	Ahmed	Department of Genetics, Faculty of Agriculture, Minia University, El-Minia, Egypt, Eg-61519
ATM	Ata	Department of Genetics, Faculty of Agriculture, Minia University, El-Minia, Egypt, Eg-61519
SAM	Osman	Department of Genetics, Faculty of Agriculture, Minia University, El-Minia, Egypt, Eg-61519
MAA-EI	Nagy	Department of Genetics, Faculty of Agriculture, Minia University, El-Minia, Egypt, Eg-61519

Introduction

Wheat is the most important staple food in Egypt, but unfortunately, Egypt is one of the largest importers of wheat. Gametoclonal variation is heritable genetic variation observed among and within regenerated plants from in vitro culture of haploid gametes. Therefore, assessing gametoclonal variation in plants of 35 gametoclones and their 6 donor Egyptian wheat cultivars was the main goal of this study.

Materials and Methods

Thirty-five gametoclones (R1& R2) obtained from in vitro anther culture of 6 Egyptian cultivars of spring bread wheats (*Triticum aestivum* L.) were evaluated at Minia Univ., Egypt during 2008-2010 on agronomical, cytological, and biochemical levels. A field experiment was done in a RCB design with 3 replicates. Eleven agronomical traits were measured and data were statically analyzed. The genotypes mean were compared using Duncan's multiple range testing (LSD; $P < 0.05$). Meiotic parameters of gametoclones and their parents were checked using the spikes. Chiasma frequencies and different chromosomal abnormalities were calculated and data were statically analyzed. Banding pattern of three enzymes (esterase, phosphorylase and α -Amylase) were tested. For isozyme analysis, crushed leaves were used. Cluster analysis was performed with MVSP software.

Results and Discussion

Agronomical studies: There were significant differences between and within the parental cultivars and its derived gametoclones for most studied characters. Some gametoclones exhibited high performance in yield and/or yield component characters in comparison with its parental cultivars. **Cytological studies:** All examined genotypes (cultivars and gametoclones) were diploid ($2n = 6X = 42$ chromosomes) and possess 21 meiotic bivalent units. Most of them were ring-shaped and few were rod-shaped. Significant differences of chiasma frequency between parental cultivars and their derived gametoclones were observed. Chromosome lagging, fragment, bridges, outside chromosomes, micronuclei and microcytes were commonly observed. **Biochemical studies:** Three enzymatic proteins (Esterase, Phosphorylase and α -Amylase) were showed as genetic variation in gametoclones and parental cultivars due to point gene mutation. Cluster analysis of enzymatic patterns, clearly showed that each wheat cultivar and its derived gametoclones are nearly together in the same group with a few exceptions.

Conclusions

The gametoclonal variation induced by anther culture offered an opportunity to broaden the genetic variation of wheats and a wide range of plant characters could be altered and detected by agronomically, cytologically and biochemically analyses. New superior and promising genotypes have been detected. However, genetic stability of those gametoclones are of out most importance when used in plant breeding programs.

References

EVALUATION OF METHAM SODIUM FOR THE CONTROL OF VOLUNTEER POTATOES

Presenter: J Allemann (Allemannj@ufs.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
J	Allemann	Department of Soil, Cop and Climate Sciences, University of the Free State, P.O. Box 339, Bloemfontein, 9300, South Africa

Introduction

The control of volunteer potatoes in succeeding crops is crucial, as they can cause problems in the rotation program and also serve as a source of pests and diseases for neighbouring potato crops. These plants are difficult to control as they emerge over an extended period of time, as well as the fact that each tuber can produce a number of plants. The aim of this project is to attempt to identify a suitable herbicide/s that can preferably be applied pre-plant or pre-emergence to the crop, so that these plants will be controlled before they become a problem.

Materials and Methods

The use of the soil fumigant metham sodium to control plants of four potato cultivars (Mondial, Sifra, Innovator and Lanorma) was investigated in a glasshouse trial (28/18°C day/night). Polyethylene pots (37x37x27.5 cm) were filled with a loamy sand soil (16% Clay). Metham sodium at rates of 0.2, 0.4, 0.6, 0.8 and 1.0x the recommended application rate of 459 kg ha⁻¹ was applied seven days after planting. The required amount of fumigant was added to 250 mL of water and evenly spread over the soil surface prior to being leached into the soil using the equivalent of 20 mm of precipitation. Harvesting took place 65 DAP when stem numbers, plant height, and tuber number, as well as plant and tuber mass were determined. Data were converted to a percentage of the control treatment in order to negate inherent cultivar differences prior to statistical analysis.

Results and Discussion

Analysis of raw data showed that cultivars reacted differently to different rates of metham sodium. Analysis of percentage of control data showed highly significant effects due to fumigant concentration, with reductions in all parameters even at the lowest application rate. Plant mass of all cultivars was significantly reduced by metham sodium applications greater than 183.6 kg ha⁻¹ (0.4x). Lanorma was the least sensitive to this product. Innovator showed the least effect regarding haulm numbers, probably due to few haulms developing in the control treatments. This resulted in no significant differences being obtained, although haulm number of other cultivars decreased at all application rates. Tuber numbers were significantly reduced by all application rates, with the exception of that of Innovator at 0.2x.

Conclusions

This product appears to be suitable for control of volunteer plants at application rates of 0.4x (183.6 kg ha⁻¹) if applied before shoots are well developed. The trial must be replicated to confirm these results.

References

Impact of drought on the allelopathic effects of Amaranth

Presenter: I Allemann (ingridallemann@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
I	Allemann	University of the Free State
M	Cawood	University of the Free State
E	Van Der Watt	University of the Free State

Introduction

Drought can be defined as a period without significant rainfall and is a major limiting factor in crop production so understanding drought stress and its effects due to global changes in the climate is very important. Morphological, physiological and metabolic systems of all plant organs are effected by drought stress and this can directly or indirectly affect its allelopathic performance. It has been proven that *Amaranthus* has allelopathic properties thus the aim of this study was to determine the effect of drought stress on these properties and its influence on lettuce germination and seedling growth.

Materials and Methods

Amaranthus cruentus plants were drought stressed for 0, 24, 48, 72 and 96 hours, while incubated under a 12 hours light photoperiod at 28/21°C day/night temperatures. The allelopathic potential of plant residues from these stressed plants was evaluated using the agar sandwich method. A doubled layered agar (5 % w/v) technique was used to evaluate the effect of dried plant residues (1 & 5 mg mL⁻¹) on the germination and seedling growth of lettuce seeds. Five seeds were placed on the upper layer of the agar in a completely randomised block design and replicated three times. The radicle and hypocotyl lengths as well as germination percentage were measure after three days of incubation in the dark at 25°C. All data were analysed using SAS and Turkey's least significant difference (LSD) test at 5% level of significance to determine statistically significant differences between treatment means.

Results and Discussion

Seed germination was significantly inhibited by residues from drought stressed plant stressed for 24 up to 96 hours at the highest concentration. Results also showed that there was a clear inhibition of 73% on the germination with non-stressed plant at the highest concentration. Seedling growth was inhibited by 100% and 96% for the radicle and hypocotyl length respectively when exposed to leaf residues stressed for 24 hours. All treatments inhibited radicle and hypocotyl lengths at 5 mg ml⁻¹.

Conclusions

Residues of all five drought treatments significant inhibited radicle and hypocotyl lengths at the highest concentration of 5 mg mL⁻¹. However the time of exposure to drought stress as well as concentration affects the allelopathic properties and its effect on seedling growth.

References

AFRICAN LEAFY VEGETABLES AS A WEAPON FOR FOOD AND NUTRITIONAL SECURITY: A CASE OF CLEOME GYNANDRA

Presenter: S.O. Amoo (amoos@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S.O.	Amoo	ARC-Vegetable and Ornamental Plants, Private Bag X293, Pretoria 0001, South Africa
M.	Moyo	Department of Horticultural Sciences, Faculty of Applied Sciences, Cape Peninsula University of Technology, Symphony way, P.O. Box 1906, Bellville 7535, Cape Town, South Africa
A.O.	Aremu	Centre of Excellence in Indigenous Knowledge Systems, Faculty of Natural and Agriculture, Science, North-West University, Mafikeng Campus, P. Bag X2046, Mmabatho 2735, South Africa
J.	Gruz	Laboratory of Growth Regulators & Department of Chemical Biology and Genetics, Centre of the Region Haná for Biotechnological and Agricultural Research, Faculty of Science, Palacký University & Institute of Experimental Botany AS CR, Šlechtitelů 11, CZ-783 71 Olomouc, Czech Republic
M.	Šubrtová	Laboratory of Growth Regulators & Department of Chemical Biology and Genetics, Centre of the Region Haná for Biotechnological and Agricultural Research, Faculty of Science, Palacký University & Institute of Experimental Botany AS CR, Šlechtitelů 11, CZ-783 71 Olomouc, Czech Republic
P.	Tarkowski	Centre of the Region Haná for Biotechnological and Agricultural Research, Department of Genetic Resources for Vegetables, Medicinal and Special Plants, Crop Research Institute, Šlechtitelů 27, 78371 Olomouc, Czech Republic
K.	Doležal	Laboratory of Growth Regulators & Department of Chemical Biology and Genetics, Centre of the Region Haná for Biotechnological and Agricultural Research, Faculty of Science, Palacký University & Institute of Experimental Botany AS CR, Šlechtitelů 11, CZ-783 71 Olomouc, Czech Republic

Introduction

African leafy vegetables (ALVs) are marginalized crops, perceived as poor man's food and regarded as inferior commodities with poor urban consumer preference, resulting in their limited commercial exploitation. Existing literature however, suggest that these crops are of strategic importance to the welfare of rural communities, especially in terms of addressing food and nutritional security, certain illnesses, women empowerment, socio economic development and nature conservation. Thus, a study was conducted to compare the nutritional profile of an underutilized ALV, *Cleome gynandra* (commonly known as spider plant, African cabbage or cat's whiskers), against two of the most widely consumed commercial vegetables in the world; viz *Brassica oleracea* (cabbage) and *Beta vulgaris* (Swiss chard).

Materials and Methods

Freeze-dried vegetable samples were analysed for their mineral element content using ICP-MS while ascorbic acid, beta-carotene, and individual phenolic acid content were quantified using HPLC. Their total phenolic and flavonoid content as well as antioxidant activity were also determined using spectrophotometric methods.

Results and Discussion

Phosphorus, potassium, calcium, iron and zinc content were significantly higher in *Cleome gynandra* compared to *Beta vulgaris* and *Brassica oleracea*. Specifically, the phosphorus content in *Cleome gynandra* was 3.3 and 5.5 times greater than that of *Beta vulgaris* and *Brassica oleracea*, respectively. Similarly, the calcium content in *Cleome gynandra* was 2.7-fold more than in *Beta vulgaris* and 10.4-fold higher than in *Brassica oleracea*. *Cleome gynandra* zinc content was twice that of *Brassica oleracea*. The concentration of β -carotene (vitamin A precursor in plants) was 21.9 times higher in *Cleome gynandra* compared to *Brassica oleracea*. Vitamin C content in *Cleome gynandra* was 3.2- and 4.7-fold higher than that of *Beta vulgaris* and *Brassica oleracea*, respectively.

Conclusions

Our findings provide compelling scientific evidence of ALVs' potential in adding diversity to our diet and contributing towards the daily nutritional requirements of millions of people. *Cleome gynandra* and other indigenous leafy vegetables may provide the ultimate weapon against dietary deficiencies in Africa and beyond.

References

Effect of Phenolic Compounds and Seedcoat Thickness of 'Hass' and 'Fuerte' Avocado (*Persea americana* Mill.) on Seed Germination

Presenter: MA ARABI (mamounarabi@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MA	ARABI	School of Agricultural Science and Agribusiness, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209, Pietermaritzburg
I	BERTLING	School of Agricultural Science and Agribusiness, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209, Pietermaritzburg

Introduction

Although avocado fruit physiology is well-researched, little is known about avocado seed physiology. The objective of the study was to determine the phenolic compounds and seedcoat thickness in the two avocado cultivars 'Hass' and 'Fuerte' in relation to germination of mature and immature seeds.

Materials and Methods

The seeds used in this study were obtained from a commercial orchard in the KwaZulu-Natal Midlands (30°16_E and 29°28_S, South Africa). 'Hass' and 'Fuerte' avocado fruit were collected from June to December, based on uniformity of appearance and size. The main parameters determined was the seedcoat thickness was measured with a digital micrometer. The tetrazolium test was employed to determine seed viability, where sound tissues produce a normal red colour, while weak, living tissues produce an abnormal color and dead tissues do not stain. Phenolic compounds were determined using a Folin-Ciocalteu method (Siger and Lampart, 2008). Germination percentage was determined over a three-week period in a germination chamber.

Results and Discussion

Mature, brown seedcoats contained higher amounts of phenolic compounds than immature ones, but the seed coat showed no physiological activity. Immature seedcoats were characterised by less phenolics and whiter and thicker seedcoats than mature seeds. The experiment showed higher initial germination of immature seeds for both cultivars, possibly due to the high phenolics inhibiting germination (Williams & Hoagland, 1982).

Conclusions

Seedcoat thickness could be involved in the reduced germination percentage of mature avocado seeds. Phenolics compound could be concentrated in seedcoats of the mature seeds and low concentration in immature seeds that effect immature seeds to germinate like mature seeds for 'Hass' and 'Fuerte'.

References

SIGER, A., NOGALA-KALUCKA, M. & LAMPART-SZCZAPA, E. 2008. The content and antioxidant activity of phenolic compounds in cold-pressed plant oils. *Journal of Food Lipids*, 15, 137-149. Williams, R., & Hoagland, R. (1982). The Effects of Naturally Occurring Phenolic Compounds on Seed Germination. *Weed Science*, 30(2), 206-212. doi:10.1017/S0043174500062342.

Agricultural use suitability assessment and characterization of municipal liquid sludge from selected wastewater treatment plants: Survey around Gauteng, South Africa

Presenter: TB Badza (tarubadza@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T	Badza	Department of Plant and Soil Sciences, University of Pretoria, Private Bag X20, Pretoria, South Africa
EH	Tesfamariam	Department of Plant and Soil Sciences, University of Pretoria, Private Bag X20, Pretoria, South Africa

Introduction

Sludge recycling as an agricultural resource has gained greater attention around the world. This has been exacerbated by the ever-rising municipal wastewater production and its potential for use as a soil amendment resource. Use of wastewater sludge in agricultural lands is limited by its quality (pathogens, pollutants, and stability). There is little information on the quality and viability of using treated municipal wastewater sludge from plants around Gauteng as a source of water and nutrients for agriculture. Hence, the aim of this study is to assess the viability of using treated wastewater sludge for irrigation.

Materials and Methods

Municipal liquid sludge samples were collected in September to November 2015 from eighteen wastewater treatment plants (WWTPs) employing various wastewater treatment processes in Gauteng province, South Africa. Samples were prepared and analysed for physical and chemical parameters following standard procedures. One way ANOVA was performed (GenStat) to determine WWTP effect on measured parameters.

Results and Discussion

Organic matter content varied significantly within and across treatment processes. It followed the order; activated > anaerobic > aerobic with averages of 73.18%, 62.78% and 55.86% for activated, anaerobic and aerobic sludge respectively. Activated sludge showed significantly higher total nitrogen averaging 5.9% compared to anaerobic (3.7%) and aerobic sludge (4.2%). However, inorganic N followed the order; anaerobic > aerobic > activated sludge, with ammonia N ($\text{NH}_4^+ - \text{N}$) significantly dominant inorganic N fraction in the three sludge types in all WWTPs. There was no consistent pattern in total phosphorus which varied significantly across WWTPs regardless of the treatment process. However, this was a different scenario for extractable P (P Bray-1) which was significantly higher for activated sludge ($\geq 0.1 \text{ mg kg}^{-1}$) relative to $\leq 0.1 \text{ mg kg}^{-1}$ for anaerobic sludge across WWTPs. Stability, pollutants and salinity are fundamental aspects that give sludge some acceptable qualities for agricultural use. About 78 % of anaerobic plants, 29% of activated and 50% of aerobic plants could not meet the minimum quality requirements. The main limitations were toxic metals and salinity (anaerobic) and stability (activated and aerobic) plants' sludge. The observed variations in various aspects of sludges in this study indicate the differences in composition and origin of the wastewater material.

Conclusions

Sludge is a complex and unique product in its own way. Toxic metals in anaerobic sludge and stability of activated sludge present the limitations to the use of sludges from WWTPs in this study. Lead, molybdenum, cobalt, vanadium and selenium were the most toxic metals present.

References

EFFECT OF HARVEST TIME, DEHYDRATION PLUS WAXING AND STORAGE TEMPERATURE ON NON-CHILLING AND CHILLING RIND PHYSIOLOGICAL DISORDERS OF 'BENNY' VALENCIA CITRUS FRUIT

Presenter: RG Baloyi (baloyigranny@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
RG	Baloyi	University of Limpopo, Private Bag X1106, Sovenga 0727, Limpopo Province, South Africa
N	Mathaba	Agricultural Research Council – Tropical and Subtropical Crops, Private Bag X11208, Nelspruit, Mpumalanga Province, South Africa
TP	Mafeo	University of Limpopo, Private Bag X1106, Sovenga 0727, Limpopo Province, South Africa

Introduction

As a phytosanitary treatment against fruit fly, South African citrus fruits must be cold sterilized during export to overseas markets. However, 'Benny' Valencia citrus fruit are highly susceptible to non-chilling and chilling rind disorders during shipping under cold sterilization at -0.6°C (Ehlers, 2016). The aim of this study was to investigate the effect of harvest time, postharvest dehydration plus waxing and storage temperature on peel pitting and chilling injury disorders of 'Benny' Valencia fruit.

Materials and Methods

'Benny' Valencia fruit were harvested early (15 June 2017), mid (05 July 2017) and late (28 July 2017) season. After harvest, fruit were transported to the Agricultural Research Council-Tropical and Subtropical Crops (ARC-TSC) for post-harvest treatment, storage and evaluation. At the laboratory, fruit were divided into treatment A (control), B (Waxed with Citrishine® and dehydrated at $25^{\circ}\text{C} \pm 45\% \text{RH}$) and C (unwaxed but dehydrated at $25^{\circ}\text{C} \pm 45\% \text{RH}$). After treatment, fruit were stored at -0.6 and 4.5°C for 28 days, thereafter 7 days at ambient temperature. During the 7 days shelf-life, fruit were evaluated for non-chilling and chilling disorders, weight loss, electrolyte leakage and firmness loss.

Results and Discussion

Non-chilling disorders were significantly higher for fruit harvested at late season, while chilling injury was higher for fruit harvested early season, especially during storage at -0.6°C . Furthermore, dehydration stress without waxing increased manifestation of both non-chilling and chilling rind physiological disorders at -0.6°C when compared with 4.5°C storage. Waxing reduced the incidence of peel pitting and chilling injury disorders, weight loss and electrolyte leakage. In addition, high peel pitting and chilling injury manifestation correlated with high fruit weight loss and electrolyte leakage.

Conclusions

In conclusion, harvesting time, dehydration after harvest plus waxing and storage temperature contribute to susceptibility of 'Benny' Valencia fruit to non-chilling and chilling rind physiological disorders.

References

Ehlers, J.L., 2016. Post-harvest rind pitting studies on 'Valencia' orange. University of Stellenbosch, PhD thesis.

WATER USE OF 'MIDKNIGHT' VALENCIA ORCHARDS IN THE WINTER RAINFALL REGION OF SOUTH AFRICA

Presenter: M Banda (mathy.banda@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M	Banda	Department Plant and Soil Sciences Private Bag X20 Hatfield 0028 South Africa
JT	Vahrmeijer	
NJ	Taylor	Department Plant and Soil Sciences Private Bag X20 Hatfield 0028 South Africa

Introduction

With the current drought conditions in South Africa, much attention has been given to the amount of water required to grow agricultural crops. The future sustainability of water supply to agriculture is of deep concern to the citrus industry. Most studies on citrus water use have focused on determining the level of water application necessary to obtain yield and quality, rather than directly determining the actual water requirements of the trees. This is important as the industry needs to justify the volumes of water used to guarantee future quotas and sustainability of the citrus industry. The Water Research Commission of South Africa solicited, funded and managed a project on quantification of citrus water use. The aim of this study was to measure transpiration of well managed drip irrigated 'Midnight' Valencia orchards.

Materials and Methods

Quantification of citrus water use was conducted in 'Midnight' Valencia orchards planted in 2000 (old) and 2008 (young). In each orchard four trees were instrumented with a validated sap flow method (heat ratio method). Individual tree water use was upscaled to orchard tree water use. Reference evapotranspiration (ET_o) was calculated from meteorological data (temperature, relative humidity, wind speed and solar radiation) collected by an automatic weather station, according to the FAO56 procedure. Measurement of plant water relations included leaf water potentials and stomatal conductance.

Results and Discussion

For both orchards, transpiration increased with VPD up to a certain point, with no further increase in transpiration once VPD exceeded between 1.5 and 2 kPa. A similar response was observed for ET_o and no further increase in transpiration was observed when atmospheric demand exceeded approximately 6 mm. Higher transpiration crop coefficient values were observed during the winter than summer. Average daily transpiration over the measuring period was 1.2 mm day⁻¹ for the younger orchard (395 days) and 1.6 mm day⁻¹ for the older orchard (717 days). The total transpiration over the measuring period was 481 mm and 1 153 mm for the young and old orchard respectively. The maximum transpiration measured was 2.1 mm day⁻¹ in the young orchard, while in the old orchard the maximum transpiration measured was 3.0 mm day⁻¹ over the measuring period.

Conclusions

The good estimates of water use obtained in this study are important for accurate irrigation planning and scheduling.

References

Acknowledgements

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OVERALL SENSITIVITY OF TOMATO CV. 'FLORADADE' TO NEMARIOC-AL PHYTONEMATOCIDE UNDER FIELD CONDITIONS

Presenter: H Bango (bangohappy@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
H	Bango	University of Limpopo, Private Bag X 1106, Sovenga, 0727, South Africa
KG	Shadung	University of Limpopo, Private Bag X 1106, Sovenga, 0727, South Africa
PW	Mashela	University of Limpopo, Private Bag X 1106, Sovenga, 0727, South Africa

Introduction

Nemarioc-AL phytonematicide has been researched and developed, with the major challenge being phytotoxic and inconsistent results in nematode suppression (Mashela et al. 2015). Allelochemicals in phytonematicides applied inappropriately could reduce plant growth of different plant species by approximately 50% to complete crop failure (Mashela et al. 2015). Therefore, the objective of this study was to determine phytotoxic response of tomato cv. 'Floradade' using different concentrations of Nemarioc-AL phytonematicide under field conditions.

Materials and Methods

Uniform four weeks-old seedlings of tomato (*Solanum lycopersicon*) cv. 'Floradade' were transplanted at 60 by 60 cm spacing (for both inter and intra-row spacing) in a field trial. The Nemarioc-AL phytonematicide experiment was laid out in a randomized complete block design with 7 treatments, namely, 0, 2, 4, 8, 16, 32 and 64% of Nemarioc-AL phytonematicide which were replicated 10 times. Treatments were applied once a week as a supplement to irrigation. At 64 days after initiation of treatments, plant variables data were collected, processed and subjected to analysis of variance using statistix 10.0 at 5% level of significance.

Results and Discussion

Nemarioc-AL phytonematicide significantly affected plant height, stem diameter, number of fruits, dry shoot mass, dry root mass and chlorophyll content, contributing 60, 77, 74, 83, 71 and 53% in total treatment variation (TTV) of the respective variables. Nemarioc-AL phytonematicide reduced plant height, chlorophyll content, stem diameter, number of fruits, dry shoot mass and dry root mass as the concentration increased. Similar results were obtained by Tseke et al. 2013.

Conclusions

Most of the variables were negatively affected by Nemarioc-AL phytonematicide under field conditions. High concentration of Nemarioc-AL phytonematicide induced phytotoxicity resulting in inhibition of plant growth.

References

Mashela PW, Dube ZP, Pofu KM. 2015. Phytotoxicity of soil-amended phytonematicides and related inconsistent results on nematodes suppression. In: Meghvansi MK, Vorm A (eds.), Organic amendments and soil suppressiveness. Switzerland: Springer International Publishers. Tseke PE, Mashela PW, Mokgalong NM. 2013. Responses of tomato plant growth and root-knot nematodes to Nemarioc-AL phytonematicide. African Crop Science Conference Proceedings 11:367–370.

Diversity of landraces using phenotypic and molecular markers

Presenter: TM Bapela (bapelat@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
TM	Bapela	Agricultural Research Council, Small Grain Institute, Bethlehem, South Africa
VL	Tolmay	Agricultural Research Council, Small Grain Institute, Bethlehem, South Africa
MC	Makungu	Department of Agriculture and Environmental science, University of South Africa, Pretoria, South Africa

Introduction

Majority of farmers depend on breeders, researchers and seed companies to provide wheat cultivars with desirable traits combined in single genotype. These genotypes are developed through crossing different plants containing desirable traits followed by extensive multiple trait evaluation and selection of superior genotypes. Landraces can be a good source of desirable traits such as tolerance to biotic and abiotic stresses and yield potential. The aim of this study is to determine (i) the phenotypic diversity of some wheat landraces using four South African biotypes of *Diuraphis noxia* (RWA) i.e. RWASA1, RWASA2, RWASA3 and RWASA4 and (ii) their molecular diversity using SSR markers.

Materials and Methods

A Russian wheat aphid resistance screening bioassay was conducted in a glasshouse in Bethlehem (28°09'55.12" S, 28°18'32.97" E), Free State. Twenty-four landraces and five check genotypes were tested using a randomised block design with three replicates of five seeds each, for each biotype RWASA1, RWASA2, RWASA3 and RWASA4. Seedling were infested with five aphids per plant and each bioassay was kept in separate cubicle to avoid cross contamination. The test entries were scored 21 days after infestation using a 1-10 damage rating scale (Tolmay et al., 2012). Leaf samples were taken from five individual plants of each landrace with superior resistance to RWASA3 and RWASA4 for genotypic evaluation. DNA was extracted using the DArT DNA extraction protocol and relevant SSR markers were tested to identify single plants containing rare but sought-after yield traits for molecular diversity of the landraces.

Results and Discussion

The results showed high resistance to RWASA1, RWASA2 and RWASA4 with susceptibility in the RWASA3 bioassay. Landraces of the same line are expected to give different reactions towards the same biotype and this was observed in each bioassay. The SSR markers have also proven to be useful tools in identifying the sought-after yield traits aiding significantly in marker-assisted selection (MAS).

Conclusions

These results are helpful in preparation to any occurrence of a new biotype or decline in wheat production in terms of knowing which cultivar to provide farmers due to yield potential.

References

Tolmay VL, Jankielsohn A and Sydenham SL. 2012. Resistance evaluation of wheat germplasm containing Dn4 or Dny against Russian wheat aphid biotype RWASA3. *Journal of Applied Entomology*, 13: pp476-480.

EVALUATING SOIL AND TERRAIN VARIABLES IN A PRODUCTION ENVIRONMENT: IMPLICATIONS FOR AGRICULTURAL LAND ASSESSMENT

Presenter: KR Barichiev (kurt.barichiev@kzndard.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
KR	Barichiev	KZN Department of Agriculture and Rural Development: Private Bag X9059, Pietermaritzburg 3201
JT	Atkinson	KZN Department of Agriculture and Rural Development: Private Bag X9059, Pietermaritzburg 3201
CE	Clarke	Department of Soil Science, University of Stellenbosch, Private Bag X1, Matieland, 7602
AB	Rozanov	Department of Soil Science, University of Stellenbosch, Private Bag X1, Matieland, 7602

Introduction

One of the biggest threats facing food security in South Africa is the loss of agricultural land to non-productive land uses. Current methods of farm-level evaluation rely on a number of predefined soil-physical and terrain related properties to delineate the landscape into homogeneous areas of similar limitations or production potential. The objective of this study is to assess how well individual land assessment based variables and sets of variables, relate to actual production in a commercial, dryland environment.

Materials and Methods

The study area is adjacent to Woodstock Dam in north-western KwaZulu-Natal and covers approximately 2 000 ha of commercial farm land, with maize and soybean being the primary crops produced. A total of 162 representative soil observation pits were dug to a depth of between 1.5 and 2 m, classified and recorded. To reduce bias, applicable observation points were buffered to 5 m and pertinent soil and terrain variables, were then assigned to these buffered points. High resolution yield data was cleaned and summarised within the given buffer and finally evaluated using the extracted soil and terrain information.

Results and Discussion

The 5 m buffer approach, for representing point to region data, produced adequate results for this analysis. The buffer maintains local relevance, while lowering the potential for errors associated with using the single closest yield point. Analysing soil and terrain properties across all yield classes masked important trends, due to data averaging. Subdividing the data into low, medium and high yield subsets improved correlation particularly for the low yield class. Generally, as the yield increased the relationship between the soil and terrain properties and yield variation decreased. Functional soil groups, such as ecotopes, performed well across all yield classes. Promisingly, combining indicators across methods, into modified sub-sets showed improved correlations in both lower and higher yielding areas.

Conclusions

The relationship between land assessment classification and actual production is often poorly understood. Results of this study indicate that many of the soil and terrain properties, used by conventional land assessment techniques, do not adequately account for production variability within a yield class. New variables within the soil and terrain components need to be investigated and introduced to the assessment method to ensure agricultural land is correctly classified in terms of actual production. It is hoped that this new integrated method will improve accuracy and standardise land assessment methodologies and ultimately safeguard more agricultural land for future food production needs.

References

EFFECT OF MORINGA LEAF EXTRACT ON GROWTH AND DEVELOPMENT OF SWISS CHARD AND PARSLEY

Presenter: I Bertling (Bertlingi@ukzn.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
I	Bertling	UKZN- PMB PBag X01 Scottsville 3209 Pietermaritzburg
MC	Mabaso	
SZ	Tesfay	

Introduction

Swiss Chard (*Beta vulgaris* var. *cicla*), often called 'spinach' in South Africa, is one of the most widely consumed green vegetables in South Africa, commercially and in home gardens. Nonetheless, little is known about the crop and its response to fertilizer and means to enhance its production. As a leafy crop, nitrogen supply is likely to be one of the major factors driving yield enhancements. This excessive supply of nitrogen to spinach (*Spinacia oleracea*) has raised health concerns over the consumption of the crops in many parts of the world. Other natural products, such as moringa (*Moringa oleifera*) leaf extracts (MLE), have also been reported to enhance vegetative growth as well as suppress certain leaf pests, thereby improving yield and quality of Swiss Chard. The aim of the study was to evaluate the effect of MLE application on certain growth and development and physiological parameters of Swiss Chard.

Materials and Methods

The experiment was conducted in a tunnel structure at the University of KwaZulu-Natal, Pietermaritzburg Campus, KwaZulu-Natal, South Africa. Swiss Chard was planted into pots filled with composted pine bark. Plants were automatically fertigated to run-off 3 times daily and MLE was applied (to run-off) several times using various concentrations of MLE. The experiment was set out in a factorial completely randomized design with three replicates. Data were collected on leaf emergence, leaf size, leaf fresh and dry mass as well as leaf colour, chlorophyll and carotenoid concentration. During production plants were scouted for pests and diseases.

Results and Discussion

Plants which received the additional MLE application outperformed the control crop in several parameters. Vegetative growth was enhanced (leaf size and fresh and dry mass) as well as the occurrence of certain phytochemicals such as chlorophylls and carotenoids, corresponding to the greener appearance of the crop. The results indicated that the application of MLE, at all concentrations used can significantly increase production of this crop.

Conclusions

The application of MLE has potential as a crop performance-enhancing treatment. Once the active ingredients have been identified, it might be possible to formulate a new crop growth enhancer using MLE.

References

Cultivar Evaluation relying on genotype main effect vs GxE analysis for “Valencia” yield and quality

Presenter: Z Bijzet (zeldab@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
Z	Bijzet	ARC-Tropical and Subtropical Crops, Private Bag X11208, Nelspruit, 1200, South Africa
MT	Labuschagne	University of the Free State, Bloemfontein, South Africa,
M	Booyse	ARC-Biometry Unit, Private Bag X5013, Stellenbosch, 7599, South Africa
AD	Sippel	ARC-Tropical and Subtropical Crops, Private Bag X11208, Nelspruit, 1200, South Africa

Introduction

To survive the highly competitive export domain, it is essential for citrus producers to expand on their cultivar basket (Ndou, 2012). The aim of this study was to resolve the intricacies of a scion-rootstock evaluation trial with regard to identifying genotypes with an improved performance over a standard control cultivar per locality over a number of years by comparing the typical univariate analysis applied by fruit tree researchers to the GxE approach commonly applied in line breeding.

Materials and Methods

The univariate approach vs GxE approach was compared for annual data analysis per locality and data analysis with regard to year effect on production and quality within the Valencia group with four selections and the control cultivar “Delta” (1043). Characteristics measured in the trials were tree size and volume, fruit production (yield) and five fruit quality characteristics. A combined ANOVA was performed annually per locality, using PROC GLM of the SAS/STAT software, Version 6.0 of the SAS System for [Unix]. SAS Institute Inc. (1990). Treatment means (e.g. scion, rootstock, scion x rootstock) were compared using Fisher’s t-test with LSD (Steel and Torrie, 1980). This approach was compared to a classical multiplicative model or AMMI (Gauch, 1992) with two multiplicative terms and genotype-by-environment interaction (GGE) models using GenStat 15th edition (Payne et al., 2012). Shapiro-Wilk test was performed to test for normality of the residuals (Shapiro and Wilk, 1965).

Results and Discussion

Regarding the Valencia group, at Malalane all of the new cultivars were better than the standard Valencia cultivar (1043) and could be recommended, and the best rootstock for yield was 575. The same applied to quality aspects where the standard Valencia cultivar (control) constantly displayed the lowest quality. It was also concluded that the best rootstocks with regard to yield and quality were 575 and 608 respectively. GEI was evident for both scions and rootstocks.

Conclusions

It was evident, in conclusion that univariate statistical tests such as ANOVA and t-tests are not sufficient to unravel the genotype x genotype interaction and its subsequent interactions with the environment. It was further concluded that in order to identify mega-environments within multi-environmental trials with a two-fold objective of identifying genotypes with both high performance and stability as well as test environments that are both representative and discriminative, multivariate models should be investigated with the available data for future application in a fruit-breeding programme.

References

Gauch HG. 1992. Statistical analysis of regional yield trials: AMMI analysis of factorial designs. Amsterdam: Elsevier
Ndou P. 2012. The competitiveness of the South African Citrus industry in the face of the changing global health and environmental standards. Alice, South Africa: University of Fort Hare
Payne RW, Harding SA, Murray DA, Soutar DM, Baird DB, Glaser AI, Welham SJ, Gilmour AR, Thompson R, Webster R. 2012. The Guide to GenStat Release 15, Part 2: Statistics. Hemel Hempstead UK: VSN International. SAS Institute, Inc. 1990.
SAS/STAT® 6.0 SAS Institute Inc., SAS Campus Drive, Cary, North Carolina 27513
Shapiro SS, Wilk MB (1965) An analysis of variance test for normality (complete samples). *Biometrika* 52:591-611
Steel RGD, Torrie JH. 1980 Principles and Procedures Of Statistics: A Biometrical Approach. New York, McGraw Hill

'NADORCOTT' MANDARIN FRUIT DEVELOPMENT AND THE INFLUENCE OF 20% WHITE SHADE NETS THEREON WITH EMPHASIS ON FRUIT QUALITY PARAMETERS

Presenter: J. Botes (botesjohane22@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
J	Botes	Department of Horticultural Science, University of Stellenbosch South Africa. Lombardi Building, Victoria street, Stellenbosch, 7602
E.W.	Hoffman	Department of Horticultural Science, University of Stellenbosch South Africa. Lombardi Building, Victoria street, Stellenbosch, 7602
L	Zacarias	Instituto de Agroquímica y Tecnología de Alimentos (IATA-CSIC), Valencia, Spain
PJR	Cronje	Citrus Research International, Department of Horticultural Science, University of Stellenbosch, South Africa. Lombardi Building, Victoria street, Stellenbosch, 7602

Introduction

In citrus fruit, size and external appearance (rind color and blemish free fruit) determines the consumer's acceptance and the sugar:acid ratio is an important determinant of the taste. Emphasis has been placed on producing fruit of good quality, and it is known that light intensity is especially important in influencing soluble solid content (SSC), rind colour (Cronje et al., 2013) and sunburn. Extreme environmental conditions are difficult factors to control. Shade nets are used over fruit crops for protection against climatic events that affect the appearance of fruit i.e. excess sunlight, wind and hail (Rajapakse and Shahak, 2007). The aim of this study was to determine the influence of 20% white shade net on the quality aspects of 'Nadorcott' mandarin fruit (*Citrus reticulata*).

Materials and Methods

The study was conducted on 'Nadorcott' trees planted in 2012 in a commercial orchard in Citrusdal, Western Cape, South Africa. Monthly orchard measurements (January to June) on fruit size and rind color were performed, in addition to destructive measurements to determine the °Brix, citric acid percentage and °Brix:acid ratio. Fruit was also evaluated for sunburn incidence.

Results and Discussion

The fruit diameter was not influenced by shade net in 2016, however a larger fruit diameter for shade net fruit occurred in 2017. Rind colour development was not influenced. This is in contrast to the findings of other studies, which showed coloration was enhanced in 'Spring' navel (Syvertsen et al., 2003) and delayed in 'Ruby Red' grapefruit (Jifon and Syvertsen, 2001). The maturity of the fruit was not influenced by shade net. The shade net was effective in reducing sunburn by 18 % and 16 % for 2016 and 2017 respectively, which is in agreement with Lee et al. (2015).

Conclusions

Shade net influenced the fruit diameter in the second season, resulting in a larger diameter fruit at the end of the season. Shade net was effective in reducing the percentage of sunburn, however the light intensity was not reduced to such an extent that it influenced the rind colouration. Furthermore, the maturity of shade net fruit was not influenced and therefore the internal quality was not influenced. The trees used in this study were young and it is important to consider the tree architecture when implementing nets, since reduced light may be detrimental in causing a dense canopy and therefore affect the fruit quality.

References

Cronje, PJR, Barry, GH, Huysamer, M. 2013. Canopy position affects pigment expression and accumulation of flavonoid carbohydrates of 'Nules Clementine' mandarin fruit, thereby affecting rind condition. *Journal of the American Society for Horticultural Science* 138(3):217-224. Jifon, JL, Syvertsen, JP. 2001. Effects of moderate shade on citrus leaf gas exchange, fruit yield and quality. *Proceedings of Florida State Horticultural Society* 114:177-181. Lee, TC, Zhong, PJ, Chang, PT. 2015. The effects of preharvest shading and postharvest storage temperatures on the quality of 'Ponkan' (*Citrus reticulata* Blanco) mandarin fruits. *Scientia Hort.* 188:57-65. Rajapakse, NC, Shahak, Y. 2007. Light-quality manipulation by horticulture industry, In: Whitelam, GC, Halliday, KJ (eds). *Light and plant development*. United Kingdom: Blackwell Publishing Ltd. pp 290-311. Reitz, HJ, Sites, JW. 1948. Relationship between position on the tree and analysis of citrus fruit with special reference to sampling and meeting internal grades. *Proceedings of Florida State Horticultural Society* 54:80-90. Syvertsen, JP, Goñi, C, Otero, A. 2003. Fruit load and canopy shading affect leaf characteristics and net gas exchange of

'Spring' navel orange trees. *Tree Physiology*. 23(13):899-906.

THE IMPACT OF PERMANENT 20% WHITE SHADE NETTING ON THE VEGETATIVE/REPRODUCTIVE BALANCE OF 'NADORCOTT' MANDARIN

Presenter: R Brown (robertbrown1035@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
R	Brown	University of Stellenbosch, Department of Horticulture
O.P.J.	Stander	Citrus Research International, Department of Horticultural Science, University of Stellenbosch, South Africa
P.J.R.	Cronje	Citrus Research International, Department of Horticultural Science, University of Stellenbosch, South Africa.

Introduction

INTRODUCTION Damage to fruit crops causes major financial losses worldwide. Important factors accounting for these include sporadic climatic extremities such as sunburn, wind and hail damage, and frost damage. In recent years the use of protective permanent shade netting has become an increasingly popular agricultural practice to protect high value fruit crops. Apart from protection of fruit, the use of shade netting has also been widely implemented to successfully prevent cross-pollination and produce seedless fruit in citrus (*Citrus* spp.).

Materials and Methods

MATERIALS AND METHODS Experiments were conducted in Citrusdal in the Western Cape of South Africa (Mediterranean climate), on 'Nadorcott' mandarin (*C. reticulata* Blanco). Tree volume, shoot growth, return bloom and fruit yield were evaluated for shade net treatments compared with open controls. Tree dimensions were measured annually and tree volume calculated using a formula from Burger et al. (1970). Shoots were tagged during each of the three main shoot growth flushes, i.e. spring, summer and autumn. Shoot length, nodes per shoot, and leaves per shoot were evaluated after harvest for each season. During full bloom, return bloom was evaluated on these shoots in September. At harvest, fruit yield (kg/tree), fruit size and fruit size distribution were recorded for each treatment.

Results and Discussion

RESULTS AND DISCUSSION Shade netting increased tree volume significantly over a period of two years, and concurs with results on 'Orri' mandarin (Wachsmann et al., 2014). Mean shoot length, nodes per shoot (no.) and leaves per shoot were not influenced by the shade netting, which suggests that increased tree volume may be the result of more than three flushes per annum under nets (Spiegel-Roy and Goldschmidt, 1996). Return bloom was not altered but was increased under netting for season 2, concurring with results in apple (Smit et al., 2007) and peach (Shahak et al., 2004). At harvest, the fruit number and total yield was not affected by the shade netting, while average fruit diameter and fruit size distribution improved.

Conclusions

CONCLUSIONS Permanent white shade netting, with a 20% shade factor increased the vegetative growth of 'Nadorcott' mandarin. This increase was however not at the expense of reproductive growth, as flowering and fruit yield was not affected negatively and fruit size increased.

References

REFERENCES BURGER, W. T., VINCENT, A. P., BARNARD, C. J., DU PLESSIS, J. A., and SMITH, J. H. E. 1970. Methodes waarvolgens die grootte van sitrusbome bepaal kan word. *South African Citrus J.* 433:13-15. SPIEGEL-ROY, P. and GOLDSCHMIDT, E.E. 1996. *The biology of citrus.* Cambridge University Press. SHAHAK, Y., GUSSAKOVSKY, E.E., COHEN, Y., LURIE, S., STERN, R., KFIR, S., NAOR, A., ATZMON, I., DORON, I., and GREENBLAT-AVRON, Y. 2004. ColorNets: a new approach for light manipulation in fruit trees. *Acta Hort.* 609-616. SMIT, A. 2007. Apple tree and fruit responses to shade netting. MSc dissertation, Stellenbosch: University of Stellenbosch. WACHSMANN, Y., ZUR, N., SHAHAK, Y., RATNER, K., GILER, Y., SCHLIZERMAN, L., SADKA, A., COHEN, S., GARBINSHIKOF, V., GILADI, B., and FAINTZAK, M. 2012. Photosensitive anti-hail netting for improved citrus productivity and quality. *Intl. CIPA Conf. on Plasticulture for a Green Planet.* 1015:169-176.

EFFECT OF SUPPLEMENTED POTASSIUM FERTILIZER ON FRUIT GROWTH, DEVELOPMENT AND QUALITY OF SUMMER SQUASH (PATTY PAN).

Presenter: ST Buthelezi (sikelelathobani@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
ST	BUTHELEZI	University of KwaZulu-Natal, Pietermaritzburg, Private Bag X01, Scottsville, 3209
I	BERTLING	University of KwaZulu-Natal, Pietermaritzburg, Private Bag X01, Scottsville, 3209

Introduction

Cucurbits are considered economically important vegetable crops and play a vital role in the human diet as well as in the African rural economy. Several studies on cucurbit fruit quality, focussing on major cucurbits, have been undertaken; the minor cucurbits have, however, been neglected, resulting in little or limited information available on how high fruit quality in such vegetables can be achieved. The aim of the study was to evaluate the influence caused by supplemented potassium fertilizer on patty pan squash, strictly on fruit.

Materials and Methods

The experiment was conducted in a glasshouse at University of KwaZulu-Natal, Pietermaritzburg Campus, KwaZulu-Natal, South Africa. Two patty pan squash (*Cucurbita pepo*) cultivars (Star 8081- yellow and Star 8080-green) were planted with four levels of fertilizer (half recommended, recommended, double recommended-supplemented with KCl and double recommended- supplemented with K₂SO₄). Vitassol fertilizer (3:1:3, (38)) was utilized for fertilization and for double recommended levels two sources of potassium (potassium sulphate and potassium chloride) were used as supplement. The experiment was set out in a factorial completely randomized design with four replicates. Data were collected on agronomic parameters includes fruit diameter, fruit thickness, number of fruits per plant, pedicel thickness, fresh mass, dry mass, moisture content in percentage, dry matter in percentage.

Results and Discussion

Supplementing with K fertilizer positively influenced many characteristics of fruit growth and development (fruit diameter, fruit thickness, number of fruits, number of staminate and pistillate). Among the application levels double recommended with KCl and K₂SO₄ improved the measured parameters, while halving the recommended level reduces patty pan quality.

Conclusions

Farmers can improve patty pan production and quality through supplementation with K fertilizer, specifically the low-cost fertilizer KCl. Consumers would benefit as well by eating an improved product. Future research should focus on determining the influence of K fertilizer supplementation on fruit physiology, more particularly post-harvest.

References

Lester, G.E., Jifon, J.L. and Makus, D.J., 2010. Impact of potassium nutrition on postharvest fruit quality: Melon (*Cucumis melo* L) case study. *Plant and Soil*, 335(1-2), pp.117-131. Sarhan, T.Z., Mohammed, G.H. and Teli, J.A., 2011. Effect of bio- and organic fertilizers on growth, yield and fruit quality of summer squash. *Sarhad J. Agric*, 27(3), pp.377-383.

The use of scanning electron microscopy and wavelength dispersive x-ray spectroscopy to quantify calcium uptake and distribution in apple white roots during winter

Presenter: A Cameron (17321735@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Cameron	Department of Horticulture, Stellenbosch University, Private Bag X1, Matieland, 7602
L	Hoffman	Department of Horticulture, Stellenbosch University, Private Bag X1, Matieland, 7602
E	Lotze	Department of Horticulture, Stellenbosch University, Private Bag X1, Matieland, 7602

Introduction

Calcium nitrate soil applications during a period of white root growth significantly increased calcium (Ca) concentration in roots and reserve tissues of locally grown 'Golden Delicious' trees by late-autumn, two weeks after application (Van Zyl, 2016). As the only source of calcium for new growth in spring, an extended white root growth peak during autumn/winter contributes substantially towards Ca uptake. However, Ca uptake during winter has not been extensively studied and encouraged an investigation on soil Ca uptake and translocation during tree dormancy.

Materials and Methods

Scanning electron microscopy and x-ray microanalysis were used to determine in situ Ca concentration and distribution along apple white root tips, following autumn soil applications, during winter.

Results and Discussion

The rate of root Ca uptake and translocation was more rapid than anticipated as trees were in leaf for an extended period during winter. Root Ca concentration of the treatment did not differ significantly from the control. Roots that grow more rapidly develop endodermal Casparian bands much further from the tip, allowing apoplastic Ca flow to the xylem in root tips, whereas band deposition closer to the tip in slower-growing roots dictate selective transport via the symplast to the xylem (Waisel and Eshel, 2002). A significantly lower root Ca concentration prior to 50% leaf drop in July suggests that Ca translocation to the shoot proceeded predominantly via the apoplastic pathway when leaf transpiration rates were high, as opposed to a more controlled delivery of Ca to the shoot towards the end of winter.

Conclusions

Substantial soil Ca uptake by apple white roots occurs during winter under local conditions. Differences in root Ca concentration was possibly related to differences in root anatomy due to differential root growth rates before and after 50% leaf drop.

References

Van Zyl, F.J., 2016. Quantifying root growth dynamics and nutrient uptake in apple trees. MSc thesis, Department of Horticultural Science, Stellenbosch University. Waisel, Y., Eshel, A., 2002. Functional diversity of various constituents of a single root system, in: Waisel, Y., Eshel, A., Kafkafi, U. (Eds.), *Plant Roots: The Hidden Half*. Marcel Dekker, New York, pp. 157-174.

ENCOURAGING INTEGRATED WEED MANAGEMENT IN THE SA SUGAR INDUSTRY

Presenter: PL CAMPBELL (peta.campbell@sugar.org.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PL	Campbell	South African Sugarcane Research Institute, , Private Bag X02, Mount Edgecombe 4300
RS	Rutherford	
P	Govender	

Introduction

The most serious weeds identified in terms of prevalence and/or difficulty to control in the South African sugarcane industry include the creeping grasses *Cynodon dactylon*, *Cynodon nlemfuensis* and *Digitaria abyssinica*. Currently, chemical control options are widely used for management of these difficult weed species. An integrated weed management (IWM) approach (i.e. integrating chemical and non-chemical methods to manage problem weeds) is an ongoing focus of SASRI weed research efforts. This paper describes the successful implementation of an IWM approach for these weeds.

Materials and Methods

Development of the IWM approach was undertaken in the following stages: (1) collation of existing IWM information; (2) identification of knowledge gaps; (3) conducting research trials to address knowledge gaps; and (4) development of resources to transfer the IWM technology, including printed format, workshops and demonstration areas. .

Results and Discussion

Collated information revealed that very limited herbicide options were available to growers and consequently, a new product, Arsenal GEN 2, was investigated and subsequently registered in sugarcane. The lack of non-chemical control opportunities was also identified as a gap. This led to the development of new approaches, including, among others: (1) use of a barrier hedge to prevent encroachment from verges into fields; (2) use of a trash cover, where although cynodon roots survived, plants were severely retarded by shading; (3) containment of in-field grass patches by hoeing perimeters inwards, and (4) planting a legume green manure that can tolerate imazapyr. Here, while the Arsenal GEN 2 label stipulates four months and 600 mm rainfall between imazapyr application and planting, this was reduced to one month and only c. 100 mm rainfall between imazapyr application and planting velvet bean (*Mucuna* spp.) (Campbell et al., 2017). The IWM methods developed were published in a manual (Campbell, 2017), with summary tables to guide selection of appropriate control methods for different grass densities in different cane growing situations, at field-scale level, and an example of how to apply IWM principles at farm-scale level.

Conclusions

Adopting IWM principles benefits the industry by improving management recommendations for major weeds, using appropriate combinations of chemical and non-chemical means, with a concomitant reduction in environmental impact from exclusive use of repeated herbicide applications. The IWM approach developed for creeping grasses is now being extended to the other problematic weed species of the SA sugar industry, with the emphasis on the development of innovative technology transfer resources and tools.

References

Campbell PL, Rutherford RS and Drew K. (2017). The investigation of a suitable summer breakcrop after imazapyr application for integrated management of *Cynodon dactylon*. Proc S Afr Sug Technol Ass: (2017): 90:135 (poster). Campbell, PL. (2017). Integrated weed management of creeping grasses in sugarcane. Published by SASRI. ISBN No. 1-874903-44-1.

YIELD, WATER USE AND PRODUCTIVITY OF SELECTED GRAIN LEGUMES IN A CONTROLLED ENVIRONMENT

Presenter: TP Chibarabada (tendaipolite@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
TP	Chibarabada	Crop Science, School of Agricultural, Earth and Environmental Sciences, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3201 Pietermaritzburg, South Africa
AT	Modi	Crop Science, School of Agricultural, Earth and Environmental Sciences, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3201 Pietermaritzburg, South Africa
T	Mabhaudhi	Crop Science, School of Agricultural, Earth and Environmental Sciences, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3201 Pietermaritzburg, South Africa

Introduction

Legumes are being promoted in the semi- and arid tropics to alleviate food and nutritional security (Chibarabada et al., 2017). This requires knowledge on their yield, water use and adaptability to these environments. Understanding of crops' response to water availability maybe challenging under field conditions where rainfall as a water input cannot be controlled. A controlled study was conducted to determine water use, yield and water productivity of two grain legumes (groundnut and dry bean) under varying water regimes.

Materials and Methods

A pot trial was conducted at the University of KwaZulu-Natal's Controlled Environment Facility with temperatures ranging from ~18/33°C (day/night) and relative humidity of 60 - 80%. The experimental design included three water treatments [80, 60 and 30% of field capacity (FC)] and two grain legume crops (groundnut and dry bean), arranged in a completely randomised design with three replications. Data collected included plant growth (plant height and leaf number), physiology (stomatal conductance and chlorophyll content index), pod yield (Y) and yield components. Water use (ET) was calculated as a residual of the soil water balance. Water productivity (WP) was obtained as the quotient of Y and ET. Data were analysed using ANOVA in Genstat®.

Results and Discussion

Leaf number and stomatal conductance differed significantly ($P < 0.05$) among water treatments and crops. Groundnut stomatal conductance was $\approx 45\%$ higher than dry bean. Significant differences ($P < 0.05$) between crops and among water treatments were observed for time to podding and maturity. Groundnut matured 157 days after planting while dry bean matured a month earlier. Crop ET was 13% higher at 80% FC relative to 60% FC; ET was 25% higher at 60% FC relative to 30% FC. Crops and water treatments showed significant differences ($P < 0.05$) for yield, harvest index and water use. Groundnut had higher pod yield (9 to 16 g per plant), but dry bean had lower ET (362 to 583 mm). This resulted in no significant differences ($P > 0.05$) for crops, water treatments and their interaction with respect to WP. Despite severe water stress the crops produced reasonable yield implying suitability for production in water scarce areas.

Conclusions

Crops showed different desirable characteristics (early maturity, smaller canopy and high harvest index in dry bean and high yield in groundnut) which breeders could tap into for development of high yielding, and water use efficient varieties of grain legumes. Although results of pot trials do not portray results under field conditions they can be used as benchmarks to understand crop performance.

References

Chibarabada, T., Modi, A., Mabhaudhi, T., 2017. Expounding the Value of Grain Legumes in the Semi- and Arid Tropics. Sustainability 9, 60. doi:10.3390/su9010060.

EFFECTS OF TILLAGE PRACTICES AND CROPPING SYSTEMS ON MAIZE GRAIN YIELD IN MOZAMBIQUE

Presenter: OJ Chichongue (ochichongue@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
OJ	Chichongue	Mozambique Agriculture Research Institute - IIAM
Van Tol	JJ	Department of Soil, Crop and Climate Sciences - University of the Free State
Ceronio	GM	Department of Soil, Crop and Climate Sciences - University of the Free State
Du Preez	CC	Department of Soil, Crop and Climate Sciences - University of the Free State

Introduction

Mozambique is witnessing severe degradation to its farmlands. Much of this degradation can be attributed to farming practices – ploughing that destroy the soil structure and degrade organic matter, burning or removing crop residues and mono-cropping. To change this situation, improved cereal and legume cropping systems in Conservation Agriculture (CA) systems were tested.

Materials and Methods

Four on-station field trials (Inhambane, Niassa, Nampula and Zambézia provinces) were conducted in two different agro-ecological zones (R2 and R10). The trial was laid in randomized complete block design in split-split plot arrangement replicated four times. The main factors are the farming system (conventional and conservation tillage). The response functions of the farming system to fertilization application at recommended rate 300 kg ha⁻¹ for maize and 150 kg ha⁻¹ for legumes and no fertilizer application in both cropping systems were the Subplots. A total of ten sub-sub plots involving maize intercropped with beans, soybean, cowpea, pigeon pea and groundnuts and four rotation levels were used. Statistical analysis was done using STATA statistical package version 15.

Results and Discussion

There was a positive response on CA compared to Conventional tillage. High increase in maize yields was observed in CA treatment compared to Conventional tillage. Conservation agriculture treatments in Inharrime and Niassa had high maize yield of 1.2 and 3 tha⁻¹ when maize was intercropped with soybean with low maize yields of 0.9 and 1.7 tha⁻¹ in sole maize respectively. Maize and cowpea intercrop give high maize yields of 3.3 and 3.5 tha⁻¹ In Zambézia and Nampula while low yield was observed in sole maize of 0.7 and 0.9 tha⁻¹ respectively. Treatments that received fertilization had positive effect for both cropping system however crop yield was lower in conventional tillage compared to fertilized plots of CA. In Conventional tillage and CA plots, maize yielded better when it was fertilized compared to no fertilization. It was remarkable that CA treatments outperformed conventional practices at different maize legume intercrops.

Conclusions

This study showed that there are benefits of adopting CA practices among smallholder farmers in Mozambique. This study also demonstrates that intercropping has potential to address the low soil fertility problem in farmers' fields and raise yields of maize. Acknowledgements The authors wish to thank the Alliance for Green Revolution in Africa (AGRA) for financial support for field experimentation.

References

Effect of irradiation levels on internal and external citrus fruit quality

Presenter: PJR Cronje (paulcronje@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PJR	Cronje	Citrus Research International, Department of Horticultural Science, University of Stellenbosch, South Africa.
J	North	Citrus Research International, Department of Horticultural Science, University of Stellenbosch, South Africa.
V	Hatthingh	Citrus Research International, Department of Horticultural Science, University of Stellenbosch, South Africa.
C	Balt	HEPRO Cape (Pty) Ltd, Montague Gardens, Cape town.
KM	Hussey	HEPRO Cape (Pty) Ltd, Montague Gardens, Cape town.
RA	Basson	HEPRO Cape (Pty) Ltd, Montague Gardens, Cape town.

Introduction

Irradiation of citrus fruit to sterilize insect larvae, such as false codling moth and various fruit fly species, could develop into a technology that would enable the reduction of the cold sterilisation protocol. It has been determined that the minimum level of irradiation to sterilize FCM larvae is 60 Gy (+ 16 days @ 2.5°C) or a stand-alone treatment of 100 Gy. Due to the complexity of administering a specific target dose to all fruit in a carton or pallet, various problems would need to be addressed. The distribution of dosage through a package of fruit (box or pallet) is not uniform. An irradiation treatment specifies the minimum dosage required and inevitably many fruit in the treated package will, therefore, be exposed to higher dosages, generally in the order of 2 to 3 times the minimum required dosage, but this could be as high as 4 times. The min-max ratio is dependent on many factors, including source of irradiation, installation, packaging and fruit type.

Materials and Methods

Earlier exploratory trials indicated that citrus fruit is sensitive to irradiation dosages in the range of 200 to 500 Gy. In this experiment 9 cultivars were exposed to 200, 300, 400 or 500 Gy and placed in cold storage at either 2 or 7°C for durations of 40 or 60 days prior to evaluation of external and internal quality.

Results and Discussion

The external fruit quality, evaluated as the incidence of rind disorders and grouped as "pitting", indicates a progressive reaction to the increased irradiation dose. This was especially true for sensitive cultivars such as 'Turkey Valencia', 'Nova' mandarin, 'Eureka' lemon and to a lesser extent 'Nadorcott' mandarin and Late navel orange. In the two cultivars most affected by irradiation, the development of rind disorders was already evident at 200 Gy ('Nova' and 'Turkey'), but for the second group of cultivars i.e. lemon, 'Nadorcott' and 'Nules', the increased negative impact only become significant after 300 Gy. Some cultivars such as the 'Midnight' Valencia and 'Star Ruby' grapefruit show a remarkable tolerance to irradiation even at 500 Gy. Internal quality could be negatively impacted by irradiation. The impact is always more negative in those cultivars susceptible to irradiation damage viz. Nova, lemon and Turkey. Whereas juice % was not significantly altered by the treatments, °Brix and citric acid content can be reduced by increasing irradiation doses. Rind colour was not negatively affected in any of the cultivars used.

Conclusions

In general, and at this stage irradiation at 300 Gy seem to be the maximum level that most cultivars could tolerate. However, a lower irradiation dose as close to 200 Gy as possible could result in the inclusion of nearly all cultivars due to the reduction in rind disorders of high-value cultivars, such as lemons and most mandarins.

References

none

21st Century Melon Breeding

Presenter: K M C Crosby (k-crosby@tamu.edu)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
KC	Crosby	Texas A&M University, Horticultural Sciences, TAMUS 2133, College Station, TX 77843
BP	Patil	Texas A&M University, Vegetable and Fruit Improvement Center, 1500 Research Pkwy, Ste 120, College Station, TX 77845
DL	Leskovar	Texas A&M AgriLife Research, 1619 Garner Field Rd, Uvalde, TX 78801
JJ	Jifon	Texas A&M AgriLife Research, 2415 East Hwy 83, Weslaco, TX 78596

Introduction

Melon (*Cucumis melo*) is an important fruiting vegetable crop in Texas and many regions of the world. It is an excellent source of vitamin C, potassium, beta-carotene, folic acid and carbohydrates. Achieving consistent quality depends on production environment, genetics and plant stress. Texas A&M melon breeding has a 70 year history of developing novel melon germplasm to enhance quality and yield. The current focus involves a combination of traditional breeding, genomics, and flavor related gene expression manipulation.

Materials and Methods

Over 600 melon germplasm accessions representing five horticultural groups have been screened for important phenotypic traits. These include disease resistance, heat and drought tolerance, maturity, root vigor and morphology, size, sugars, beta-carotene and appearance. More than 800 new families have been created through controlled pollinations in a greenhouse to introgress desirable traits into muskmelon and honeydew types. Selection for improved root systems, resistance to vine decline pathogens, mildew and viruses, fruit quality and yield has resulted in improved inbred lines. A genetically diverse subset of these lines is currently being utilized to map abiotic and biotic stress resistance quantitative trait loci and investigate gene expression in flavor-associated biochemical pathways.

Results and Discussion

Two melon cultivars, 'Chujuc' and 'Pacal,' with enhanced beta-carotene and mildew resistance have been released (Crosby et al, 2015; Crosby et al, 2008). Two hundred elite inbred lines of *reticulatus* and *inodorus* melons have been created for F1 hybrid development. A preliminary molecular marker map of the melon genome with 12 linkage groups has been created, with some markers linked to quality and virus resistance QTL. Novel resistance to vine decline caused by *Monosporascus cannonballus* has been identified in melon germplasm and introgressed into muskmelon and honeydew breeding lines. Families have been created to combine major, dominant genes with QTL for resistance to more races of powdery mildew. *Reticulatus* breeding lines with modified rinds to reduce enteropathic bacterial contamination have also been developed. Investigations into flesh firmness, shelf-life and flavor are ongoing, with the goal of improving all three simultaneously.

Conclusions

The TAMU melon improvement project is multi-faceted and seeks to create sustainable solutions for producers in Texas and elsewhere. Combining abiotic and biotic stress resistance with quality attributes is essential to ensure economic viability of the melon industry. Deployment of novel genetics will improve quality, reduce waste, and enhance market appeal for this crop to reverse declining consumption trends.

References

Crosby, K.M., Leskovar, D., Jifon, J.L. and J. Masabni. 2015. 'Pacal' Orange Casaba: a multi- disease resistant, specialty melon cultivar from Texas A&M AgriLife Research. *HortSci*. 50: 1723-1725. Crosby, K.M., Jifon, J.L. and D.I. Leskovar. 2008. 'Chujuc'- a New Powdery Mildew Resistant U.S. Western Shipper Melon with High Sugar and Beta-Carotene Content. *Hort. Sci*. 43(6):1-3.

PERFORMANCE OF UPLAND RICE (*Oryza sativa* L.) AS INFLUENCED BY COMPOST, NPK FERTILIZER AND NITROGEN FIXED BY COWPEA

Presenter: O. A Dada (oadada247@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
O. A	Dada	Crop Protection and Environmental Biology, University of Ibadan, Nigeria
M	Rasheed	Crop Protection and Environmental Biology, University of Ibadan, Nigeria.
F. R.	Kutu	Department of Crop Science, NorthWest University, Mafikeng, South Africa

Introduction

There is a wide yield and demand gap in rice due to poor soil fertility management techniques (Seck et al., 2013; Gao et al., 2014). Biological nitrogen fixation (BNF) using a legume crop is rarely used in rain-fed rice ecology (Gholizadeh et al., 2011; Oyedeki et al., 2014). Therefore, the effects of atmospheric nitrogen fixed by cowpea plant singly or in combination with organic and inorganic fertilizers in upland rice field were investigated.

Materials and Methods

Pot study was carried out at the Crop Garden of Department of Crop Protection and Environmental Biology, University of Ibadan in 2016 and 2017. Treatments comprised three upland rice cultivars: NERICA2, NERICA8 and CG14 and five soil amendments: control (unfertilized), BNF, BNF + NPK, BNF + Compost and BNF+ cattle dung laid out in a completely randomised design (CRD) with six replicates. Data were collected on Number of leaves (NL), Plant Height (PH, cm), Tillering (NT) and Leaf Area (LA, cm²), Number of Panicles (NP), Number of Filled Grains (NFG), Weights of Panicle (WP, g), Weight of Filled (WFG, g) and Weight Unfilled Grains (WUFG, g) and Grain Yield (GY, g) and dry matter accumulation. Uptake concentration (mgkg⁻¹) of N, P and K was determined following standard procedures. Data were analysed using ANOVA of Statistical Analysis System. The differences in means were separated with LSD at α 0.05.

Results and Discussion

Compost+cowpea treatment had significantly highest NL (51.67), PH (82.44), NT(16.89) compared to other treatments. Cultivar CG14 had highest NL(92.33), PH (83.67), NT(32.33) and LA (3534.9) in compost+cowpea treatment. This is in line with report of Saito et al. (2007). CG14 produced significantly highest tiller (39.00) in plots supplied NPK fertilizer and intercropped with cowpea. Kyei-Boahen et al. (2017) shared similar view. Cultivar CG14 had significantly highest NP(23.27), NFG(532.80), WP(16.21), WFG(11.65), WUFG(2.70) and GY(14.31) relative to NERICA cultivars under cowpea+NPK treatment while, highest total biomass yield (26.97) was observed in CG14 grown on cowpea+NPK. This confirms report of Akanbi et al. (2010). Cultivar CG14 absorbed highest N(15.26), P(40.23) and K(12.08) concentration in pots containing soil supplied compost + cowpea. Cultivar CG4 had better N(368.5 %), P(17.9 %) and K(118.96 %) utilization compared to NERICA2 and NERICA8 in the pots augmented with compost+ cowpea.

Conclusions

Cultivar CG14 performed better than newly developed NERICA cultivars under compost + cowpea augmentation. Biological nitrogen fixation through cowpea in combination with compost enhanced growth, yield and nutrient use efficiency of upland rice on marginal soil.

References

- Akanbi, W.B., and Togun, A.O. 2002. Productivity and Influence of maize stover compost on Growth, Yield and Nutrient Uptake of Amaranth. *Scientia Horticulture*. (93):1-8. Gao, Y., Wu, P. T. Zhao, X., N., and Wang, Z. K., 2014. Growth, yield, and nitrogen use in the wheat/maize intercropping system in an arid region of north western China. *Field Crop Resources*. 167: 19–30. Gholizadeh, A.M., Amin, A.M., Anuar, A.R., Aimrun, A., and Saberioon, M. M., 2011. Temporal variability of SPAD chlorophyll meter readings and its relationship to total nitrogen in leaves within a Malaysian paddy field. *Australian Journal of Basic and Applied Sciences*. 5(5): 236-245. Kyei-Boahen, S., Savala, C., Chikoye, D. and Abaidoo, R., 2017. Growth and yield responses of cowpea to inoculation and phosphorus fertilization in different environments. *Frontier Plant Science*. 8:646. Oyedeki, S., Animasaun, D.A., Bello, A. A., and Agboola, O. O., 2014. Effect of NPK and Poultry Manure on Growth, Yield and Proximate Composition of Three Amaranths. *Journal of botany*. 2014:1-6. Seck, P.A., Toure, A. A., Coulibaly, J. Y., Diagne. A. and Wopereis, M. C. S. 2013. Impact of rice research on income, poverty and food security in Africa: an ex-ante analysis. In: *Realizing Africa's Rice Promise*. CAB International, Wallingford. 24-33.

EFFECTS OF DIFFERENT RATES OF POULTRY MANURE AND NPK 15-15-15 FERTILIZER ON GROWTH AND YIELD OF SUNFLOWER

Presenter: O. A Dada (oadada247@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
V. I.	Abumere	Crop Protection and Environmental Biology, University of Ibaddan, Nigeria
O. A.	Dada	Crop Protection and Environmental Biology, University of Ibadadn, Nigeria.
A. G.	Adebayo	National Horticultural Research Institute, Ibadan, Nigeria
F.R	Kutu	Food Security and Safety Niche Area Research Group, North-West University, Mafikeng, Campus
A. O.	Togun	Crop Protection and Environmental Biology, University of Ibaddan, Nigeria

Introduction

Cultivation of sunflower on nutrients-deficient soils potentially results in poor growth, low seed yield and oil quality. This study investigated the effect of different rates of poultry manure and NPK 15-15-15 fertilizers on growth, nutrient uptake, seed and oil yields of sunflower on nutrient limiting soil.

Materials and Methods

Field experiments were carried out at the National Horticultural Research Institute, Ibadan; during 2014 and 2015 planting seasons. Eight treatments comprising four rates of poultry manure (5, 10, 15 and 20 t/ha), three rates of NPK 15-15-15 (30, 60 and 90 kg N/ha) and a control was laid out in a randomized complete block design with three replicates. Growth attributes, chlorophyll content, seed and oil yields of sunflower were evaluated. Nutrient uptake concentration was determined following standard procedures. Data were analyzed using ANOVA and means were compared with Duncan's multiple range tests at $p \leq 0.05$.

Results and Discussion

Growth, shoot nutrient uptake, seed yield and oil contents of sunflower were superior in field fertilized with 20 t/ha poultry manure which was comparable to 90 kg N/ha NPK fertilizer. Plots supplied with 60 kg N/ha NPK had significantly highest (190.2 cm²) leaf area but not statistically different from that obtained in plots supplied 10 t/ha poultry manure. Tallest plant (130.3 cm) was observed in plots treated with 10 t/ha poultry manure. Also, highest stem girth (5.8 cm) and flower bud diameter (17.9 cm) were observed in plots augmented with 10 t/ha poultry manure whereas. Highest number of leaves (35.1) in plots fertilized with 60 kg N/ha. Flower bud with the highest weight (71.9 g) and number of seeds/bud (285.7) were obtained in plots amended with 20 t/ha poultry manure. Significantly highest oil content (33.8%) was obtained in plots amended with 20 t/ha poultry manure. Highest chlorophylls a and b contents (74.35 and 99.26 mg/g) was recorded in plots supplied 90 kg N/ha NPK. Sunflower had highest potassium (0.85 cmol/kg), and iron (0.27 mg/g) uptake in plots amended with 5 t/ha poultry manure. Meanwhile, magnesium and zinc uptake were highest (0.28 and 105.8 mg/g) in plots fertilized with 30 kg N/ha NPK. Application of 60 kg N/ha NPK fertilizer enhanced highest copper uptake. However, in the unamended plot sunflower had the highest manganese (139.5 mg/g) uptake.

Conclusions

Application of either 10 t/ha poultry manure or 60 kg N/ha using inorganic NPK fertilizer gave comparable but superior sunflower plant growth, seed yield and oil contents than any other rates.

References

DEVELOPMENT AND OPTIMISATION OF A TECHNIQUE TO DETERMINE THE WATER DISPERSIBLE CLAY IN SOILS

Presenter: S Dinwa (sdinwa@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S	Dinwa	Stellenbosch University
C.E	Clarke	Stellenbosch University
A.B	Rozanov	Stellenbosch University

Introduction

Water dispersible clay (WDC) is defined as the colloid fraction which disperses in water without removal of cementing compounds or the use of dispersing agents. It is a commonly determined parameter and is used in many erosion models and is a proxy for aggregate stability and clay dispersivity. There is no standard method for determining WDC, and although modified particle size analysis (PSA) is the most common technique, numerous other methods are also employed to save time, bench space and reduce sample size. These methods have not been tested against the benchmark PSA method and vary in terms of agitation (time and type), extraction, measurement and expression of WDC. This makes comparison between these methods very difficult. This study aims at developing, testing and optimising a simple, reduced sample centrifuge method for WDC in order to allow analysis of archive samples

Materials and Methods

Samples from ISCW Land Types were collected, manually ground, passed through a 2mm sieve and analysed. Efficiency and accuracy was measured with respect to the sedimentation PSA method and a laser particle size analyser.

Results and Discussion

The extraction efficiency of WDC is highly dependent on the physical agitation energy exerted on the samples. Increasing the headspace in the centrifuge tube increased the WDC extraction efficiency by 32%. Shaking time has a major influence on WDC extraction efficiency, with a minimum shaking time of 22 hours required to get maximum extraction. This demonstrates the need to standardise the method as numerous extraction techniques use less than 6 hours shaking time for WDC extraction. Sonication prior to shaking for 22 hours results in a WDC extraction efficiency of 94% for the new centrifuge method compared to the traditional PSA method. The centrifuge method was shown to be effective in selectively separating the $< 2 \mu\text{m}$ phase, however, turbidity was not a reliable technique to measure clay in a suspension, due to the clay mineralogy affecting turbidity. This means the gravimetric method cannot be replaced, but centrifugation has both a time saving and sample reducing benefit.

Conclusions

The new centrifuge technique for the extraction of WDC is a viable alternative to the PSA method and has the benefits of reducing sample size and extraction time and increasing the number of samples that can be analysed at one time. Standardisation of WDC is important due to the effects of agitation type and duration on the extraction efficiency

References

AN ELECTRONIC DECISION SUPPORT SYSTEM TO DETERMINE THE SITE-SPECIFIC FITNESS-FOR-USE OF IRRIGATION WATER

Presenter: HM Du Plessis (meiringd@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
HM	du Plessis	Department of Plant and Soil Sciences, University of Pretoria, Private Bag X20, Hatfield 0028
JG	Annandale	Department of Plant and Soil Sciences, University of Pretoria, Private Bag X20, Hatfield 0028
N	Benade	Department of Plant and Soil Sciences, University of Pretoria, Private Bag X20, Hatfield 0028

Introduction

Agriculturists often need to evaluate the fitness of a given water source for irrigation purposes, while water resource managers require an answer to the question of what the water quality should be in order to maintain successful irrigation in a specific area. The South African Department of Water and Sanitation identified the additional need for a risk based assessment of water quality, that also consider site specific considerations. A Decision Support System (DSS) which satisfy these needs was developed in response to a directed call for research by the Water Research Commission (WRC).

Materials and Methods

A team of specialists reviewed the current South African and international irrigation water quality guidelines (IWQG) to identify the factors that determine general and site-specific risks attributable to water quality constituents, and how they can be used to quantify risk. This knowledge was built into a PC-based DSS that estimates the effect and risk water constituents pose to soil quality, crop yield and quality and irrigation equipment.

Results and Discussion

The DSS operates at two levels to assess the effect that water quality constituents may have on soil quality, crop yield and quality and irrigation equipment. A number of 'suitability indicators' serve to divide these effects further into a number of sub-components. The colour coded DSS output displays the fitness-for-use of water evaluation as being 'ideal', 'acceptable', 'tolerable' or 'unacceptable'. Tier 1 assessments provide generic, conservative guidance regarding the effects of water quality constituents. These assessments assume, e.g. no dilution of irrigation water by rain and crops that are generally sensitive to water quality constituents. The guidance provided at this level resembles those provided by currently published IWQG. Tier 2 assessments are more rigorous and are used to determine whether the assessed fitness-for-use of a water would not be improved when site specific conditions are taken into account. These assessments employ a scaled down version of the Soil Water Balance model to dynamically simulate the interactions between irrigation water constituents and the soil-crop-atmosphere system over a period of up to 50 years in order to quantify the probability and severity of a specific effect occurring.

Conclusions

A DSS was developed that provides an indication of the likelihood of specific consequences when water of a known composition is used for irrigation at a specific site. It can also provide guidance about what the water quality should be in order to maintain successful irrigation.

References

DEVELOPING NITROGEN FERTILISER MANAGEMENT STRATEGIES FOR CANOLA (BRASSICA NAPUS) UNDER CONSERVATION AGRICULTURE PRACTICES IN THE WESTERN CAPE

Presenter: E Du Toit (etiennedt@elsenburg.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
E	Du Toit	Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7600, South Africa and Stellenbosch University, Department of Agronomy, Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.
J	Labuschagne	Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7600, South Africa
P.A.	Swanepoel	Stellenbosch University, Department of Agronomy, Stellenbosch, Private Bag X1, Matieland, 7602, South Africa

Introduction

Adopting conservation agricultural practices (CA) changed the face of grain producing areas of the Western Cape. Less soil disturbance and inclusion of non-related crops in cropping systems resulted in an increase in, amongst others, soil C, active C, aggregate stability and microbial diversity. These changes will influence the potential of the soil to mineralise N and the resultant crop response. The aim of this study was therefore to develop N management strategies for the different canola producing areas of the Western Cape.

Materials and Methods

Canola, cultivar Hyola 575, was planted at five research sites namely Riversdale (Uitkyk), Riviersonderend (Tygerhoek), Moorreesburg (Langgewens), Darling (Klipvlei) and Porterville (Nuhoop). The trial layout was a randomised block design. Seven topdressed N rates (0, 25, 50, 75, 105, 135 and 165 kg N ha⁻¹) plus a control was included in the study and replicated four times. Except for the control, that did not received any fertiliser N, 25 kg N ha⁻¹ was applied at planting. Crops were managed according to best practices and harvested with a small combine whereafter seed yield and oil content were determined.

Results and Discussion

Canola yield gradually increased ($P=0.05$) as topdress N rates were increased from 0 to 25, 50 or 75 kg N ha⁻¹ depending on site. Further increases in topdress N rate did not increase canola seed yield, even caused a non-significant reduction in yield at certain sites. Increasing topdress N rate above 25 kg N ha⁻¹ at Riversdale and Tygerhoek did not significantly increase canola yields. At Langgewens and Darling increasing N top-dress rate above 75 kg ha⁻¹ and 50 kg ha⁻¹ respectively, did not significantly increase canola yields. A gradual decrease in oil content, sometimes significantly so, was recorded as topdressed N rate was increased.

Conclusions

Preliminary results show that the optimum topdressed N rate for the southern Cape could be lower compared to the Swartland and Darling areas. Optimum topdressed N rate will be site specific and expected to be within the 25-75 kg N ha⁻¹ range. Final recommendations will be formulated on completion of at least 3 years of data capturing.

References

INFECTIVITY OF NEMATODE POST-EXPOSURE TO PHYTONEMATICIDE

Presenter: ZP Dube (zakheleni_dube@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
ZP	Dube	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa
PW	Mashela	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa

Introduction

The in vitro influence of Nemarioc-AL and Nemafric-BL phytonematicides on egg hatch, juvenile mobility and mortality had since been observed as contributing to the overall suppression of *Meloidogyne incognita* numbers (Dube 2016). The ability of these phytonematicide exposed nematodes to infect and cause disease on susceptible host plant has not been documented. The objective of this study, therefore, was to determine the infectivity of *M. incognita* juveniles exposed to various concentrations of Nemarioc-AL and Nemafric-BL phytonematicides on susceptible tomato plant.

Materials and Methods

Freshly hatched second stage juveniles of *M. incognita* were exposed for 10 d to eleven water-diluted concentrations of 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 and 5% Nemarioc-AL and Nemafric-BL phytonematicides in 5 cm petri dishes. Thereafter, phytonematicide solutions were diluted 5 times and incubated for a further 5 d. In separate experiments, arranged in a randomised complete block design with 4 replications, juveniles exposed to phytonematicides were inoculated on uniform 3-week-old tomato (*Solanum lycopersicum*) cv. 'Floradade' seedlings.

Results and Discussion

Thirty-two days after inoculation, all plant variables were not significant except for the number of galls per root system. Number of galls expressed against increasing phytonematicide concentrations exhibited a density-dependent growth (DDG) pattern. The DDG model was explained by 92 and 95% for Nemarioc-AL and Nemafric-BL phytonematicides, respectively. Relative to untreated control, root galling was reduced by 2-100% for Nemarioc-AL phytonematicide and 0-100% for Nemafric-BL phytonematicide. Inhibition of *M. incognita* J2 infectivity on susceptible tomato cultivar by Nemarioc-AL and Nemafric-BL phytonematicides observed in this study is the first of such a report for the two phytonematicides. Aqueous and methanol extracts of neem were observed to reduce the number of galls in roots of susceptible soyabean plants (Silva et al. 2008).

Conclusions

Besides influencing egg hatching, juvenile mobility and mortality, the two phytonematicides also reduced infectivity of *M. incognita* juveniles.

References

Dube ZP. 2016. Nemarioc-AL and Nemafric-BL phytonematicides: Bioactivities in *Meloidogyne incognita*, tomato crop, soil type and organic matter. PhD Thesis. University of Limpopo, Sovenga, South Africa. Silva JCT, Oliveira RDL, Jham GN, Aguiar NDC. 2008. Effect of neem seed extracts on the development of the soybean cysts nematode. *Tropical Plant Pathology* 33:171-179.

Genetic variation and heritability of traits among Corchorus species

Presenter: SP Dube (phindiledube2010@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
SP	Dube	ARC-Vegetable and Ornamental Plants, Private bag X 293, Pretoria, 0001
D	Marais	University of Pretoria, Department of Natural and Agricultural Sciences, Private Bag X 20, Hatfield, 0028
S	Mavengahama	North-West University Crop Science Department, Private Bag x 2046, Mmabatho, 2735
CM	Van Jaarsveld	University of Zululand, Department of Science and Agriculture, Private bag X 1001, Kwa-Dlangezwa, 3886
AS	Gerrano	ARC-Vegetable and Ornamental Plants, Private bag X 293, Pretoria, 0001

Introduction

Introduction Corchorus species has been reported to be rich in nutrients such as beta-carotene, Fe, Zn, Ca, and Mg. Its use as a food crop needs to be promoted and for this to be achieved there is a need to understand the genetic background and generate knowledge for cultivation through plant breeding and precision agronomic studies (Jansen van Rensburg et al. 2007).

Materials and Methods

Materials and Methods Eleven Corchorus species were evaluated in a field for morpho-agronomic traits using a randomised complete block design with three replications across two seasons in 2015 and 2016 at ARC-VOP farm. No fertilizers and chemicals (insecticides, fungicides etc.) were applied throughout the seasons. Plants were kept weed free during the experiment by hand weeding. The experiment was conducted under rainfed conditions. Data were subjected to ANOVA using the Genstat statistical software (12th edition, version 12.2; VNS International Ltd.2010).

Results and Discussion

Results and Discussion Corchorus species showed significant ($P < 0.05$) differences in all the quantitative traits evaluated. The first two principal components (PCs) accounted for 78.52% of the total variance. The cluster grouped the species into two different groups based on their genetic similarity. Genetic parameters were estimated for morphological quantitative traits and showed the considerable amount of genetic variability. A high genotypic coefficient of variation (GCV), broad sense heritability (H^2), and genetic advance (GA) were computed for plant height (59.2%, 89.2%, and 115.1), number of leaves per plant (39.7%, 74.7%, and 70.6), pod length (49.0%, 97.0% and 99.4), number of pods (144.4%, 80.1%, and 266.3), and number of seeds per pod (54.1%, 88.4%, and 104.9), respectively, which permits effective selection.

Conclusions

Conclusions This study revealed sufficient genetic variability in Corchorus species which can be exploited for crop improvement.

References

References Jansen van Rensburg WS, Van Averbeke W, Slabbert R, Faber M, Van Jaarsveld P, Van Heerden I, Wenhold F, Oelofse A. 2007. African leafy vegetables in South Africa. Water SA, 33: 317-326.

OPPORTUNITIES FOR SOIL FERTILITY MANAGEMENT IN A SMALL HOLDER MAIZE-TOBACCO FARMING SYSTEM. A CASE OF SVOSVE COMMUNAL AREA, ZIMBABWE.

Presenter: N Dunjana (ntandodunjana@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N	Dunjana	School of Agricultural, Earth and Environmental Sciences, University of KwaZulu Natal, Pietermaritzburg, South Africa, Marondera University of Agricultural Sciences and Technology, P. O Box 35, Marondera, Zimbabwe.
R	Zengeni	School of Agricultural, Earth and Environmental Sciences, University of KwaZulu Natal, Pietermaritzburg, South Africa
P	Muchaonyerwa	School of Agricultural, Earth and Environmental Sciences, University of KwaZulu Natal, Pietermaritzburg, South Africa
M	Wuta	Department of Soil Science and Agricultural Engineering, University of Zimbabwe, P.O Box MP 162, Mt Pleasant, Harare, Zimbabwe.

Introduction

Combined organic and inorganic fertiliser application has over the years been prescribed as a preferential intervention for alleviation of soil infertility while increasing crop yields. However, blanket recommendations often fail to be effective because of variability in quality of manures, availability and location diversity thus necessitating tailored and targeted recommendations. This study sought to explore the potential of augmentation of cattle manure quality through co-composting with tobacco residues in a smallholder maize-tobacco production system and evaluating the effects on maize growth parameters and grain yield on a sandy and sandy loam soil.

Materials and Methods

The experimental design was a randomised complete block design with the fertility treatments cattle manure-tobacco scrap (CM-TSC), cattle manure-tobacco stalk (CM-TSK), tobacco scrap-tobacco stalk (TSC-TSK) composts and cattle manure (CM) all applied at 5 and 10 t ha⁻¹, 250 kg NPK basal fertiliser and an unamended control treatment. Top dressing fertiliser was applied at 120 kg N ha⁻¹, except for the control.

Results and Discussion

Maize height and biomass yield significantly ($p < 0.05$) varied from 5 and 7 weeks after crop emergence (WAE) on the sandy and sandy loam soil respectively, reflecting responsiveness of the sandy soil to fertility management during early growth stages. Biomass yield was least in the control followed by inorganic fertiliser treatment, composts and cattle manure respectively. Among the organic amendments, application of CM-TSC at 10 t ha⁻¹, gave the significantly highest biomass yield. On the sandy loam soil, a similar trend was observed, although there were no significant differences between 5 and 10 t ha⁻¹ application rates. Grain yield ranged between 5 and 7.5 t ha⁻¹ on sandy loam soil and was significantly ($p < 0.05$) higher in the combined CM and compost treatments over the control and sole inorganic fertiliser treatments by at least 22%. On the sandy soil the control grain yield (1.4 t ha⁻¹) was significantly lower than fertilized treatments reflecting the nutrient deficient status of the soil, a condition that was ameliorated to varying extents by application of inorganic fertiliser or cattle manure (3.7 t ha⁻¹), and composts (≈ 4 t ha⁻¹). The highest yield of 5.2 t ha⁻¹ was realised with 10 t ha⁻¹ CM-TSC.

Conclusions

The results attest to the benefit of targeted combined organic and inorganic fertiliser recommendations through the exploitation of locally available organic sources which could contribute to more integrated soil fertility management, particularly on nutrient deficient sandy soils.

References

ROSE-SCENTED GERANIUM (PELARGONIUM SPP.) ESSENTIAL OIL AS INFLUENCED BY HERBAGE DRYING AND DRYING METHOD

Presenter: V Dyafta (viwedyafta@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
V	Dyafta	Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare, Alice 5700, South Africa
BK	Eiasu	Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare, Alice 5700, South Africa
HT	Araya	Agricultural Research Council-Vegetables and Ornamental Plants Institute, Pretoria 001, South Africa

Introduction

To determine the effect of drying method on essential oil of rose-scented geranium, the harvested leaves were dried in direct sunlight and shade. Rose-scented geranium essential oil is produced and stored in trichomes that are based on the leaf epidermis and projecting out of the surface of the leaves and are extracted through hydro-distillation (Eiasu et al., 2009). Drying of the mesophyll, therefore, may not affect the contents of the trichome. Successful leaf drying prior distillation without significant loss of essential oil yield and quality could reduce volume and mass of the herbage distilled, saving energy and distillation time. The objective of the study was to investigate the effects of leaf drying and drying condition on oil quality and quantity of essential oil of rose-scented geranium.

Materials and Methods

Plants used for this study were collected between December 2014 and January 2015 from a rose-scented geranium grown in University of Fort Hare Research farm and glasshouse. Immediately after harvesting, the initial fresh mass was taken for each sample. The plant material was divided randomly into seven batches replicated four times. One group of batches was freshly distilled and the other six groups were made to lose water in the sun (20-35°C) and in a shade condition (25°C/room temperature) and then weighed again immediately before they were distilled between at 24 hour intervals. Essential oil composition was analysed at the Döhne Agricultural Development Institute using the gas chromatography (GC) analysis technique. Analysis of variance was performed using MSTAT-C software and means were separated using Tukey's student test at $p \leq 0.005$.

Results and Discussion

The plant material dried under shade condition and in the sun started to lose significant amount of essential oil on the third day of storage, when they lost about 35-40 of their initial water content. The drop in essential oil content was not as fast as the water loss. Water loss was greatly affected by temperature, while the essential oil showed steady decline with the storage duration. In general, the oil losing trend was higher in the herbage dried in the sun (46-66%) than under shade condition (34-32%). Citrenellol:geraniol ratio showed a declining trend with drying duration, indicating that citronellol was more volatile than geraniol.

Conclusions

The current results showed that drying/storing harvested rose-scented geranium herbage prior to distillation results in significant yield loss although it lowers the C:G ratio.

References

Eiasu B.K.. 2009. Influence of soil water management on plant growth, essential oil yield and oil composition of rose-scented geranium (*Pelargonium spp.*) PhD thesis. Pretoria: University of Pretoria, South Africa.

MICRONUTRIENT PROBLEMS IN SOILS, CROPS AND HUMANS IN SOME AFRICAN COUNTRIES

Presenter: MM El-Fouly (mohelfouly@link.net)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MM	El-Fouly	Fertilization Technology Department, National Research Centre, PC 12311, ElBehoothstr., Dokki - Giza, Egypt

Introduction

Introduction Micronutrient such as Iron (Fe), Zinc (Zn), Copper (Cu) and others are very essential for the growth and productivity of crops. Crops normally get their needs from these nutrients from the soil. In case the soils are containing insufficient amounts, the crops give low yield with low content of these nutrients in the edible part. When animals or humans eat these parts, their supply with the nutrient will be low, which reflects in causing different diseases to animals and humans.

Materials and Methods

MICRONUTRIENT DEFFICIENCIES IN HUMANS IN AFRICA It is very well documented that micronutrient deficiencies in Africa are severe. The paper will concentrate on the effect of micronutrients which are essential for crops and humans focusing mainly on Fe and Zn, whose deficiency in the content in different population groups (females, mothers, young children) is very widespread. The relation between deficiency in soils, forage and animals and the possible diseases in animals related to micronutrient deficiency will also be discussed Deficiencies depend on soil type, characterization, crop and crop management practices.

Results and Discussion

REMEDY MEASURES FOR THE DEFICIENCY There are different practical methods, which proved to different extent to overcome the micronutrient deficiencies in humans and animals. Out of these are: Soil treatment Seed treatment Foliar application Biofortification Chemical fertilization Plant breeding Medical treatment Mineral blocks (in animals)

Conclusions

Different remedy measures shall be discussed and their suitability for different causes occurring in Africa shall be discussed with particular stress on the crop management and breeding measures, which are more efficient and sustainable. **ACKNOWLEDGEMENT** This contribution is prepared within the activities of the Egyptian-German project on micronutrients and plant nutrition problems in Egypt, in cooperation with the Lehrstuhl of plant nutrition of the TU Munich, Germany, (Prof.Dr.U.Schmidhalter). Thanks are due to the Egyptian Academy of Scientific Research and Technology and the German Agency for International Cooperation.

References

THE ESTIMATION OF RESERVE-K AND K IMMOBILIZATION USING MID INFRARED SPECTROSCOPY AND MULTIPLE LINEAR REGRESSIONS

Presenter: DE Elephant (Dimpho.Elephant@sugar.org.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
DE	Elephant	South African Sugarcane Research Institute, P/Bag X02, Mount Edgecombe, 4300, South Africa
N	Miles	South African Sugarcane Research Institute, P/Bag X02, Mount Edgecombe, 4300, South Africa
P	Muchaonyerwa	School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, P/Bag X01, Scottsville 3209, South Africa

Introduction

The role of potassium (K) in photosynthesis and the translocation of sugars requires accurately predicted K requirements calculated from soil K tests. Some improvements in predicting K requirement has been achieved using modifiers to soil K thresholds based on clay content and base status. Further improvements can be accomplished by also including modifications based on levels of reserve-K and K fixation; however, these measurements are laborious and time consuming. This paper reports on the use of mid-infrared (MIR) spectroscopy and multiple linear regression in estimating levels of reserve-K and K fixation.

Materials and Methods

A total of 132 topsoil samples, varying widely in their physical and chemical properties, were collected and analyzed using wet chemistry techniques. The soils varied in reserve-K (determined by extraction with boiling HNO₃) from 0.11 to 7.27 cmolc kg⁻¹ (median 0.85 cmolc kg⁻¹), and in potassium requirement factor (KRF, an estimation of K fixation) from 1.99 to 7.73 kg K ha⁻¹ per unit soil test (median 3.0). A diffuse reflectance infrared Fourier Transform (DRIFT) MIR (Bruker, HTS-XT) was calibrated for reserve-K and K fixation using wet chemistry analysis data. Multiple linear models were also developed from routinely measured soil properties.

Results and Discussion

A calibration for reserve-K was successful with r^2 of 0.84, root mean square error of estimate (RMSEE) of 0.50, and the residual prediction deviation (RPD) of 2.53. These parameters indicated that the calibration is of good quality but should be used with caution. Hence, in order to cater for RMSEE, there is a need to adjust criteria used to formulate K requirements. Prediction of KRF using MIR met with limited success with r^2 of 0.32, RMSEE of 0.73, and RPD of 1.22. These parameters indicate that the calibration is not satisfactory and requires further investigations. A multiple regression model for reserve-K with extractable Si (0.01 M CaCl₂), volume weight, organic carbon and exchangeable Mg accounted for 40.4% of variance with standard error of prediction of 0.937. A regression model for KRF with Mg, volume weight, oxalate extractable Fe and exchangeable Zn accounted for 48% of variance with a standard error of prediction of 0.51. The difficulty in predicting both reserve-K and KRF using multiple linear regression could be due to the fact that these components are strongly influenced by clay mineralogy, particularly mica and vermiculites.

Conclusions

The MIR has a potential of predicting reserve K and KRF, which are necessary for formulating K requirements, but rigorous testing is still required.

References

EFFECTS OF ORGANIC AND INORGANIC FERTILIZERS ON GARDEN EGGPLANT (*Solanum melongena*)

Presenter: VI Esan (ishola.vincent@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
VI	Esan	Department of Crop Production and Environmental Management, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria
OO	Omilani	Department of Crop Production and Environmental Management, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria

Introduction

Eggplant (*Solanum aethiopicum* L.) is one of several horticultural crops grown in Nigeria. It is cultivated for its high nutritious value which is essential in the human diet. There is a high demand for eggplants and this is due to the increasing awareness of the nutritional and health benefits of the eggplant in meeting the nutritional requirements of the household. Despite its benefits, the optimum yield from its cultivation has not been attained in Nigeria. Therefore, the objectives of this study are to (1) investigate the effect of NPK and manure fertilizers on vegetative and reproductive stages of eggplant and (2) determine the impact of the combination of manure and NPK on the yield and yield components of eggplant.

Materials and Methods

Seeds of 'three varieties (V1, V2 and V3) of eggplant obtained from a farmer in Iwo city were used. The experiment was laid out as randomized complete block design with three replications, where four fertilizers treatments: N-P-K, manure, N-P-K/manure and control were applied. Morphological and yields parameters were measured and data collected were subjected to statistical analysis.

Results and Discussion

The results showed that there were significant differences ($P < 0.05$) amongst the treatments. V3 resulted in the longest branches (23.66 cm) in a combination with manure while in the control, a length of 9.83 cm was recorded with the same variety. The leaf lengths of the plants were statistically different ($P < 0.05$). The longest leaves were recorded in V2 (41.88 cm) and V3 (41.50 cm) in a combination with NPK and manure respectively. The shortest leaves were realized in a combination with no fertilizer in all the varieties (21.22 cm for V1). The highest fruit yield was obtained from V1 (1166.66g) with NPK and was statistically different ($P < 0.05$) from the other two varieties. The lowest fruit yield was realized in the control (200g).

Conclusions

V1 in a combination with only N-P-K fertilizer treatment recorded the best result in terms of fruit production or yield. This infers that the best option for the eggplant farmer is to combine V1 and N-P-K fertilizer if he is to realize optimum yield.

References

SUSTAINABLE WEED MANAGEMENT OPTIONS FOR PATERSON'S CURSE (*Echium plantagineum* L.) SUPPRESSION: PRELIMINARY RESULTS

Presenter: MI Ferreira (mikefe@elsenburg.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MI	Ferreira	Plant Sciences, Department of Agriculture Western Cape, Private Bag X1, Elsenburg, 7607 South Africa
CL	Lyons	ARC-Plant Protection Research Institute, Private Bag X5017, Stellenbosch 7599 South Africa

Introduction

Paterson's curse is a significant environmental weed in the Western Cape along the West Coast, where both conservation areas and agricultural land are severely affected. The aim of this study was to evaluate sustainable weed management options for Paterson's curse control, including smother crops and biological mulches, with minimum to zero use of herbicides.

Materials and Methods

The smother crop mixtures white mustard-lupine, rye-serradella and black oats-vetch, were each planted annually over three years at Darling, Western Cape. No agricultural chemicals were applied during the cultivation of smother crops. A second experiment was conducted which included treatments with rye-vetch and rye-lupine as well as mulches of both wood chips and thatch grass. Plots were laid out in a randomised block design with three replicates. The control was an untreated plot of similar dimensions. Student's t-test significant difference was calculated at the 5% level to compare treatment means.

Results and Discussion

None of the smother crop treatments in Experiment 1 could suppress Paterson's curse effectively. This was due to low biomass production at under 1 t ha⁻¹ due to soil and climatic factors. Under these conditions the treatments with introduced mulches in Experiment 2, controlled Paterson's curse effectively at above 90%, while the rye-vetch smother crop treatment provided suppression at 82%. These results indicate that the introduction and mechanical placement of mulches, sourced from renewables, may provide sustainable suppression of Paterson's curse.

Conclusions

Paterson's curse may be managed without the use of herbicides in environmental and field reserve settings. This could set in motion plant succession of indigenous vegetation and lead to the rehabilitation of infested land.

References

THE EVALUATION OF INTER ROW COVER CROPS FOR WEED SUPPRESSION IN ROOIBOS PRODUCTION SYSTEMS

Presenter: MI Ferreira (mikefe@elsenburg.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MI	Ferreira	Plant Sciences, Department of Agriculture Western Cape, Private Bag X1, Elsenburg, 7607 South Africa

Introduction

Rooibos tea is uniquely South African and grows naturally in some regions of the Western and Northern Cape Provinces, respectively. However, weeds not only interfere in terms of rooibos crop production, but may also contaminate the final product. The aim of this study was to evaluate six smother crop mixtures on weed suppression.

Materials and Methods

Smother crop mixtures consisting of rye-serradella, rye-vetch, rye-lupine, black oats-lupine, black oats-vetch and fodder barley-lupine were established annually from 2012 until 2016 at two localities in the rooibos production area, namely Clanwilliam and Nieuwoudtville. No herbicides or fertilisers were applied during the cultivation of these crops. Plots were laid out in a randomised block design with four replicates each. The control was an untreated plot of similar dimensions. Student's t-least significant difference was calculated at the 5% level to compare treatment means.

Results and Discussion

Only rye-vetch and rye-lupine crop mixtures on average produced biomass of more than 0.8 t ha⁻¹, namely 0.92 and 0.87 t ha⁻¹, respectively. Nevertheless, this was not sufficient to provide effective weed suppression when compared to the control. Although fodder barley-lupine biomass production reached 4.36 t ha⁻¹ in 2013 in a year of good rainfall at Nieuwoudtville, this dropped to 0.78 t ha⁻¹ when below average rainfall was experienced. However, results indicate that over the trial period, rye-vetch and rye-lupine crop mixtures, consistently produced the greatest annual amount of biomass. The low biomass production at these localities, could be ascribed to the infertile sandy acidic soils in this area with a pH below 5 and the long term annual average rainfall under 300 mm at Clanwilliam.

Conclusions

Rye-vetch and rye-lupine crop mixtures may be use for weed inter row weed suppression in rooibos production systems, but to circumvent adverse environmental conditions, the evaluation of introduced biological mulches should be considered in future research

References

EFFECT OF WEED INTERFERENCE ON THE PERFORMANCE OF OKRA (*Abelmoschus esculentus* L. MOENCH) IN BUEA, CAMEROON

Presenter: LA Fontem (lumfontem@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
LA	Fontem	University of Buea, Cameroon
D	Nuyega	University of Buea, Cameroon
D	Chikoye	International Institute of Tropical Agriculture, Zambia

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is an important vegetable crop widely cultivated in Cameroon. It is a good source of vitamins and minerals. Weeds are a major constraint to its production; they cause up to 90% losses in fruit yield. The objective of this study was to determine the effect of weed interference on the growth and yield of okra.

Materials and Methods

A field experiment was conducted in the University of Buea in March 2017. The treatments were three weeding regimes: unweeded, weeded once at 3 weeks after planting (WAP) and weeded at 3 and 6 WAP. The experimental design was a randomised complete block with three replications. The variety of okra used was Clemson spineless. Data were collected on weed biomass, okra stem diameter and number of branches at 9 WAP, as well as yield at harvest. The data were analysed using the SPSS software and treatment means were compared using the Tukey HSD test at a probability level of 5%.

Results and Discussion

There were significant differences in the data collected from the treatments for the different parameters. The unweeded treatments had the lowest okra stem diameter, number of branches and fruit yield. Okra weeded at 3 WAP had higher weed dry biomass than those weeded at 3 and 6 WAP. The highest weed dry biomass was recorded in the unweeded plots. All the weeded plots had similar okra fruit yield (4.6 t/ha). The unweeded treatments reduced fruit yield by 67% compared to the plots weeded at 3 WAP and at 3 and 6 WAP.

Conclusions

All weeded treatments had lower weed biomass, better okra growth and yield than the unweeded plots. Okra weeded at 3 WAP had similar fruit yield with that weeded at 3 and 6 WAP. Based on these results, okra should be weeded once at 3 WAP

References

COVER CROP PERFORMANCE IN AN APPLE ORCHARD

Presenter: JC Fourie (fouriej@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
JC	Fourie	ARC Infruitec-Nietvoorbij, Private Bag X5026, Stellenbosch,, 7599, South Africa
KM	Adams	ARC Infruitec-Nietvoorbij, Private Bag X5026, Stellenbosch,, 7599, South Africa

Introduction

Uncontrolled weeds may reduce crop yield by as much as 80%. An increasing number of weed species is developing resistance to herbicides. Cover crop management is a non-specific biological method of pre-emergence weed control. The aim of this study was to evaluate five cover crop treatments.

Materials and Methods

The study was executed in an irrigated Royal Gala/M109 apple orchard newly established on a loamy sand with a clay content of less than 10% near Vyeboom (34 07 S, 19 11 E). Five treatments were applied. Treatment B1: chemical control in the tree row from bud break to harvest, with dwarf Fescue (*Festuca arundinaceae*) established in the work row and slashed regularly. Treatment B2: Saia oats (*Avena strigosa* cv. Saia) as cover crop in the work row, with full surface chemical control applied end of September and the beginning of December (CC). Treatment B3: pink Seradella (*Ornithopus sativus* cv. Emena) in the work row and Campeda (*Trifolium subterraneum* L. cv. Campeda) in the tree row, with CC. Treatment B4: a mixture of Saia oats and pink Seradella in the work row, with CC. Treatment B5: canola (*Brassica napus* cv. AVGarnet) and Caliente 199 (*Brassica juncea* cv. Caliente 199) in the work row, with CC. Cover crop performance was determined in September, while weed control efficacy was determined in September, early December and early March.

Results and Discussion

The seasonal rainfall and temperatures did affect cover crop performance. The average cover crop production was as follows: $B4 \geq B2 > B1 \geq B3 > B5$. The average winter weed suppression was as follows: $B2 \geq B4 \geq B1 \geq B3 \geq B5$. Treatments B2 to B5 controlled the early summer weeds significantly better than B1. B1 tended to give the best on average suppression of the late summer weeds.

Conclusions

Saia oats (CC) gave the most effective winter weed suppression. The CC treatments (B2 to B5/) controlled the early summer significantly better than the perennial dwarf Fescue being slashed end of September and early December (B1). Although not significant, B1 resulted in the best on average suppression of the late summer weeds. The use of canola/Caliente 199 mixture is not recommended.

References

Poor farmers - poor yields: socio-economic, soil fertility and crop management indicators affecting climbing bean productivity in northern Rwanda

Presenter: AC Franke (FrankeAC@ufs.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
AC	Franke	Soil, Crop and Climate Sciences, University of the Free State, Bloemfontein, South Africa
F	Baijukya	International Institute of Tropical Agriculture (IITA), Dar es Salaam, Tanzania,
S	Kantengwa	International Institute of Tropical Agriculture (IITA), Kigali, Rwanda
M	Reckling	Institute of Land Use Systems, Leibniz Centre for Agricultural Landscape Research (ZALF), Muencheberg, Germany
B	Vanlauwe	International Institute of Tropical Agriculture (IITA), Nairobi, Kenya
KE	Giller	Plant Production Systems Group, Wageningen University, Wageningen, the Netherlands

Introduction

Climbing bean is the key staple legume crop in the highlands of East and Central Africa. We assessed the impact of interactions between soil fertility characteristics, crop management and socio-economic factors, such as household resource endowment and gender of the farmer, on climbing bean productivity and yield responses to basal P fertiliser in northern Rwanda.

Materials and Methods

Through a combination of detailed characterisations of 12 farms and on-farm demonstration trials at 110 sites in northern Rwanda, we evaluated variability in grain yields and responses to fertiliser. Also socio-economic characteristics of farmers and their households were recorded.

Results and Discussion

Grain yields varied between 0.14 and 6.9 t ha⁻¹ with an overall average of 1.69 t ha⁻¹. Household resource endowment and gender of the farmer was strongly associated with climbing bean yield, even though these were partly confounded with administrative Sector. Poorer households and women farmers achieved lower yields than wealthier households and male farmers. Household resource endowment and gender were likely to act as proxies for a range of agronomic and crop management factors that determine crop productivity, such as soil fertility, current and past access to organic manure and mineral fertiliser, access to sufficient quality staking material, ability to conduct crop management operation on time, but we found evidence for only some of these relationships. Poorer households and female farmers grew beans on soils with poorer soil fertility. Moreover, poorer households had a lower density of stakes, while stake density was strongly correlated with yield. Diammonium phosphate (DAP) fertiliser application led to a substantial increase in the average grain yield (0.66 t ha⁻¹), but a large variability in responses implied that its use would be economically worthwhile for roughly half of the farmers only.

Conclusions

Variability in climbing bean yield and responses to fertilizer application was large among smallholder farmers. Socio-economic status of households served as a better indicator of yield and response to fertilizer than many soil and crop management characteristics. Thus, a typology based on household characteristics can be a useful tool to structure rural households within areas that are relatively uniform in agro-ecology and use the typology to target agricultural innovations to those households that are most likely to adopt.

References

Franke AC, Baijukya F, Kantengwa S, Reckling M, Vanlauwe B, Giller KE (2017) Poor farmers - poor yields: socio-economic, soil fertility and crop management indicators affecting climbing bean productivity in northern Rwanda. *Experimental Agriculture*, in press, doi: 10.1017/S0014479716000028.

GROWTH, YIELD AND QUALITY RESPONSE OF TWO GINGER SPECIES TO DIFFERENT NITROGEN APPLICATION RATES

Presenter: A Gatabazi (auges2012@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Gatabazi	Department of Plant and Soil Sciences, University of Pretoria, Pretoria 0002, South Africa
D	Marais	Department of Plant and Soil Sciences, University of Pretoria, Pretoria 0002, South Africa
J.M	Steyn	Department of Plant and Soil Sciences, University of Pretoria, Pretoria 0002, South Africa
H.T	Araya	Agricultural Research Council, Vegetable and Ornamental Plant (VOP), Private Bag X293, Pretoria 0001, South Africa

Introduction

Products from medicinal plants have significantly increased due to substantial use of natural medicines, food and fibre. Ginger demand exceeds market supply. The bioactive constituents of this plant (flavonoids, phenolic and antioxidants) are important in reducing the risk of contracting several diseases (e.g. migraines, nausea and cancer). The aim of the study was to examine the growth, yield and quality of ginger species in response to nitrogen application rate.

Materials and Methods

A glasshouse experiment was conducted at the Experimental Farm of the University of Pretoria, South Africa. Two ginger species, commercial (G15) and African ginger were grown for two seasons (from November 2015 to August 2017). A total of six treatments were arranged in a Randomized Complete Block Design (RCBD) replicated four times. Artificial growth media were used and supplemented with N fertiliser at different rates. Ginger rhizomes, 20 to 30 g, were planted in polypropylene bags filled with 30 l of perlite. Once the rhizomes enlarged, 20 l of coir medium was added on top of the perlite, increasing the total volume to 50 l. Nitrogen was added at 0, 1.375 and 1.625 g plant⁻¹. Phosphorus and potassium were applied as basal fertilisers at the rate of 1.375 g plant⁻¹.

Results and Discussion

Height, tiller and leaf numbers and chlorophyll content increased with an increase in nitrogen application rate. Plant height, tiller and leaf numbers were higher in commercial ginger as compared to African ginger. Fresh and dry yield of commercial ginger were than in African ginger. Flavonoids, phenolics and antioxidant content also increased with an increase in nitrogen application rates.

Conclusions

The experiment showed that the growth and yield of ginger species respond positively to nitrogen application.

References

FARMERS' KNOWLEDGE AND PERCEPTIONS OF GENETICALLY MODIFIED (GM) CASSAVA IN KENYA

Presenter: VN Gathaara (vgathaara@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
VN	Gathaara	Kenya Agricultural and Livestock Research Organisation, PO Box 14733, Nairobi 00800
C	Valdaina	University Missouri, Private Bag 65211, Columbia, 1230
D	Sheikh	Kenya University, Private 43844-Nairobi, 00100
MD	Kengo	Kenya Agricultural and Livestock Research Organisation, PO Box 14733, Nairobi 00800
SJ	Harvey	University Missouri, Private Bag 65211, Columbia, 1230
F	Murithi	Kenya Agricultural and Livestock Research Organisation, PO Box 14733, Nairobi 00800

Introduction

Genetic modification of cassava (*Manihot esculenta*) has been going on in Kenya with the aim of developing varieties with improved pest and disease resistance and, nutritional quality. The crop which plays a key role in food security and income generation in Kenya has adversely been affected by Cassava mosaic and Cassava brown streak diseases. The storage roots, the main consumption parts provide mainly carbohydrates.

Materials and Methods

A study was conducted between 2012 and 2014 with 132 (36 men and 96 women) smallholder farmers in four cassava growing areas in the Coastal regions. The aim was to assess farmers' knowledge and perceptions of genetic modification; intended and unintended consequences of introducing GM cassava and how best to communicate information on GM cassava to the farmers in Kenya. The study was conducted through individual interviews and focus group discussions guided by a semi-structured questionnaire and a check list. Data was analysed using quantitative and qualitative tools and methods.

Results and Discussion

The study reviewed that 34% of the farmers had no education while the majority (47%) had primary education. Most (98%) farmers (men and women) had not heard about genetic modification. However, a few of them had heard about GM maize; mainly from parliamentary debates, radio, newspapers, local leaders and other farmers. The farmers' perceived GM crops to be high input demanding compared to existing varieties; fast growing, a characteristic that was likely to be passed to human beings upon consumption of GM products such as GM cassava varieties leading to people aging faster among others health issues including obesity. Farmers also feared losing traditional/local cassava in the event of adopting GM cassava leading them vulnerable in case of failure of GM varieties. Even with these concerns and fears, farmers expressed willingness to adopt GM cassava based on the intended benefits to include disease resistance and nutritional value. The farmers expressed the need for credible, relevant and well documented information on the new varieties and product fitness for human consumption among other risks and benefits. The farmers express that the information to be disseminated should be from recognised government research organisation and institutions to include researchers, medical practitioners and extension agents.

Conclusions

Awareness and sensitization on GM is therefore critical in introducing and accelerating adoption of GM products especially at farm level. Consideration should be made on trusted sources of information and be inclusive in GM cassava information dissemination processes.

References

AGRONOMIC PERFORMANCE AND NUTRITIONAL PHENOTYPING OF OKRA (ABELMOSCHUS ESCULENTUS) GENOTYPES AND TRAIT ASSOCIATIONS IN SOUTH AFRICA

Presenter: AS Gerrano (agerrano@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
AS	Gerrano	Agricultural Research Council, Vegetable and Ornamental Plants, Private Bag X293, Pretoria 0001, South Africa

Introduction

Okra, *Abelmoschus esculentus* L. (Moench) is an important fruit vegetable crop belongs to family Malvaceae. It is a good source of protein, carbohydrates, vitamins, minerals, and enzymes which are often lacking and/or found in small amount in the diet of developing country. Okra is a highly nutritious fruit vegetable. However, despite its importance for food, nutritional and health benefits the crop is rarely produced in some parts of the provinces in South Africa. The study was carried out to assess the genetic diversity using agro-morphological traits and nutritional content in the plant for use in the breeding programme. The objective of this study was therefore to assess the genetic diversity of okra genotypes based on agro-morphological traits and nutritional composition in the fruits of okra in South Africa.

Materials and Methods

The experiment was carried out at the Roodeplaats research farm of the Agricultural Research Council in a randomized complete block design replicated three times. Agro-morphological data was recorded on the field. The analysis of variance for agronomic traits and nutritional compositions showed highly significant differences for most traits recorded. The multivariate analysis showed wide genetic diversity among the okra genotypes, which could be exploited in selecting suitable and potential parents when breeding for high yield and nutritional qualities. The morphological phenotypic and nutritional data were subjected to analysis of variance using Agronomix computer software (Agronomix, 2008). The means of all okra genotypes were compared by the least significance difference (LSD) at 0.05 probability level. The mean data were standardized and subjected to multivariate analysis [28] using principal component analysis (PCA). The correlation coefficients were also computed to determine the degree of trait association (NCSS, 2004).

Results and Discussion

The present study revealed the genetic potential of the genotypes studied and their importance for use in the breeding programme aimed towards addressing malnutrition, food security and poverty alleviation by breeding for increased yields, and nutritional contents in South Africa.

Conclusions

Characterization and evaluation of crop species is essential in crop improvement programme to identify potential parents according to their traits.

References

Agronomix. 2008. Agrobases Generation II. Agromix Software, Winnipeg, Manitoba, R2N0S4, Canada. NCSS. 2004. Number Cruncher Statistical Systems. Jerry L. Hintze, 329 North 1000 East, Kaysville, Utah 84037, Canada.

EVALUATION OF ORGANIC SMALLHOLDER FARMER SOIL AMENDMENT PRACTICES ON SOIL FERTILITY, BROCCOLI YIELDS AND MINERAL NUTRIENTS

Presenter: TKS Gobozi (20429320@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
TKS	Gobozi	Department of Soil Science, Stellenbosch University, Private Bag X1, Matieland 7602
AG	Hardie	Department of Soil Science, Stellenbosch University, Private Bag X1, Matieland 7602

Introduction

Peri-urban, smallholder farmers surrounding Cape Town, which are the main producers of fresh vegetables in the region, are generally not producing at their optimum level due to lack of agronomic support, marginal sandy soils and socio-economic constraints. The aim of this study was to evaluate the soil amendment practices of an organic smallholder farmer in comparison with potential alternative organic and chemical amendments on soil fertility and broccoli growth, yield and quality; and economic profitability.

Materials and Methods

The trial was conducted in a smallholding farm near Stellenbosch in collaboration with an organic smallholder farmer in 2016/2017. The farmer's routine soil amendment practice was to apply 10 t/ha of a commercial compost (CC) two weeks prior to each cropping season. This practice was compared to application of two on-farm produced composts, i.e., composted plant and animal waste (CW) and composted waste with 20% biochar (CB) applied at typical smallholder application rate (10 t/ha), and with CW also applied at broccoli N requirement equivalent to 22 t/ha, and a control (C) treatment. These treatments were further compared with a commercial inorganic fertilizer (CF) programme for broccoli. Soil mineral N was measured weekly, while soil macro and micro nutrients were determined at planting and at harvest. Broccoli yields and mineral nutrient content were determined. Marginal analysis was performed.

Results and Discussion

Application of CF significantly ($p < 0.05$) increased broccoli yields (88%) which was associated with a significantly ($p < 0.05$) higher (150-160%) cumulative soil mineral N content compared to the organic or control treatments, followed by CW at 10 t/ha (28%). Application of CW at 22 t/ha or CB resulted in no significant increase in yield compared to CC or control, which was attributed to too much C being added to soil compared to N. There were no significant differences in nutrient contents of broccoli heads between treatments. The CF was the most profitable treatment (455% increase) followed by CW at 10 t/ha (151% increase) through determination of marginal rate of returns from each treatment relative to the farmer's current practice (CC).

Conclusions

The smallholder farmer is likely to generate more income when he produces his own compost using easily accessible organic materials or uses a chemical fertilizer programme instead of buying a commercial compost. The availability of soil mineral N had the strongest effect on broccoli yields in this study, and it was shown that composts mineralised little N despite having low C:N ratios, especially when added in larger amounts.

References

Reversing Initial Low Oxygen Stress (ILOS), a new way to control scald on Granny Smith.

Presenter: HM Griessel (henkg@tru-cape.co.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
HM	Griessel	Tru-Cape Fruit Marketing, 36 St James, Somerset West
D	Meiring	Two-a-Day Group. 1 Villiersdorp Road, Grabouw

Introduction

Granny Smith apples are prone to develop a storage defect, called superficial scald. Traditionally a post-harvest chemical, DPA, was used to control this defect. With the EU reducing the mrl to 0.1 ppm, the use of DPA has become mostly redundant. 1MCP has been used as an alternative to control scald with varying levels of success. Initial Low Oxygen Stress (ILOS) has been used to control scald for limited storage time (Van Der Merwe et al, 1997).

Materials and Methods

All the fruit in 18 rooms was treated at loading with 1MCP and kept under CA conditions. During July, 10 rooms of Granny Smith were packed and on arrival the fruit had severe scald. The remaining 8 rooms were re-treated with 1 MCP in August. If the ethylene threshold of 2 ppm of the remaining 8 rooms was exceeded, the rooms were flushed and placed under Dynamic CA (DCA) conditions. At closing, all the rooms were stressed using the Harvest Watch technology. The stress treatment was repeated a week prior to out-loading.

Results and Discussion

Initial low oxygen stress (ILOS) controlled scald as reported by Van Der Merwe et al (1997). The drawback of this procedure was that if fruit were stored too long, scald re-appeared. Before DPA's mrl was reduced, the best control for long term storage was by treating with DPA, 1MCP and keeping the fruit under DCA. Because the effect of alcohol was not fully understood, it was postulated that by adding a stress treatment just before opening of the room, another scald control mechanism was added. It was postulated that the reason for limited success previously with ILOS, is because the formed alcohol dissipates, as does its effect in scald control. By delaying the time of ILOS to just prior to out-loading, it was thought that this would control scald the longest, as the fruit leaves the CA store with the highest level of alcohol. The results of this large commercial trial were better than expected. Not only was the fruit of 8 rooms scald free but fruit was stored until January.

Conclusions

Fruit alcohol seems to have a strong antiscald effect. During the 8 weeks after packing alcohol dissipates and, once below a certain unknown level, scald reappears. By stressing the fruit just before opening the room, enough alcohol was accumulated to prevent scald from appearing, avoiding tissue damage.

References

VAN DER MERWE, J.A., COMBRINK, J.C., TRUTER, A.B. & CALITZ, F.J., 1997. Proceedings of the Seventh International Controlled Atmosphere Research Conference, Davis, California

A GLOBAL REVIEW OF PLANT DENSITY EFFECTS ON MAIZE YIELD

Presenter: SJ Haarhoff (17807328@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
SJ	Haarhoff	Department of Agronomy, Stellenbosch University, Private Bag X1, Matieland 7602
PA	Swanepoel	Department of Agronomy, Stellenbosch University, Private Bag X1, Matieland 7602

Introduction

Maize grain yield is strongly related to plant density. The optimal plant density is dependent on viz. climate and soil tillage practice, whereas maize phenotype may influence crop responses to these agronomic management practices. Over the past decades, a tremendous amount of work has been done to evaluate the effects of plant density on maize grain yield across a wide variety of environments. However, a better understanding of the effect of climate and soil tillage practice on the optimal plant density would be beneficial to comprehend the importance of these factors in a certain environment. The aim was to assess the effects of plant density and soil tillage systems on maize grain yield on a global scale.

Materials and Methods

A meta-analysis was conducted using experimental data from various field trials across the globe by collecting eligible publications using the ISI Web of Science Database. Six different combinations of keywords were used. The retrieved papers were screened based on title, keywords and abstract to compile a list for further examination. Screening criteria involved evaluation of plant density as a treatment to investigate the effects thereof on grain yield. A wide set of data were extracted from these publications, including inter alia spatial, temporal, experimental and climate data, as well as agronomic information and data. For the purpose of this contribution, the effects of varying levels of plant densities on grain yield was assessed over a wide range of rainfall groups, ranging from arid (200 to 400 mm mean annual rainfall) to super-humid (>1000 mm) conditions, as well as the influence of tillage or no-tillage systems.

Results and Discussion

Seventy seven peer-reviewed publications were used representing 14 countries and five continents, but predominantly located in North America and China. In sub-humid (600 to 800mm) and super-humid regions there was an increasing trend in yield as plant density increased. For semi-arid (400 to 600mm) and humid (800 to 1000mm) regions, the same trend was observed, but reached a maximum when the plant density reached 90 000 plants ha⁻¹. Where soil tillage was performed, higher yields were obtained in all rainfall groups when compared to no-tillage practices.

Conclusions

Climate conditions and tillage practice both influenced the optimal plant density to achieve the highest maize grain yield. There is a lack of research on the effects of plant density, row width and prevailing soil and climate conditions in Africa, Australasia, Europe and the western part of Asia.

References

MOLECULAR CHARACTERISATION OF LITCHI

Presenter: E Hajari (HajariE@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
E	Hajari	Agricultural Research Council, Tropical and Subtropical Crops, Private Bag X11208, Nelspruit, 1200, Mpumalanga, South Africa.
D	Nonyane	Agricultural Research Council, Tropical and Subtropical Crops, Private Bag X11208, Nelspruit, 1200, Mpumalanga, South Africa.

Introduction

Litchi (*Litchi chinensis* Sonn.) belongs to the Sapindaceae family and is a commercially important fruit tree in tropical and subtropical regions. China is the main producer of litchi followed by India and other countries such as Taiwan, Thailand and South Africa. At the Agricultural Research Council-Tropical and Subtropical Crops, the plant improvement programme for litchi is based on breeding new material adapted to local conditions and the evaluation of local selections and imported cultivars for commercial use. At present, litchi cultivars and selections are evaluated based on phenotypic characteristics. However, there are limitations in the use of morphological descriptors. Molecular markers can be used to supplement morphological characterisation, particularly in cases where confusion arises. This is common in litchi where nomenclature is poorly defined. The aim of the present study was to use molecular markers to characterise the genetic diversity of selected litchi cultivars.

Materials and Methods

Genomic DNA was extracted from leaves using a commercially available kit. Sixteen Sequence-Related Amplified (SRAP) markers (combinations of ME1-EM4) were tested using the available germplasm. The results were repeated for verification purposes. The PCR products were visualised using capillary electrophoresis, the resulting bands were scored and used to create a molecular genotype reference database. The data was analysed and dendrograms were generated to indicate genetic relationships.

Results and Discussion

The UPGMA dendrogram that was generated with the Jaccard method produced a good co-phenetic correlation coefficient of 0.860. This indicated a good fit between the data and analysis method. Some relationships were evident between the molecular and morphological or physiological data. For example, there was clear separation of cultivars based on time of harvest (early and late season cultivars). In addition, grouping of cultivars were apparent based on the size of seeds and fruit produced. A Principal Co-ordinates Analysis was also conducted. This confirmed the results found in the dendrograms.

Conclusions

The current study confirmed that the tested SRAP markers are useful in elucidating relationships amongst litchi cultivars. The results have been used to develop a molecular genotype reference database which provides a tool to verify cultivars. Work is ongoing to determine if the tested markers are the most appropriate or if more suitable markers are available for the abovementioned applications.

References

The Warburgia Story: inter-disciplinary approaches addressing extinction concerns

Presenter: K Hannweg (karin@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
K	Hannweg	ARC-TSC, Private Bag X11208, Nelspruit, 1200
M	Hofmeyr	SANPARKS Conservation Services, Private Bag X402, Skukuza, 1350
W	Froneman	South African National Biodiversity Institute - Lowveld National Botanical Garden, Nelspruit, 1200
L	Swemmer	SANPARKS Scientific Services, Phalaborwa
T	Neary	SAPPI Pty (Ltd), Braamfontein, Johannesburg

Introduction

The SANParks Warburgia salutaris Conservation Programme seeks to address the threat of pressure on local populations that could become locally and eventually regionally extinct in the wild, with negative implications for biodiversity conservation and socio-economic wellbeing. Warburgia salutaris is an important medicinal plant. It is used widely to treat a number of different ailments and as a result is under threat due to overharvesting. It is currently listed as an endangered species and is only found in isolated populations in the wild in the eastern regions of South Africa. Highly sought-after on the traditional medicine markets, it is becoming increasingly expensive since supply does not keep up with demand. The KNP populations face intensive illegal harvesting even though they are relatively isolated from any other wild population/s and therefore there is concern for local extinction. While field rangers are employed to monitor illegal harvesting activities, several interdisciplinary initiatives have been implemented to address this concern.

Materials and Methods

The interdisciplinary initiatives include not only monitoring of existing population size and stability, but also the identification of 'new' populations; the use of alternative sustainable sources of material (i.e. leaves) for harvesting, various propagation methods, distribution of propagated trees, as well as workshops with traditional healers and technology transfer.

Results and Discussion

A synopsis of field observations as well as the results obtained will be presented. Several unknown populations were 'discovered' during the course of the study and these were documented and monitored over time to determine not only poaching activities but also phenological cycles (i.e. flowering and fruit set). A number of studies included investigations of the reproductive limitations of the species as well as propagation methods including clonal and seed propagation. Young trees are distributed to traditional healers and workshops are held to discuss sources of plant material and the care of trees. Additionally, information is disseminated with any tree distributed in the form of posters ('How to Plant and Care for Your Tree') which are available in five South African languages.

Conclusions

As a result of the collaboration between the ARC, SANParks, SANBI and SAPPI, enormous strides have been taken towards the conservation of Warburgia salutaris. With the species being extremely high in demand, poaching incursions were a regular occurrence. However, with the combination of the field ranger patrols as well as the propagation and distribution initiatives, illegal harvesting within the Park's boundaries has become substantially reduced. Similar programmes are envisaged for other species of concern.

References

SEED GERMINATION AND IN VITRO PROPAGATION OF ALOE REITZII - AN ENDEMIC AND THREATENED ORNAMENTAL SPECIES

Presenter: N A Hlatshwayo (HlatshwayoN@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N A	Hlatshwayo	Agricultural Research Council - Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001.
S O	Amoo	Agricultural Research Council - Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001
J O	Olowoyo	Department of Biology, P O Box 139, Sefako Makgatho Health Sciences University, Medunsa, 0204

Introduction

Aloe reitzii is a threatened ornamental species endemic to South Africa. The species has a declining population trend and presents an archetypal conservation challenge due to over-exploitation and habitat loss. The use of plant biotechnology techniques for conserving plant resources is well established. However, scientific information on the propagation and cultivation of this species is lacking. Developing a propagation protocol for *Aloe reitzii* is crucial for its conservation. This study was aimed at developing effective propagation techniques for *Aloe reitzii*.

Materials and Methods

Seed germination studies were conducted by placing *Aloe reitzii* seeds in petri dishes lined with filter paper, moistened with distilled water. Twenty-five seeds were placed in each petri dish, replicated four times and incubated under varying temperatures (15, 20, 25 and 30°C) and photoperiods (24 h dark, 24 h light, and 16:8 h light/dark) to determine the optimum temperature and photoperiod conditions for seed germination. Germinations were recorded daily. Following culture initiation using shoot explants, the effect of different cytokinins [meta-topolin (mT), meta-topolin riboside (mTR), 6-benzyladenine (BA) and kinetin] on shoot multiplication was evaluated in order to establish an in vitro mass propagation protocol for *A. reitzii*. Different cytokinin concentrations (0.0, 2.5, 5.0, 7.5, 10.0 and 15.0 µM) were used.

Results and Discussion

Temperature and photoperiod are essential for seed germination, as significant differences were observed in the mean germination time (MGT). Seeds incubated at 30 °C and 16:8 h light/dark showed a significant reduction in MGT. Overall, less than 50% germination was recorded prompting the development of an *in vitro* propagation protocol. In vitro shoot multiplication proved to be a more successful method of propagation. The highest number of shoots per explant (16) was obtained using 5.0 µM mT, resulting in shoot production that was five times higher than with the control. This BA derivative cytokinin proved to be superior when compared to commonly used kinetin and BA.

Conclusions

Conditions for the optimum germination of *Aloe reitzii* seeds were established. An efficient tissue culture protocol for shoot multiplication was achieved. The propagation protocol developed is useful for its cultivation and reducing pressures on the wild population. This will ensure sustainable use of *Aloe reitzii* while meeting the ornamental needs of this species.

References

DETERMINATION OF THE EFFECT OF PACLOBUTRAZOLE APPLICATION ON THE BIOMASS, ROOT YIELD AND BETA-CAROTENE CONTENT OF SWEET POTATO

Presenter: IN Hlerema (Hleremai@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
IN	Hlerema	ARC-VOPI, Private Bag X293, Roodeplaat.
SM	Laurie	ARC-VOPI, Private Bag X293, Roodeplaat.
B	Eiasu	University of Fort Hare, Private Bag X1413, Alice

Introduction

Paclobutrazole (PBZ) is a plant growth retardant. PBZ might therefore be useful for sweet potato growers to achieve higher plant populations per hectare since it will reduce the plant canopy. However, it should also be checked if the PBZ application does not affect nutrient content of roots and leaves especially the beta-carotene content of orange-fleshed cultivars. The objective of this study was to determine the effect of PBZ on sweet potato growth, storage root yield and to determine the effect of PBZ on beta-carotene content of sweet potato leaves and storage roots.

Materials and Methods

The field trial was repeated over two seasons the 2014/15 and the 2015/16 season. The field experiment was a split plot experiment. The main plots was paclobutrazole levels and the two cultivars (Bophelo and Blesbok) and two plants spacing's (20cm and 30cm) were randomly allocated into the subplots. The paclobutrazole levels applied were 0 mg, 100 mg, 200 mg and 300 mg of active ingredient in 1 l of water applied forth-nightly 4 weeks after planting. Root yield and biomass accumulation was recorded. In a pot experiment using cultivar Bophelo, paclobutrazole levels 0 mg, 100 mg and 200 mg/l were applied forth-nightly 4 weeks after planting. The leaf and root samples (150g and 400g of a composite sample respectively) were collected and analysed for total phenols, total flavonoids, vitamin C and beta-carotene

Results and Discussion

The field trial results revealed significant difference ($P < 0.05$) in leaf and stem mass between the PBZ levels applied. 0 mg had the highest leaf and stem mass. There was no significant differences in root yield between the PBZ levels. The results of leaf and root analysis for Bophelo showed significant differences ($P < 0.05$) in total phenols, total flavonoids, vitamin C and beta-carotene in leaf samples of the three levels of PBZ applied. The beta-carotene for the leaf was increased at 100mg/l PBZ. PBZ application reduced the beta-carotene content for the roots from 18,91 to 13,97 to 10,77 mg/100g dry weight for 0mg/l, 100mg/l and 200mg/l, respectively.

Conclusions

Application of PBZ to sweet potato reduces the biomass yield but does not have an effect on the root yield. Thus a higher plant density can be used to achieve higher yield and returns on investment. The leaves can be used as a relish and can be sold to supplement income. However, PBZ further reduces the beta-carotene content of the roots and are not be recommended for use with orange-fleshed cultivars.

References

EFFECT OF LEAF HARVESTING FREQUENCY ON YIELD PARAMETERS OF FOUR SWISS CHARD (*BETA VULGARIS*) CULTIVARS

Presenter: JK HUMA (Kamogelo@Highveldmail.co.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
JK	Huma	Limpopo Department of Agriculture and Rural Development, Towoomba Research station, Private Bag X1615, Bela-Bela, South Africa

Introduction

Swiss chard (*Beta vulgaris* L.), often commonly referred to as spinach, is a leafy vegetable popular in South Africa for its nutritional properties. Little is known about the effects of leaf harvesting frequency on yield parameters of Swiss chard under open field conditions. The main objective of the study was to determine the effect of leaves harvesting frequency on yield of Swiss chard cultivars under open field conditions.

Materials and Methods

The study was conducted as RCBD in a single factorial experiment arranged in a Split-plot with two treatment factors namely: four Swiss chards cultivars (Fort Hook Giant, Star 1801, Bright Light and Green Wave) as main plots, and four leaf harvesting frequencies (7, 14, 21 and 25 days) as sub plots with three replications. Harvesting was done continuously at the frequency of 7, 14, 21 and 25 days respectively and the following parameters were recorded, number of bunches, leaf length, width, leaves yield (fresh biomass), petioles length and mass.

Results and Discussion

There was a significant increase in leaf fresh biomass and bunch mass with increase harvesting frequency. The highest yields were obtained by cultivar Star 1801 at harvesting frequency of 25 days, followed by Ford Gook Giant, Bright Light and Green Wave respectively. There was a significant interaction between Swiss chard cultivars and harvesting frequency.

Conclusions

Findings of the study demonstrate that, Swiss chard cultivars responded differently to harvesting frequencies. The highest yields were obtained at the harvesting frequency of 25 days but it will not be economically viable to harvest once a month, as such good yields can also be achieved by biweekly harvesting intervals. Star 1801 gave outstanding performance across all harvesting frequencies.

References

MABOKO, MM, Du PLOOY, CP (2013) Effect of plant spacing and harvesting frequency on the yield of Swiss chard (*Beta vulgaris* L.) in a closed hydroponic system. African Journal of Agricultural Research 8: 936 - 942.

PRE-EMERGENT APPLICATION EFFECTS OF NEMAFRIC-BG PHYTONEMATICIDE ON GROWTH OF POTATO CULTIVAR 'MONDIAL G3' AND SUPPRESSION OF MELOIDOGYNE JAVANICA

Presenter: TI Huma (tiegohuma@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T.I	Huma	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa
K.M	Pofu	Agricultural Research Council-Vegetable and Ornamental Plants, Roodeplaat, Private Bag X293, Pretoria 0001, South Africa
P.W	Mashela	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa

Introduction

South African resource-poor smallholder farmers have been successfully utilizing ground dried fruits and fermented crude extracts of wild watermelon (*Cucumis africanus*) as Nemafric-BG and Nemafric- BL phytonematicides, respectively in managing plant parasitic nematodes in various crops, through a ground leaching technology (GLT) system and Botinomagation system, respectively. However, active ingredients in cucurbitacin-containing phytonematicides are allelochemicals, with the potential of inducing phytotoxicity on crops protected against nematode damage (Mashela et al., 2017). Under field conditions most phytonematicides are highly phytotoxic (Mafeo et al., 2011). The objective of the study, therefore, was to establish whether pre-emergent application of Nemafric-BG phytonematicide would have effect on potato growth and suppression of *M. javanica* under field conditions.

Materials and Methods

Potato seed tubers were planted at an inter- and intra-row spacing of 0.6 m, in autumn (March-May) 2017, under field conditions. Treatments, namely, 0, 2, 4, 8 and 16 g Nemafric-BG phytonematicide were arranged in a randomised complete block design, with fourteen replicates at planting. At 56 days after initiation of treatments the experiment was terminated, and the following plant variables were measured: plant height, fresh root mass, chlorophyll content, tuber mass, stem diameter. After termination of the trial, nematodes were also extracted from roots.

Results and Discussion

At 56 days after initiation of treatments, treatments significantly ($P \leq 0.05$) affected fresh root mass, tuber mass and chlorophyll content, contributing 57, 58 and 35 % to total treatment variation of the three variables, respectively.

Conclusions

In conclusion, Nemafric-BG phytonematicide was phytotoxic to potato cultivar 'Mondial G3'. Therefore, the product should not be used in ground formulation.

References

Mafeo TP, Mashela PW, Mphosi MS. 2011. Modelling responses of maize, millet and sorghum seedlings to crude extracts of *Cucumis myriocarpus* fruit as pre-emergent bio-nematicide. *African Journal of Agricultural Research* 6: 3678-3684. Mashela PW, De Waele D, Dube ZP, Khosa MC, Pofu KM, Tefu G, Daneel MS, Fourie H. 2017. Alternative nematode management strategies. In: Fourie H, Spuull VW, Jones RK, Daneel MS, De Waele D (eds.). *Nematology in South Africa: A view from 21st century*. Springer International Publishing: Heidelberg.

Evaluating the effect of three commercial nitrogen formulations on fruit tree physiology, quality and yield of 'Rosy Glow' apples

Presenter: L.J.v.Vuuren (14028891@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
L	J.v.Vuuren	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland, 7602
E	Lötze	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland, 7602
J	Stander	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland, 7602

Introduction

Optimal management of applied nitrogen (N) is needed to develop a system for sustainable fruit production. Understanding and managing the effect of different rates and timing of fertilizer applications are two of the processes of understanding and improving external nitrogen use (Tagliavini & Millard, 2005). The most prominent formulations of N, nitrates and ammonium, are currently applied in apple orchards, but are different regarding their mode of action (Mattson et al., 2009). This study evaluated the effect of different N formulations, as soil applications, on tree physiology, yield and quality of 'Rosy Glow' apple on a loamy clay soil in Ceres.

Materials and Methods

A commercial, bearing orchard of 'Rosy Glow' apples was selected for trial purposes on Alhambra farm, Bo Swaarmoed Valley in the Western Cape. Three fertilizer treatments (UreaHB (control), BlackUrea™ and BlackDAP™) were applied as a granular soil application at three phenological stages: budburst to full bloom; six weeks post full bloom and post-harvest, according to recommended N levels. Shoot length, photosynthesis, yield and fruit quality were determined with standard protocols on specific dates. White root numbers were quantified with a mini-rhizotron on a monthly basis.

Results and Discussion

BlackUrea™ and BlackDAP™ showed no significant differences regarding internal or external quality of 'Rosy Glow' compared to UreaHB. BlackDAP™ showed significantly higher photosynthesis compared to the other treatments. Yield efficiency was higher in the BlackUrea™ and BlackDAP™ treatments compared to the Urea HB, but this was only significant at 10%. Shoot growth did not differ significantly. Both treatments showed less overall white root numbers compared to UreaHB having the highest count of white roots.

Conclusions

Although no significant differences were found at 5%, it was evident that there is a difference in the mode of action between the formulations. However, BlackDAP™ shows potential regarding yield efficiency with also higher photosynthesis compared to the control. This should be investigated further as benefits with nutrition often only occur later.

References

Mattson, N., Leatherwood, R., Peters, C., 2009. Nitrogen, all forms are not equal. Cornell Greenhouse Horticulture. GMPRO Magazine, Cornell University. Tagliavini, M., Millard, P., 2005. Fluxes of nitrogen within deciduous fruit trees. Acti Sci. Pol, Hortorum Cultas 4(1), 21-30.

FACTORS AFFECTING THE DECLINE OF RUSSIAN WHEAT APHID (*Diuraphis noxia*) IN WHEAT PRODUCTION AREAS OF SOUTH AFRICA

Presenter: A Jankielsohn (jankielsohna@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Jankielsohn	ARC-Small Grains, Private Bag X29, Bethlehem, 9700

Introduction

Because the Russian wheat aphid (RWA) pose a threat to the wheat industry in South Africa, it is important to understand the key factors affecting population density fluctuations in the RWA biotype complex. Changes in the climatic environment have a significant impact on agricultural production and the agricultural landscape is subjected to constant change. The area utilized for wheat production in South Africa showed a declining trend which will likely influence the population structure of RWA and the structure of the RWA biotype complex.

Materials and Methods

RWA samples were collected from 2010 to 2016 during the wheat growing seasons in the main wheat production areas of South Africa. Samples were collected from cultivated wheat, barley and oats as well as volunteer wheat, wild oats, rescue grass and false barley. Infested leaves were placed in Petri dishes containing moist filter paper, sealed with parafilm and stored in an icebox for transportation. The biotype of each RWA sample was determined by screening its feeding damage on 11 previously established plant resistant sources containing designated resistance genes. Biotype (clones) groups across all plant differentials were analyzed using a two-way (clone, plant entry) analysis of variance (ANOVA). Mean damage rate entries with significant ($P < 0.05$) clone-by-plant interactions were separated by Fisher's protected least significant difference (LSD) test at the 5% level.

Results and Discussion

The surveys suggest that the RWA bioype complex was more diverse in the Eastern Free State, with this area supporting all known RWA biotypes. There was a shift in Russian wheat aphid biotype composition over time. There was a decrease in the area planted with wheat in the summer rainfall area (Free State) over seasons, which coincided with an increase in the percentage of fields not infested by RWA. There was an increase in the area planted with wheat in the winter rainfall region during the 2014 season, which coincided with a decrease in fields not infested by RWA.

Conclusions

These observations emphasizes the value of intercropping and crop rotation in managing insect pests and can serve as model for RWA management. RWA populations fluctuate when the environment changes, but persists in the wheat production areas of South Africa, at low population levels with minimal damage to wheat crops. This may change with changing environmental conditions, because RWA is capable of surviving at low numbers for a relatively long time, and can cause sudden population outbreaks with conditions beneficial for population growth.

References

POTATO (*SOLANUM TUBEROSUM*) YIELD IN RESPONSE TO PACLOBUTRAZOL APPLICATION AT DIFFERENT PLANTING DATES

Presenter: K.B. Jokazi (kbjokazi@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
K.B.	Jokazi	Döhne Agricultural Development Institute, Private Bag X15, Stutterheim, 4930; Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare, Private Bag X1314, Alice, 5700
B.K.	Eiasu	Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare, Private Bag X1314, Alice, 5700

Introduction

Potato (*Solanum tuberosum*) is an adaptable crop which can tolerate a wide range of climatic conditions. When the crop is planted early, because of the cool spring weather, potatoes tend to develop tuber initials earlier at the expense of haulm growth and development and vice versa (Vandam et al., 1996). Esmailpour et al. (2011) suggest that high plant density encourages an increase in potato yield; however, vigorous haulm growth decreases tuber yield (Tsegaw et al., 2005). Paclobutrazol (PBZ) is a triazole compound that blocks the biosynthesis of gibberellins, which are known to stimulate shoot elongation in plants. In potatoes, PBZ limits GA biosynthesis and improves assimilate partitioning to the tubers (Esmailpour et al., 2011) and increases yield (Tekalign and Hammes, 2005).

Materials and Methods

A study to determine the influence of PBZ (measured in mg of active ingredient per liter of water) on potato yield was conducted at the University of Fort Hare Research Farm. Planting took place at different planting dates, during the 2015/16 (23/10/2015, 09/12/2015 and 02/02/2016) and 2016/17 (01/11/2016 and 13/02/2017) planting seasons. Paclobutrazol was foliar-applied (at 0, 100, 200 and 300mg/L) on day 40 after planting and destructive data collection commenced two weeks after application and continued on a biweekly basis until haulm senescence to determine growth parameters; thereafter the rest of the plants were harvested and tuber yield was measured. Data for all measured parameters were subject to analysis of variance using SAS statistical software. Where significance was observed, means were separated using Tukey multiple separation procedure at the 0.05 level of significance.

Results and Discussion

Paclobutrazol application at 300mg/L at early planting (September to November) significantly controlled haulm growth, while the control (0mg/L) produced the highest haulm growth in fresh mass. However, at late planting (December to February) 0, 100 and 200mg/L were not significantly different from each other, but they were significantly different from 300mg/L. Tuber yield from early planting showed a significant difference between treated plants and the control, with control having the lowest tuber yield. While at late planting, there was no significant difference between the treatments.

Conclusions

This study showed that early planted potatoes positively respond to PBZ application, with the highest yield being recorded at the highest rate of PBZ treatment. Late planting on the other hand, did not respond favourably to the PBZ treatment. PBZ must be applied at low concentrations and less frequently to avoid its residue buildup in the soil.

References

Esmailpour, B., Hokmalipour, S., Jalilvand, P. and Salimi, G., 2011. The investigation of paclobutrazol effects on growth and yield of two potato (*Solanum tuberosum*) cultivars under different plant density. *Journal of Food, Agriculture and Environment*. 9: 289-294. Tekalign, T. and Hammes, P. S., 2005. Growth and biomass production in potato grown in the hot tropics as influenced by paclobutrazol Plant Growth Regulation. 45: 37-46. Tsegaw, T., Hammes, S. and Robbertse, J., 2005. Paclobutrazol-induced Leaf, Stem and Root Anatomical Modification in Potato. *HortScience*. 40: 1343-1346. Vandam, J., Kooman, P.L. and Struik, P.C., 1996. Effects of temperature and photoperiod on early growth and final number of tubers in potato (*Solanum tuberosum* L.). *Potato Res.* 39: 51-62.

THE EFFECT OF SEEDING DEPTH AND GROWING MEDIA ON ALOE FEROX SEED GERMINATION

Presenter: L.B. JOKO (200905491@ufh.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
LB	JOKO	Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare Private Bag X1314, Alice, 5700
A	SOKOMBELA	Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare Private Bag X1314, Alice, 5700
TS	MTHOKO	Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare Private Bag X1314, Alice, 5700
BK	EIASU	Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare Private Bag X1314, Alice, 5700

Introduction

There is increasing harvesting of wild aloe plants due to commercial and traditional demands for medicinal purposes and for bitters trade (Melin, 2009; Newton & Vaughn, 1996). A close observation in the wild habitats where *Aloe ferox* is growing indicates the limited growth of new *A. ferox* plants. Although the plant produces seeds, the seeds are germinating at a very slow pace and the development of new plants is slow. Currently, there is limited information on methods of propagating *A. ferox*, yet the harvesting continues to increase in the wild. Therefore, this study was conducted to address the effect of growing media and seed age and seeding depth on the germination and emergence of the specie.

Materials and Methods

Seed were harvested in the wild six months prior to the first experiment. They were stored in brown paper bags kept at room temperature. They were then assessed for vigour at six, eight and 12 months. In another experiment, six growing media were allocated to the main plots, laid-out as a randomized complete block design, replicated four times, and with four seeding depths (0.5 cm, 1.0 cm, 1.5 cm, and 2.0 cm) in the subplots. The growing media used were pine bark (PB), hygro mix (HM), Vermiculite (V), Mixture of PB and HM at 1:1 ratio, Mixture of PB and V at 1:1 ratio, Mixture of HM and V at 1:1 ratio by volume.

Results and Discussion

Seeding depth and growing media were found to have a role in the germination and early seedling emergence of the bitter aloe. PB had the highest germination (98%) of all the growth media. The lowest germination (66%) was recorded for both PBHM and V. Seeding depth of 0.5 cm had the highest percentage germination ($p < 0.05$), while the 2 cm seeding depth resulted in the lowest germination (37.4%). No significant germination differences were observed among the seeds stored in brown bags for eight and twelve months.

Conclusions

A depth of 0.5 cm is ideal for *A. ferox* germination. Pine bark (PB), as a growing media for *A. ferox*, promoted germination. As the scope of the study was limited to the early germination, it is recommended that further studies be done to investigate which growing media will achieve the highest seedling survival and development over time.

References

Newton D.J & Vaughan H. (1996): South Africa's Aloe ferox plant, parts and derivatives industry, TRAFFIC, Johannesburg 61 pp. Melin A. (2009). A bitter pill to swallow: A case study of the trade & harvest of Aloe ferox in the Eastern Cape, South Africa. Available online: <https://www.iccs.org.uk/wp-content/thesis/consci/2009/Melin.pdf> [accessed: 15/06/2017 16: 57]

SUSTAINABILITY OF WATER ABSTRACTION FROM SAND RIVER BEDS FOR IRRIGATION ON EMERGING FARMS IN THE LIMPOPO PROVINCE

Presenter: N Jovanovic (njovanovic@csir.co.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N	Jovanovic	CSIR, Natural Resources and Environment, Stellenbosch, South Africa
R	Bugan	CSIR, Natural Resources and Environment, Stellenbosch, South Africa
T	Lebea	Limpopo Department of Agriculture and Rural Development, Giyani, Limpopo, South Africa; University of Limpopo, Polokwane, Limpopo, South Africa
M	Kena	University of Limpopo, Polokwane, Limpopo, South Africa
K	Ayisi	University of Limpopo, Polokwane, Limpopo, South Africa

Introduction

A cycle of research was conducted to investigate sustainable farming practices and business development on emerging farms in the Limpopo Province lowveld (South Africa). One of the main limiting factors for intensive agricultural production in this region is water availability. The objectives of this study were: i) to improve irrigation management practices for selected tomato varieties and under-utilized *Amaranthus* spp.; and ii) to determine the sustainability of shallow groundwater abstraction for irrigation.

Materials and Methods

Field experiments were carried out on two emerging farms in the ephemeral Molototsi River catchment, a torrential tributary of the Letaba River. Three seasons of experimental data were collected on five tomato cultivars (Commander, Star 9006, Rodade, HTX14 and MFH) and four varieties of *Amaranthus* (Arusha, Applebosch, NL and Greenstem). Data collection included climatic data, soil water and chemical properties, crop growth and irrigation water volumes. The sustainability of shallow groundwater abstraction was investigated through a geophysical survey, establishment of boreholes, hydrogeological characterization, monitoring of groundwater levels, quality and abstraction rates, and groundwater modelling.

Results and Discussion

Fresh tomato yields under full irrigation ranged between 10 and 60 t ha⁻¹ depending on variety and environmental factors (heat waves and disease incidence). Seasonal evapotranspiration of tomato ranged between 400 and 600 mm depending on the duration of harvest. Three harvests of *Amaranthus* spp. required about 200 mm of water to produce 7-13 t ha⁻¹ of fresh biomass depending on the variety. Groundwater monitoring indicated that the highly fractured aquifer may not be directly connected to the sand river bed (alluvial aquifer). Based on the hydrogeological characterization, it was estimated that 100 m reach of the Molototsi River would store about 7,200 m³ of very good quality water that could be abstracted if numerous wells were established or recovery periods were allowed. This water volume would be sufficient to irrigate 1.8 ha of vegetables for one season, assuming irrigation water requirements of 400 mm (4,000 m³ ha⁻¹). This could represent a useful reserve during periods of severe drought, with recharge being essential from occasional flood events.

Conclusions

Limited opportunities therefore exist to increase groundwater use and expand irrigation in the Molototsi catchment. Water storage could be augmented to a certain extent by establishing river bed sand dams. The viability of groundwater use for small-holder irrigation also depends on other factors, such as priority water users (e.g. domestic supply), availability of arable land, groundwater yield, availability of infrastructure as well as the farming community.

References

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Rooting as affected by the biochemical profile of honeybush (*Cyclopia* spp.) cuttings

Presenter: PA Karsen (pippak@elsenburg.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PA	Karsen	Directorate Plant Sciences, Department of Agriculture Western Cape, Private Bag X1, Elsenburg 7607
EW	Hoffman	Department of Horticultural Science, Stellenbosch University
A	Valentine	Department of Botany and Zoology, Stellenbosch University

Introduction

The success of honeybush cultivation depends on our ability to produce volume and quality in line with market demands. This study explores the viability of cuttings as an alternative, preferred method of propagation. The aim is to understand how the initial biochemical factors from the mother plant (MP) propagation material may impact on the rooting of cuttings, and how stimulating vegetative growth may affect the rooting potential.

Genetic characteristics, as well as, physiological and biochemical status of MP are known to influence rooting ability (Osterc, 2009). In addition, environmental conditions (Moe and Andersen, 1988) to which MPs are exposed can also influence physiological conditions. In turn, auxin, carbohydrate, mineral nutrients, and phenolics levels are all affected by environmental factors, thus influencing initial levels within the cutting during the early stages of root development. Thus, through careful MP selection, positive characteristics that favour the promotion of adventitious root formation, can be targeted.

Materials and Methods

Four 6-year-old clones of *Cyclopia genistoides* were collected from the farm, Toekoms, near Bredasdorp, Western Cape, South Africa. The pruned MP were taken as terminal, softwood cuttings (9-months-regrowth), whilst the control cutting material consisted of terminal, semi-hardwood cuttings (year-and-9 months-regrowth). All cuttings were dipped in Seradix 2 to promote rooting. Rooting parameters were evaluated 3-months after treatment and included rooting percentage, number and length of primary and secondary roots. A representative sample from the MP's was freeze-dried for analysis of phenolics, starch and soluble sugar, whereas mineral nutrient analysis was determined on oven-dried (60°C, 36 hours) material.

Results and Discussion

The physiological status of the MP significantly influenced the rooting potential of cuttings. Carbohydrate levels have an indirect role in rooting as it's an important reserve metabolite prior to root formation. Cuttings made in spring (October) from pruned MP showed significant higher rooting percentages, di-and-oligosaccharides, non-structural starch, total sugars, phenolics and mineral nutrients (namely iron, nitrogen and potassium) than the control. Boron levels were however, significantly higher in control MPs. Pruning back the MP showed an increase rooting percentage of 75%, thus juvenile material is paramount to ensure successful rooting.

Conclusions

Rooting of honeybush cuttings is a result of an interaction of a number of factors influencing rooting. The physiological status of the MPs plays a significant role in rooting success. The rejuvenation of the MP by pruning back promotes the cutting rooting percentage. Further research is required to identify other physiological factors that could be manipulated to increase rooting of cuttings and improve field establishment.

References

Moe R., Andersen A. S. (1988). "Stockplant environment and subsequent adventitious rooting," in *Adventitious Root Formation in Cuttings - Advances in Plant Science Series* eds Davis T. D., Haissig B. E., Sankhla N., editors. (Portland: Dioscorides Press) 214-234. Osterc G. (2009). "A change in perspective: Stockplant qualities that influence adventitious root formation in woody species," in *Adventitious Root Formation of Forest Trees and Horticultural Plants - from Genes to Applications* eds Niemi K., Scagel C., editors. (Kerala: Research Signpost) 175-186.

Performance of Drought Tolerant Maize Varieties under Rainfall Stress in Malawi

Presenter: S.P. Katengeza (samkatengeza@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S.P.	Katengeza	Nowergian University of Life Sciences, Postboks 5003, 1432 Ås, Norway
S.T.	Holden	Nowergian University of Life Sciences, Postboks 5003, 1432 Ås, Norway
M.	Kassie	International Centre of Insect Physiology and Ecology, P.O. Box 30772-00100 Nairobi, Kenya

Introduction

Drought tolerant (DT) maize is a technology that has been developed to help smallholder farmers cope with drought and drought-related constraints. It is estimated that DT maize can produce up to 30% of their potential yield after six weeks of water stress, before and during grain-filling (Magorokosho, 2007). In Malawi, a country heavily dependent on rain-fed agriculture during a single rainy season and greatly affected by erratic rains (Kassie et al., 2015), DT maize offers an option to hedge against drought-related yield loss. We examine the impact of this promising technology on maize productivity on female- and male-headed households in Malawi.

Materials and Methods

The paper uses three-waves of household panel data collected in 2009, 2012 and 2015 from six districts in Malawi. Data analysis uses correlated random effects (CRE) tobit models with a control function (CF) approach (Wooldridge, 2009).

Results and Discussion

Results show higher maize yield on households that grew DT maize than those that grew other varieties. On average, maize yield is 503 kg/ha higher on plots with DT and 76 kg/ha less with local maize relative to other improved maize varieties. The impact is greater on plots for female-headed households than those cultivated by male-headed households. These results show that DT varieties offer yield advantage over other maize varieties under rainfall stress. This could be evidence that the poor harvests that have characterized most smallholder farmers in Malawi under rainfall stress, is largely due to lack of appropriate technologies. While, alternative climate-smart agriculture technologies such as irrigation, inorganic fertilizer and organic manure are expensive, availability of technologies such as DT maize can offer smallholder farmers, female-headed households in particular, an option to hedge against drought-related poor yields.

Conclusions

The paper provides evidence that drought tolerant maize increases maize yield under rainfall stress. We therefore recommend support on programs that promote development and distribution of good technologies such as DT and investment in complementary inputs such as inorganic fertilizer. There is a need also for deliberate efforts to give female-headed households equal access to complementary technologies to minimize yield gap with male-headed households.

References

Kassie, M., Teklewold, H., Marennya, P., Jaleta, M. & Erenstein, O. 2015. Production risks and food security under alternative technology choices in Malawi: Application of a multinomial endogenous switching regression. *Journal of Agricultural Economics*, 66, 640-659. Magorokosho, C. 2007. Genetic diversity and performance of maize varieties from Zimbabwe, Zambia and Malawi. Texas A&M University. Wooldridge, J. M. 2009. *New Developments in Econometrics, Lecture 6: Non-linear Panel Data Models*. Cemmap Lectures.: University College London.

ESCHERICHIA COLI COUNTS IN TREATED WASTEWATER AND BOREHOLE WATER USED FOR IRRIGATION AT UNIVERSITY OF LIMPOPO EXPERIMENTAL FARM

Presenter: P.M. Kgopa (pholosho.kgopa@ul.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
P.M.	Kgopa	University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa
P.W.	Mashela	University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa
A.	Manyevere	University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa

Introduction

The use of treated wastewater for irrigation is associated with some health risks due to the presence of pathogens, leading to pollution on agricultural soils and produce (Al-Lahham et al., 2003). Therefore, this study investigated the distribution of E. coli counts in treated wastewater used for irrigation at the University of Limpopo Experimental Farm (ULEF).

Materials and Methods

The study was conducted at Polokwane Wastewater Treatment Plant (PWTP) exit pond 16, where water flows into the furrow that conveys water to the night-dam at ULEF, then at the entry and exit sites of the night-dam and the adjacent borehole. The study comprised a 4 × 5 factorial, with water samples collected from 4 points once a month for five months. Water samples were collected in 500 mL sterile glass bottles and analysed for E. coli counts. Data were transformed using $\log_{10}(\chi + 1)$, prior to factorial analysis of variance using Stata 12.0 software (StataCorp, 2011).

Results and Discussion

Collection site was highly significant on E. coli counts, contributing 87% in total treatment variation. Time of sampling and the interaction had no effects on E. coli counts. The highest counts were observed in pond 16, with the lowest observed in borehole water samples. Relative to borehole water, E. coli counts increased by 88, 97 and 106% in night-dam exit, night-dam entry and pond 16, respectively.

Conclusions

In conclusion, the study demonstrated that movement and storage of wastewater post the treatment plant decreased the E. coli counts, thereby improving the quality of treated wastewater for irrigation.

References

Al-Lahham O, El-Assi NM, Fayyad M. 2003. Impact of treated wastewater irrigation on quality attributes and contamination of tomato fruits. *Agricultural Water Management* 61:51-62. StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP. www.stata.com.

INFLUENCE OF DROUGHT ON SYMBIOTIC PERFORMANCE DURING SOYBEAN (GLYCINE MAX) NODULE DEVELOPMENT

Presenter: T.R Kibido (Tsholofelo.kibido@fabu.up.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T.R	Kibido	Department of Plant and Soil Science, Forestry and Agricultural Biotechnology Institute, University of Pretoria, Pretoria, 0002, South Africa.
B.J	Vorster	Department of Plant and Soil Science, Forestry and Agricultural Biotechnology Institute, University of Pretoria, Pretoria, 0002, South Africa.
M.E	Makgopa	Department of Plant and Soil Science, Forestry and Agricultural Biotechnology Institute, University of Pretoria, Pretoria, 0002, South Africa.

Introduction

Drought is considered to be a major threat to soybean (*Glycine max*) production worldwide. The symbiotic interaction between soybean and rhizobia facilitates atmospheric nitrogen fixation, a process that provides essential nitrogen to support plant growth and development. Under drought conditions, this interaction is however short-lived leading to the elimination of the rhizobial partner and a reduction in symbiotic nitrogen fixation (SNF). Symbiotic efficacy and abiotic stress tolerance of soybean micro-symbionts remains limited, this study was therefore aimed at selecting symbiotically efficient abiotic stress tolerant rhizobia for soybean inoculation.

Materials and Methods

Osmotic tolerance of bacterial strains was assessed on yeast extract-mannitol (YEM) medium supplemented with different concentrations of sodium chloride ranging from 0.5%-3%. All strains were tested for drought tolerance simulated by PEG6000 added to YEM medium. Soybean plants were grown under greenhouse conditions subjected to two drought regimes (60% and 30% soil water content) and inoculated with strains differing in osmo-tolerance. The effect of drought and the contribution of the rhizobial partner on nodulation and plant development was assessed.

Results and Discussion

Rhizobium strain *S. fredii* SMH12 was the most osmotolerant and was able to withstand 0.5M NaCl. In contrast, strain *B. japonicum* WB74-1 was the least osmo-tolerant. Inoculation of soybean seeds with osmo-tolerant strain SMH12 resulted in significant higher nodule numbers and nodule water potential. Although plants inoculated with strain WB74-1 had higher shoot dry weight than SMH12 inoculated plants, no significant difference in shoot parameters was found in plants inoculated with the two different strains. Drought treatment further reduced photosynthesis in all inoculated plants. However, plants inoculated with strain SMH12 had a significantly higher decrease in photosynthetic CO₂ assimilation and stomatal conductance when compared to plants inoculated with WB74-1.

Conclusions

The selection of osmo-tolerant Rhizobium strains, which better tolerate drought conditions, may contribute to the formulation of more efficient legume inoculants for drought-exposed regions of South Africa. Furthermore, drought-tolerant rhizobial isolates with better symbiotic performance could improve soybean production in Africa avoiding application of costly chemical nitrogen fertilization

References

Quantification of lenticels in Japanese plum cultivars and their effect on peel water vapour permeance

Presenter: I Kritzinger (imke2@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
Imke	Kritzinger	Department of Horticultural Science
Karen	Theron	Department of Horticultural Science
Elmi	Lötze	Department of Horticultural Science

Introduction

The protective cuticle that covers fruit surfaces acts as a moisture loss barrier (Dietz et al., 1989). The structure and composition of the cuticle and underlying tissues influence the rate of moisture loss from fruit. Water vapour permeance ($P'H_2O$) indicates the ease with which moisture can escape the fruit and is affected by cuticle composition, and openings in the peel such as wounds, cracks or open lenticels (Maguire et al., 2000). This study was conducted to determine whether the number of lenticels varies between selected plum cultivars, and if a relationship exists between open lenticels and the water vapour permeance of the fruit peel.

Materials and Methods

The study was carried out on 'Laetitia', 'Songold', 'Sapphire' and 'African Delight™' from 2015 to 2017. From three weeks before harvest, fruit were sampled from a commercial farm in Stellenbosch, South Africa. Water vapour permeance of each fruit was determined, where-after lenticels were quantified per fruit to determine whether a relationship exists between the two parameters.

Results and Discussion

Peel permeability differed between cultivars and changed over time, agreeing with findings by Theron (2015). No clear trend was established for number of open lenticels over time. Poor, non-significant correlations were found between peel permeability and the number of open lenticels per fruit.

Conclusions

The number of lenticels per cultivar seems to be genetically predetermined. Since fruit peel permeability differs between seasons (Theron, 2015), the effect of the environment on the cuticle and lenticels cannot be ignored. This study established that open lenticels are not the main avenue of moisture loss in plums. Differences in peel permeability between cultivars are thus due to other factors, like cuticle composition, and is currently being investigated.

References

Dietz, T.H., Raju, K.R.T., Joshi, S.S., 1989. Studies on loss of weight of mango fruits as influenced by cuticles and lenticels, in: 2. International Symposium on Mango, Bangalore, India. May 1985. ISHS. Maguire, K.M., Banks, N.H., Lang, A., Gordon, I.L., 2000. Harvest date, cultivar, orchard, and tree effects on water vapor permeance in apples. J. Am. Soc. Hortic. Sci. 125, 100-104. Theron, J., 2015. Moisture loss studies in Japanese plums (*Prunus salicina* Lindl.). MScAgric thesis, Faculty of AgriSciences, Stellenbosch University.

EFFECTS OF ORGANIC AND INORGANIC FERTILISERS ON THE GROWTH AND YIELD OF AMARANTH (*Amaranthus hybridus* L.)

Presenter: E.N. Kunene (enkunene@uniswa.sz)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
E.N.	Kunene	Swaziland Institute for Research in Traditional Medicine, Medicinal and Indigenous Food Plants (SIRMIP), University of Swaziland, Private Bag 4 Kwaluseni
M.T.	Masarirambi	Department of Horticulture, University of Swaziland, P. O. Luyengo, Luyengo
T.H.	Gadaga	Swaziland Institute for Research in Traditional Medicine, Medicinal and Indigenous Food Plants (SIRMIP), University of Swaziland, Private Bag 4 Kwaluseni
P.S.	Dlamini	Swaziland Institute for Research in Traditional Medicine, Medicinal and Indigenous Food Plants (SIRMIP), University of Swaziland, Private Bag 4 Kwaluseni
M.P.	Ngwenya	Swaziland Institute for Research in Traditional Medicine, Medicinal and Indigenous Food Plants (SIRMIP), University of Swaziland, Private Bag 4 Kwaluseni
V.S.	Vilane	Swaziland Institute for Research in Traditional Medicine, Medicinal and Indigenous Food Plants (SIRMIP), University of Swaziland, Private Bag 4 Kwaluseni

Introduction

Amaranthus hybridus L. belongs to the Amaranthaceae family. Amaranth is a common name of the genus *Amaranthus*, which has been consumed throughout history. Amaranth has great potential as a sustainable crop that could improve household food security, nutrition security and farm incomes. The growth environment of amaranth, can have a major impact not only on the productivity of the crop but its nutritional value as well. Production of amaranth in developing countries like Swaziland is very low, if any at all. This could be attributed to, among other reasons, lack of agronomic information on production of amaranth. The objective of this study was to determine the influence of kraal manure and compound NPK (2.3.4 (39) + 5% Zn) fertiliser on the growth and yield of *Amaranthus hybridus* L.

Materials and Methods

The trial was carried out at Malkerns Research Station, in Swaziland. The treatments comprised of 20 t/ha kraal manure, 40 t/ha kraal manure, 100 kg/ha 2.3.4 (39) + 5% Zn (compound NPK), 150 kg/ha 2.3.4 (39) + 5% Zn, and the control (no fertiliser). The five treatments were laid out in a randomised complete block design with four replications. Data were collected at 4, 5 and 6 weeks after planting. The data were subjected to analysis of variance through SPSS 20, and mean separation test was performed using the Duncan's New Multiple Range Test at $P = 0.05$.

Results and Discussion

Addition of any type of fertiliser significantly ($P < 0.05$) increased plant growth indices (plant height and number of leaves) and yield parameters (fresh and dry shoot mass) of *Amaranthus hybridus*. However, kraal manure and 2.3.4 (39) + 5% Zn applied at different application rates were not significantly ($P > 0.05$) different from each other in all the growth and yield parameters at the different harvest stages.

Conclusions

It was concluded that addition of fertiliser, either organic or inorganic, promotes growth rate and yield of *Amaranthus hybridus*. For sustainable amaranth production, and soil health, the use of organic fertilisers like cattle manure is recommended.

References

CONVENTIONAL VS CONSERVATION AGRICULTURE IN THE WESTERN CAPE: THE TRUTH LIES IN STATISTICS

Presenter: J. Labuschagne (johanl@elsenburg.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
J	Labuschagne	Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7600, South Africa; Stellenbosch University, Department of Agronomy, Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.
H	Van Zyl	Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7600, South Africa
W	Langenhoven	Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7600, South Africa
A	Mokwele	Western Cape Department of Agriculture, Private Bag X1, Elsenburg, 7600, South Africa

Introduction

Adoption of conservation agriculture (CA) changed the face of the grain producing areas of the Western Cape. Although minimum soil disturbance and crop rotation with non-related crops are practiced by many producers, less attention was initially been given to stubble retention. Stubble retention and testing the feasibility of cover crop inclusion to enhance the positive effects of CA gain popularity during the last few years. The positive effects of introducing CA are however not instantaneous and might take several years to develop. In this presentation, a comparison will be drawn between conventional agriculture (monoculture/conventional tilled system) and systems where one or more principles of CA were practiced over the past 10 years.

Materials and Methods

Long-term trials were initiated in 2007 at the Langgewens (Moorreesburg, Swartland) and Tygerhoek (Riviersonderend, Rûens) Research Farms of the Western Cape Department of Agriculture. Three crop rotations namely: continuous wheat (WWWW), medic-clover/wheat/medic-clover/wheat (McWMcW) and lupin/wheat/canola/wheat (LWCW) were allocated to main plots with four replications. Each main plot was subdivided into four sub-plots allocated to four tillage treatments, namely: zero-till (ZT) - soil left undisturbed, no-till (NT) - soil left undisturbed until planting and then planted with a tined, no-till planter, minimum-till (MT) - soil scarified March/April and then planted with a no-till planter and conventional tillage (CT) - soil scarified late March/early April, then ploughed and planted with a no-till planter.

Results and Discussion

Analysing 10 years of crop yield data showed that the magnitude of CA impacts was area specific. At Langgewens wheat grain yield produced in McWMcW-NT, LWCW-NT and CWLW-NT outperformed WWWW-CT by 33, 24 and 29 percent respectively. Corresponding figures for Tygerhoek were 54 (McWMcW-NT), 51 (LWCW-NT) and 58 (CWLW-NT) percent respectively. Contrary to wheat, canola in the mentioned cropping systems responded positively to soil disturbance resulting in 10 and 8 % lower yields in NT compared to CT at Langgewens and Tygerhoek respectively.

Conclusions

Adopting CA proved to be of great benefit to producers in the Western Cape. Data collected over a period of 10 years showed that the benefit of CA was more pronounced during the wheat sequences compared to the canola sequences.

References

FOOD SECURITY & RESILIENCE OF CROP PRODUCTION SYSTEMS IN URBANIZING ARID & SEMI-ARID ZONES: A SYSTEMATIC REVIEW OF THE LITERATURE

Presenter: CJ Lagerkvist (assem.abouhatab@slu.se)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
CJ	Lagerkvist	Swedish University of Agricultural Sciences, Sweden
A	Abu Hatab	Swedish University of Agricultural Sciences, Sweden
S	Nedumaran	International Crops Research Institute for the Semi-Arid Tropics, India

Introduction

Urbanization is an ongoing trend which is re-shaping the future of global food security. Already-stressed crop production systems (CPS) are accordingly undergoing significant pressures and adjustment processes. As much of urban growth takes place in developing regions, the dynamics of urbanization would have further implications for CPS and food security in these countries.

Materials and Methods

We aimed to identify and assess interlinkages between the dynamics of urbanization, land use changes, food security and the resilience of CPS in arid and semi-arid contexts in developing countries. To this end, an explicit, rigorous and transparent literature search within a systematic literature review framework was undertaken using the ISI Web of Science and Scopus databases over the period 1980-2017. Particularly, our assessment of the relevant research focused on the interactions between these key components. Based on the outcomes of the systematic literature review, a number of 294 articles were identified and included in the final review.

Results and Discussion

The “preliminary” results of the review reveal that increased rural-urban linkages, due to urban sprawl and other factors which intensified the interdependencies of urban and CPS, present both challenges and opportunities for achieving improved food and nutrition security in a variety of complex and interlinked ways throughout CPS. However, when this relationship between urban and CPS is investigated, the focus of the literature comes to either: land use change; urban resilience and development; or urban and peri-urban agriculture. The existing literature widely fails to account for interactions between urbanization stresses, resource use constraints and transformations, the resilience of CPS, and then onto food production and finally food and nutritional security in urban and rural areas. These results represent therefore a useful point of departure from traditional urbanization studies which do not account for the dynamics of urban sprawl from a systems perspective. The “final” results of this review are expected to i) synthesize relevant system-resilience frameworks available in the literature, ii) assess the state-of-the-art research on urbanization in relation to agricultural and natural systems, iii) and, identify key methodological approaches in ecological, social and economic sciences, related to the study of urban and CPS system resilience.

Conclusions

By framing urban sprawl from an inter-linked resilience perspective, we identify critical components and develop a framework which can direct attention of researchers and policymakers to micro-perspectives and governance which are relevant for developing CPS and enhancing food security to meet the needs of increasing urban population and economic growth in developing countries

References

THE FOOD VALUE CHAIN ENVIRONMENT FOR INCORPORATING ORANGE-FLESHED SWEET POTATO IN THE LOCAL DIET

Presenter: SM Laurie (slaurie@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
SM	Laurie	Agricultural Research Council - Vegetable and Ornamental Plants (ARC-VOP), Pretoria
M	Faber	Non-Communicable Diseases Research Unit, Medical Research Council, Cape Town
N	Claasen	Unit for Transdisciplinary Health Research, North-West University, Potchefstroom

Introduction

Orange-fleshed sweet potato (OFSP) is considered the single most successful example of biofortification of a staple crop, and presents a feasible option to alleviate vitamin A deficiency, particularly in rural areas. Recently attention has shifted towards applying food systems approaches (linking consumers, food environments and food supply systems) as a vehicle to deliver high-quality diets. This paper reviews OFSP initiatives within the South African food environment and food supply systems.

Materials and Methods

The potential and role of OFSP in the following aspects were considered: 1) Beta-carotene and carbohydrate content, and potential contribution of orange-fleshed sweet potato to improving vitamin A intake; 2) South African diets and consumption patterns of sweet potatoes; 3) Food environments including availability, price and consumer acceptability; and 4) Food supply systems in South Africa and entry points for increasing OFSP consumption.

Results and Discussion

For the major OFSP variety, Bophelo, 66 g is sufficient to meet the recommended dietary allowance for vitamin A for 1–3 year old children. Consumption of sweet potato, mostly cream-fleshed, is low and OFSP should be considered a “new” crop. OFSP promotion should be within the context of the co-existence of vitamin A deficiency, stunting and overweight/obesity in the country. Marketing of sweet potato is not regulated and prices are determined by market demand and supply. Currently, small-scale commercial OFSP producers prefer to deliver their produce to local informal markets, because of the challenges to meet the high standards of larger retailers' centralised procurement systems. Yet, large retailers may have the power to increase the demand of OFSP, by improving availability, access and developing marketing strategies to raise awareness on its health benefits. There are various unexploited opportunities for processing of OFSP. Currently, the largest scope for scaling out OFSP is potentially through public sector programmes such as the National School Nutrition Programme, Community Nutrition and Development Centres, Small-holder Farmer Programmes and Agriparks.

Conclusions

Innovative strategies will be needed for the successful promotion of OFSP production and consumption particularly in rural areas. There is large scope for OFSP up-scaling within the South African food system, the focus being on increasing consumption, rather than replacing cream-fleshed varieties. To increase sustainable availability of and access to OFSP, all aspects of the food supply system need to be considered, including agricultural production, trade, food transformation and food retail and provisioning.

References

Laurie, S.M., Faber, M., and Claasen, N. 2017. Incorporating orange-fleshed sweet potato into the food system as a strategy for improved nutrition: the context of South Africa. Food Research International. <https://doi.org/10.1016/j.foodres.2017.09.016>

THE INFLUENCE OF DROUGHT ON THE RELATIONSHIP OF VARIOUS PARAMETERS IN SWEET POTATO

Presenter: R.N. Laurie (rlaurie@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
RN	Laurie	ARC-VOP, Private Bag X 293, Pretoria
SM	Laurie	ARC-VOP, Private Bag X 293, Pretoria, 0001

Introduction

Sweet potato is the seventh most important crop in the world. Although the crop is drought tolerant, water scarcity severely influences proper growth and yield. The study aimed to determine the effect of drought on the various traits of a number of sweet potato cultivars in the field. An understanding of the physiological factors ruling growth and water use efficiency in sweet potato varieties subjected to drought stress is needed to develop selection criteria for improved water efficiency and optimum yield.

Materials and Methods

Thirty five sweet potato cultivars and breeding lines were grown in the field and rain-out shelters respectively in control and drought stress treatments. Soil water in the rain out shelters was kept at 30% availability, while the soil in control conditions were irrigated once a 30% soil water depletion was recorded. Agronomical measurement and leaf sampling were done twice during the growth period, after which leaf samples were freeze dried and stored at -80 degrees. Various physiological traits were determined from leaf samples.

Results and Discussion

The decline in the values of yield, stomatal conductance, canopy cover, plant height, nitrate reductase and chlorophyll content were significant in almost all the varieties subjected to drought stress compared to the control plants. Proline, glutathione and total carotene values, however, increased significantly in the drought stressed plants. A strong correlation between yield and leaf area index was observed, indicating the effect that leaf coverage has on the root production. These results correlate with earlier findings in wheat, namely a significant correlation between yield and % reduction in plant height. Strong correlation was observed between yield (t/ha) and nitrate reductase (NR) activity as well as yield and chlorophyll content (CCI) values. Garker et al. (2011) found in sugar cane a parallel reduction in total chlorophyll content, nitrate reductase activity and yield when subjected to drought. Reduction in NR activity will therefor decrease the supply of N for the formation of chlorophyll (Garkar et al., 2011) and will cause a decline in chlorophyll content. This explains the relationship between NR and CCI. Since the decline in NR will have a negative effect on the chlorophyll content, the photosynthetic processes should be affected which will in turn affect the formation of storage roots in the plant.

Conclusions

Good correlations were found between various parameters such as yield, stomatal conductance, chlorophyll content and nitrate reductase activity that indicated such parameters could be used to identify promising genotypes in breeding programmes.

References

GARKAR RM, BHARUD RW and MATE SN, 2011. Effect of water stress on chlorophyll, nitrate reductase activity and cane yield in sugarcane (*Saccharum officinarum* L.). Journal of Sugarcane Research 1: 43 - 49

TOMATO YIELD AND EARLY BLIGHT INCIDENCE IN RESPONSE TO CULTIVAR AND IRRIGATION MANAGEMENT PRACTICES IN THE GIYANI MUNICIPALITY

Presenter: TJ Lebea (lebeatj@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T.J	Lebea	Limpopo Department of Agriculture and Rural Development, Private bag x653, Giyani, 0826.
MA	Kena	University of Limpopo Department of Plant Production, Soil Science and Agricultural Engineering, Private Bag x1106, Sovenga, 0727
K	Ayisi	University of Limpopo Department of Plant Production, Soil Science and Agricultural Engineering, University of Limpopo Department of Plant Production, Soil Science and Agricultural Engineering Private Bag x1106, Sovenga, 0727
WG	Mushadu	Limpopo Department of Agriculture and Rural Development,
N	Jovanovic	Csir

Introduction

Early blight caused by *Alternaria solani* is the most destructive economically important tomato disease worldwide under varying farming systems (El-Abyad et al., 1993; Gomaa, 2001; Abdel-Sayed, 2006; Abada et al., 2008). Managing plant stress conditions is expected to improve plant tolerance to this disease, thus reducing disease incidences and increasing crop yield. The disease is more prevalent under small-holder farming system where farmers lack knowledge on the proper application of fungicides. The aim of the study is to investigate the prevalence of early blight incidence and the effectiveness of applying various irrigation management practices on crop yield.

Materials and Methods

Field experiments were conducted at two farms in Limpopo, Giyani Municipality, namely A hi tirheni Mqekwa farm and Duvadzi farm. The experiments were laid out in a randomized complete block design (RCBD) in a split plot arrangement, with irrigation as the main plot treatment and tomato variety as the subplot treatment, and treatments replicated four times. The irrigation treatments consisted of full irrigation up to field capacity and deficit irrigation. The tomato varieties were HTX14, Rodade, STAR9006 and Commander, and were irrigated with a drip irrigation system. The following measurements were done for all treatments: soil water content with a HydroSense II probe; leaf area index with an LAI-2000 leaf area meter; leaf chlorophyll content with a CCM-300; fresh yield; irrigation volumes with a water meter. Diseased leaves were categorized as per scale given by Pandey with modifications.

Results and Discussion

The two water treatments (full and deficit irrigation) in both farms have shown no significant pairwise differences among the means. There was a significant difference ($P > 0.05$) in early blight disease severity in both farms. There was a significant difference in cultivar response to water treatments and disease severity. Average at Duvadzi farm on the first experiment was between 9.2 and 10.6 t/ha and 19.61 on the second experiment. Average yields at A hi tirheni Mqekwa were between 47.1 and 59.7 t/ha in the season March-August 2016, comparable to optimal yields recorded in the area for these varieties. The second experiment yielded 28.75 during Jan - May 2017. There was no statistical significant difference on yield among the four varieties.

Conclusions

Deficit irrigation can be used effectively to produce high yields in tomato production provided the cropping season window does not coincide with the hottest time of the year. Full and deficit irrigation did not have influence on the early blight disease incidence on tomato plants.

References

ABADA, K.A., MOSTAFA, S.H. and HILLAL, M.R. (2008). Effect of some chemical salts on suppressing the infection by early blight disease of tomato. *Egyptian Journal of Applied Sciences*, 23: 47-58. ABDEL-SAYED, M.H.F. (2006). Pathological, physiological and molecular variations among isolates of *Alternaria solani* the causal of tomato early blight disease. Ph.D. Thesis, Faculty of Agriculture, Cairo University. 181 pp. EL-ABYAD, M.S., EL-SAYAD, M.A., EL-SHANSHOURY, A.R. and EL-SABBAGH, S.M. (1993). Towards the biological control of fungal and bacterial diseases of tomato using antagonistic *Streptomyces* sp. *Plant and Soil*, 149: 185-195. GOMAA, A.M.I.

(2001). Pathological studies on early blight of tomato. M.Sc. Thesis., Faculty of Agriculture, Cairo University.

Calibration and validation of the APSIM Model to Simulate Climate Smart Practices under Dryland Maize Production: Model evaluation and application

Presenter: R.G. Lekalakala (lekalakala@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
R.G.	Lekalakala	Limpopo Department of Agriculture and Rural Development
M.	Hoffman	University of Goettingen
K.	Ayisi	University of Limpopo
J.	Odhiambo	University of Venda
A.M.	Whitbread	International Crops Research Institute for the Semi-Arid Tropics (India)

Introduction

Rainfed agricultural productivity in the Limpopo Province is low and increasingly threatened by high climatic variability. Rainwater harvesting and soil-water conservation management practices have potential to mitigate these effects and improve the sustainability of the maize-based smallholder systems in the area. Models enable for evaluating the performance and likely productivity of intervention practices in untested locations. The purpose of this study was to evaluate the ability of the APSIM simulation model to predict the maize growth and yields, and soil-water, under different tillage practices.

Materials and Methods

Field experiments were conducted in the Limpopo Province on the effects of the conventional tillage (CT), no-tillage (NT) and insitu rainwater harvesting (IRWH) on maize growth and yields, and soil available water. This dataset, and secondary datasets representing different locations and maize varieties under CT, NT and IRWH were used in deriving parameters, calibration and validation of APSIM-maize (for three maize varieties, ZM421, ZM521 and PAN6P-563R) and -soil water modules. The APSIM maize model was carried out by manually changing the crop phenological parameters to match field observations. The approach for simulating CT, the tillage module in APSIM was used to simulate disk tillage in field, whereas for NT run without any tillage, similar to field conditions. The modification made was in the simulation of IRWH (i.e. its runoff generation and collection areas), instead of changing runoff curve numbers as that presented by Mupangwa et al. (2011), a rudimentary cascading in surface and subsurface flow responses from runoff generating to a collection soil profile was used, concept adopted from PARCHED-Thirst model (Mzirai and Tumbo, 2010). The calibrated APSIM model was validated using independent datasets, using grain yields, biomass, and plant available water content.

Results and Discussion

The model calibration indicated a positive strong relationship between predicted and observed maize grain yields and biomass with an r coefficient of 0.96 and 0.92, respectively. The model validation using field experimental data and three secondary independent datasets suggest that the model is capable of simulating soil-water, biomass ($r = 0.82$ and RMSE of 572 kg.ha⁻¹) and grain yields ($r = 0.76$ and RMSE = 2 577 kg.ha⁻¹).

Conclusions

The overall model's validation indicated a positive strong relationship between predicted and observed maize grain yields and biomass. The simulation of tillage practices in APSIM model yielded a strong correlation with observed data. Similarly, there was a good fit between observed and simulated soil-water content. The calibrated model gives confidence in the model predictive ability.

References

Mupangwa, W., Dimes, J., Walker, S. and Twomlow, S. 2011. Measuring and simulating maize (*Zea mays* L.) yield responses to reduced tillage and mulching under semi-arid conditions. *Agricultural Sciences* (2)3: 167-174. doi:10.4236/as.2011.23023
Mzirai, O.B. and Tumbo, S.D. 2010. Macro-catchment rainwater harvesting systems: challenges and opportunities to access runoff. *Journal of Animal and Plant Science*, 7: 789 – 800.

ONCE-OFF TILLAGE BEFORE CANOLA IN CONSERVATION AGRICULTURE: THE FACTS

Presenter: I.R. Leygonie (izane@soill.co.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
IR	Leygonie	Southern Oil, Koringland Street, Swellendam Industrial, 7643

Introduction

The positive effects of conservation agriculture (CA) are well known, although some negative effects, like nutrient stratification and increased bulk density may develop over time. Above mentioned effects may be addressed through, amongst others, cultivation of soil. The objective of this study was to determine the effect once-off tillage of no-till land has on certain soil quality properties and therefore the resultant canola crop response.

Materials and Methods

The study was conducted as a short term study during 2014 to 2015 at the Langgewens Research Farm near Moorreesburg (33016'42.33" S; 18042'11.62" E; 191 m). The experimental design was a randomised complete block with a split-plot treatment design with four replications. Canola after wheat in a wheat/lupine/wheat/canola (WLWC) sequence was allocated to main plots. Main plots were subdivided into three sub-plots and allocated to tillage treatments, namely: continuous no-till (NT), soil left undisturbed until planting and then planted with a tined no-till planter, non-inversion tillage (NIT), deep tine to a depth of 400 mm and inversion tillage (IT), soil inverted using mouldboard plough to a depth of 250 mm. Soil organic C (SOC) and aggregate stability was determined for the 0-100 mm, 100-200 mm, 200-300 mm and 300- 400 mm soil depths before tillage treatments (February 2014) were applied and again one year later (May 2015). Active C content was determined for the 0-200 mm soil depth before tillage, after tillage and one year after tillage. Biomass production (BMP) was determined at physiological maturity. A plot combine was used to determine seed yield.

Results and Discussion

SOC and aggregate stability were not influenced ($P=0.05$) by the tillage treatments included in the study. No significant differences ($P=0.05$) in active C content were found before tillage and after tillage in 2014. However one year after tillage (2015) NIT resulted in a significantly higher active C content compared to NT and IT. Significant higher BMP were produced where IT were practised in both 2014 and 2015, while no differences were recorded in seed yield of canola for all tillage treatments included in the study.

Conclusions

It is concluded that the use of a once-off strategic NIT or IT (or variations thereof) can be considered as management option to address some of the constraints caused by conservation agriculture.

References

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EFFECT OF STORAGE ON THE TOTAL PHENOLIC AND FLAVONOID CONTENT OF SOME SWEET POTATO CULTIVARS

Presenter: K Lodama (lodamakm@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
K	Lodama	Agricultural Research Council - Roodeplaat Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001
B	Ncube	Agricultural Research Council - Roodeplaat Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001
SM	Laurie	Agricultural Research Council - Roodeplaat Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001
A	Ndhlala	Agricultural Research Council - Roodeplaat Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001

Introduction

Many of the developing world's poorest farmers and food insecure people are highly dependant on root and tuber crops as source of food, nutrition and cash income (CIP, 2000). One of the major constraints to the potential of sweet potatoes is its perishability and loss of its nutritional elements commencing soon after harvesting. In this study, the effect of storage period on total flavonoid and phenolic of sweet potato (*Ipomoea batatas* (L). Lam.) cultivars was investigated.

Materials and Methods

Storage roots of eight sweet potato cultivars were harvested from the Agriculture Research Council (ARC-VOP) experimental farm in Pretoria and directly stored at ambient conditions for different periods of time including immediately harvested roots (G1), and stored two weeks (G2), four weeks (G3), six weeks (G4), and eight weeks (G5) after harvesting. At each stage, samples were taken from the storage facility and pre-processed by washing; peeling; and cooking then freeze dried before analysis of total flavonoid and phenolic content (Rautenbach et al., 2010). Differences between storage time and cultivars for the same group were determine by a One-way analysis of variance (ANOVA) using Fisher least significant difference (LSD) determined differences between the storage time and cultivars for the sweet potatoes using version 9.1. Genstat.

Results and Discussion

The result obtained from this study showed significant differences in total phenolic and flavonoid content among different cultivars stored for different periods. In terms of storage period, the phenolic content decreased significantly ($p \leq 0.05$) from 3.98 mg/g DW immediately after harvesting (G1) to 1.14 mg/g after eight weeks of storage (G5). Similar observations were made from total flavonoid content with also decreased significantly from immediately after harvesting to eight weeks storage of 0.72 mg/g DW to 0.20 mg/g DW respectively. The results of the analysis of the stored sample showed significant variations ($p \leq 0.05$) in total flavonoid and phenolic content between various cultivars. For example, Ribbok (T5) and 199062.1 (T2) presented the highest levels of phenolic and flavonoid compared to the other cultivars.

Conclusions

Storage has an effect on phenolic content in sweet potato as is evident from the decrease in the compounds with storage time in all cultivars.

References

Rautenbach F., Faber M, Laurie SM and Laurie RN (2010). Antioxidant capacity and antioxidant content in root of 4 sweet potato varieties. *Journal of Food Science* 75:400-405

CALCIUM DYNAMICS OF REPRODUCTIVE APPLE BUD TISSUES DURING DORMANCY IN THE WESTERN CAPE, SOUTH AFRICA

Presenter: E. Lötze (elotze@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
E	Lötze	Department of Horticultural Science, Stellenbosch University, Stellenbosch
M	Frazenburg	Central Analytical Facility, Stellenbosch University, Stellenbosch
S.S	Turketti	Department of Horticultural Science, Stellenbosch University, Stellenbosch
L	Dreyer	Department of Botany and Zoology, Stellenbosch University, Stellenbosch

Introduction

Calcium (Ca) deficiency in apples causes a known disorder, bitter pit, in susceptible cultivars that results in reduced income (Lötze et al., 2006). Bitter pit is initiated a few weeks after full bloom. Little information regarding Ca concentration of dormant, reproductive buds exists (Wilsdorf, 2011). This study was performed to determine the Ca concentration of susceptible 'Braeburn' and non-susceptible 'Cripps Pink' reproductive buds during winter.

Materials and Methods

Five buds per cultivar were sampled bi-weekly from June to September during two seasons (2012, 2014) for both cultivars. Standard procedures were followed for sample preparation of the buds. WD SEM technology was used to quantify total Ca concentration as Ca weight percentage of parenchyma, vascular tissues and bracts.

Results and Discussion

Total Ca concentration in the bud and various tissues differed between June and September. In June, Ca concentrations were the highest in the parenchyma tissues, while the vascular tissues showed the highest values in September. 'Cripps Pink' had a higher total bud Ca concentration and this prevailed during the period. 'Cripps Pink' showed a declining trend towards September that contrasted with an increasing trend of 'Braeburn'.

Conclusions

Results showed a clear difference in the Ca concentration of reproductive buds in a susceptible and non-susceptible apple cultivar during the winter months. Ca in the different tissues changed during this period but the trends differed between cultivars. Changes in the Ca concentration may be explained partly by the time of xylem formation in the bud and the genetic susceptibility of the cultivar to Ca disorders.

References

Lötze, E., Sadie, A., Theron, K.I., 2006. Determining bitter pit probability in 'Golden Delicious' through postharvest mineral content of individual fruit. *Jnl Hort Sci Biotech* 81 (2): 276-280. Wilsdorf, R.W., 2011. Seasonal changes in concentration and distribution of Ca²⁺ in apple fruit after soil and foliar calcium applications. MSc Agric thesis, Faculty of AgriScience, Stellenbosch University, Stellenbosch.

INOCULATION OF FLY ASH AMENDED VERMICOMPOST WITH PHOSPHATE SOLUBILIZING BACTERIA (PSEUDOMONAS FLUORESCENS) IMPROVES VERMI-DEGRADATION, NUTRIENT RELEASE AND BIOLOGICAL ACTIVITY

Presenter: NS LUKASHE (201103884@ufh.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
NS	LUKASHE	Department of Agronomy, University of Fort Hare, P. Bag X1314, Alice, South Africa.
HA	MUPAMBWA	Department of Agronomy, University of Fort Hare, P. Bag X1314, Alice, South Africa.
PNS	MNKENI	Department of Agronomy, University of Fort Hare, P. Bag X1314, Alice, South Africa.

Introduction

INTRODUCTION Vermicomposting is being promoted as a viable technology with potential to improve the fertilizer value of inorganic waste materials like fly ash for use as soil amendments. The known synergy of earthworms and microbes during vermicomposting offers an opportunity to enhance nutrient mineralization by altering the microbe community with nutrient mineralizing microorganisms such as phosphate solubilizing bacteria (PSB).

Materials and Methods

MATERIALS AND METHODS This study evaluated the potential of PSB (*Pseudomonas fluorescens*) and *E. fetida* in improving nutrient release and biodegradation during vermicomposting of fly ash and cow dung - waste paper mixture. Extractable P, enzyme activity, microbial growth was analysed biweekly during the process over a period of 16 weeks

Results and Discussion

RESULTS After 16 weeks of vermicomposting, combination of *Pseudomonas fluorescens* and *E. fetida* significantly decreased the C/N ratio ($P < 0.05$) from 30:1 to 11:1 compared to the control (CP + FA alone) which had a final C/N ratio of 18. Olsen extractable P was also significantly influenced by the inoculation of *Pseudomonas fluorescens* and *E. fetida* ($P = 0.0012$) with a 48 % increase for the FA + CP with *E. fetida* and *P. fluorescens* treatment relative to 20% for the control with no earthworm or PSB. Alkaline phosphatase was not significantly influenced by inoculation with *Pseudomonas fluorescens*. However, significant differences were observed for FDA enzyme with final activity of 609ug fluorescein/g-dryweight in FA + CP with *E. fetida* and *P. fluorescens* relative to 580ug fluorescein/g-dryweight of the control. Olsen P and enzyme activity showed significant ($P < 0.001$) correlation with PSB growth of 0.6308 and 0.6605, respectively.

Conclusions

CONCLUSION Inoculation of a fly ash amended vermicompost with *Pseudomonas fluorescens* during vermicomposting significantly improves the compost biodegradation and nutrient mineralization.

References

REFERENCES Bhattacharya SS Chattopadhyay GN. 2002. Increasing bioavailability of phosphorous from fly ash through vermicomposting. *Journal of Environmental Quality*.31:2116-2119.

NITROGEN RELEASE FROM DECOMPOSING LEGUME CROP RESIDUES OVER THREE SUBSEQUENT CROPS

Presenter: N.Z. Lupwayi (newton.lupwayi@agr.gc.ca)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N.Z.	Lupwayi	Agriculture & Agri-Food Canada, P.O. Box 3000, Lethbridge, Alberta, Canada, T1J 4B1
Y.K.	Soon	Agriculture & Agri-Food Canada, P.O. Box 29, Beaverlodge, Alberta, Canada T0H 0C0

Introduction

Legumes grown for grain are believed to contribute little N to subsequent crops relative to those grown as green manures (GM) because (a) most of the N is removed with the grain at harvest, so residues have little N, and (b) the high C/N ratios of the residues limit decomposition and N release. But such studies are usually conducted in only one subsequent crop. How much N is released in later subsequent crops?

Materials and Methods

A four-year rotation was established at Beaverlodge, Alberta, Canada, in 2007. The first year of the rotations consisted of two field pea types (green pea and forage pea, both grown for seed), faba bean, faba green manure (GM), and chickling vetch GM. Wheat, canola and barley were then grown in each rotation in 2008, 2009 and 2010, respectively. The litterbag method was used to determine the N release patterns of the legume residues from 2007 to 2010. The N release data were analyzed by analysis of variance. Treatment means were separated by the least significant difference method when analysis of variance indicated significant treatment effects at $P = 0.05$. More details on methodology were reported by Lupwayi and Soon (2015).

Results and Discussion

Faba bean grown for grain, forage pea and vetch GM residues contained the most N (129-153 kg ha⁻¹), and green pea the least (65 kg ha⁻¹) because green pea had high grain yield. Green manure residues released more N (>80% of their contents) than pea residues (about 50% of their N) in the first year when wheat was grown because GM residues had low C/N ratios, but pea residues released more N than GM residues in the second and third years when canola (oilseed rape, *Brassica napus* L.) and barley, respectively, were grown. Residues of faba bean grown for grain released 63% of their N in the first year. After three years, only 3-5% of GM residue N was unreleased, but pulse crop residues had 13-16% of their N unreleased. Therefore, grain legume residues and GM legume residues had different N mineralization profiles with different benefits to the first and later subsequent crops.

Conclusions

The rotational N benefit of grain legumes is underestimated when evaluated only in the first subsequent crop. The pattern of N release is as important as the amount of N released.

References

Lupwayi, N.Z. and Soon, Y.K. 2015. Carbon and nitrogen release from legume crop residues for three subsequent crops. *Soil Science Society of America Journal* 79:1650-1659.

BIOCONTROL OF SELECTED FUSARIUM SPECIES USING MEDICINAL PLANT EXTRACTS

Presenter: M Luvhengo (luvhengom@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M.	Luvhengo	ARC-Vegetables and Ornamental Plants, Private Bag X293, Pretoria 0001, South Africa
S.O.	Amoo	ARC-Vegetables and Ornamental Plants, Private Bag X293, Pretoria 0001, South Africa
R.A.	Adeleke	ARC-Institute of Soil, Climate and Water, Private Bag X79, Pretoria 0001, South Africa
C.	Bezuidenhout	North West University, Private Bag X6001, Noordbrug 2520, South Africa

Introduction

The genus *Fusarium* includes phytopathogenic species of economic importance causing damage to crops. The loss of crops in the field, during harvest and storage due to *Fusarium* species infection remains a serious problem to farmers. Ingestion of crops contaminated with toxins produced by *Fusarium* species can give rise to allergic symptoms and can be carcinogenic with long-term consumption. The aim of this study was to evaluate the potency of selected medicinal plant extracts in controlling diseases caused by *Fusarium* species in crop plants.

Materials and Methods

Different plant parts (leaves, roots, barks and buds) of twenty-two medicinal plant species traditionally used to treat different diseases were collected and extracted using three solvents namely water, acetone and petroleum ether. The plant extracts were tested against *F. verticilloides*, *F. solani*, *F. proliferatum*, *F. subglutinans* and *F. graminearum* using a microdilution method in 96-well plates (Masoko et al. 2005).

Results and Discussion

Different plant parts showed noteworthy activity (minimum inhibitory concentration below 1 mg/ml) against four or five tested *Fusarium* species at a concentration ranging between 0.02 and 0.63 mg/ml. Eleven plant species inhibited the growth of all tested fungi. Nine plant species inhibited all five tested *Fusarium* species using acetone extracts at a concentration below 1 mg/ml and seven plant species inhibited the growth of fungi using petroleum ether extracts at a concentration below 1 mg/ml. Acetone was the best extraction solvent. The use of chemicals to control infection on crops can be hazardous to living beings and affects the microbial population present in the ecosystem. Therefore, the use of medicinal plants for control in crop plants against *Fusarium* species offers an alternative that is environmentally-friendly and safe for human and animal consumption. Moreover, smallholder farmers can use these medicinal plants to treat fungal infections in their crops.

Conclusions

The findings from this study provide a rationale for the renewed interest in the use of botanicals in crop production. Further studies are in progress for the identification of bioactive compounds responsible for the observed antifungal activity.

References

Masoko P, Picard J, Elloff JN. 2005. Antifungal activities of six South African Terminalia species (Combretaceae). *Journal of Ethnopharmacology* 99:301-308.

WATER USE AND WATER USE EFFICIENCY OF MAIZE LANDRACE-BAMBARA GROUNDNUT-DRY BEAN INTERCROP SYSTEM

Presenter: T Mabhaudhi (mabhaudhi@ukzn.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T	Mabhaudhi	University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa
VGP	Chimonyo	University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa
AT	Modi	University of KwaZulu-Natal, Private Bag X54001, Durban 4000, South Africa

Introduction

Crop production in the semi- and arid tropics faces challenges related to declining and variable rainfall and decreasing land availability due to soil degradation. Intercropping offers prospects for increasing resource efficiencies and crop diversity under such conditions. Therefore, the aim of this study was to determine the productivity of intercropping maize landraces with either dry bean or bambara groundnut, a minor legume.

Materials and Methods

Field trials were conducted during the summer of 2015/16 in KwaZulu-Natal, South Africa, under rainfed and irrigated conditions. The component crops were maize landraces, dry bean and bambara groundnut. The experimental was a split-plot design arranged in randomised complete blocks with three replications. The main plots were allocated to water regimes [rainfed (RF) vs. irrigated (IRR)]. The sub-plots were allocated to the intercrops, which included maize landraces (sole), dry bean (sole), bambara groundnut (sole) and additive intercrops of maize landraces-dry bean and maize landraces-bambara groundnut. Data collection included grain yield (Y) and water use (ET). Water use efficiency (WUE) was determined using Y and ET. Intercrop productivity was assessed using land equivalent ratio (LER). All data were analysed using GenStat statistical package.

Results and Discussion

Intercropping maize with either dry bean or bambara groundnuts did not have any negative effect ($P > 0.05$) on yield of maize landraces. Results of LER showed that intercropping maize landraces with either bambara groundnut or dry bean resulted in 30% higher productivity across water regimes. Overall, cropping systems grown under IRR had higher water use (286 mm) relative to RF (210 mm). Water use efficiency was higher (41%) under RF relative to IRR. Based on mean values across water regimes, the trend in WUE was such that dry bean ($5.7 \text{ kg mm}^{-1} \text{ ha}^{-1}$) > maize landraces ($3.2 \text{ kg mm}^{-1} \text{ ha}^{-1}$) > bambara groundnut ($1.9 \text{ kg mm}^{-1} \text{ ha}^{-1}$). Under RF, intercropping maize landraces with either bambara groundnut or dry bean resulted in lower ET (31 and 11%, respectively) relative to maize landrace sole crop. This was attributed to improved soil water availability due to low soil evaporation as the understorey acted as live mulch.

Conclusions

Productivity for maize intercrop systems were more stable across both water regimes. However, under low water availability, maize - bambara groundnut resulted higher improvements in WUE and should be recommended as a viable water management strategy.

References

THE EFFECT OF LONG-TERM STORAGE TEMPERATURES ON POLLEN VIABILITY AND GERMINATION OF FOUR LITCHI (LITCHI CHINENSIS SONN) CULTIVARS

Presenter: A Mabirimisa (mabirimisaA@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Mabirimisa	ARC-TSC, Private Bag X11208, Nelspruit, 1200
Z	Bijzet	ARC-TSC, Private Bag X11208, Nelspruit, 1200
M.T	Labuschagne	University of the Free State, P.O Box 339, Bloemfontein,9300

Introduction

The assessment of pollen viability is crucial in artificial pollination and other breeding programmes. Pollen storage knowledge is important for breeding experiments, as shortage of pollen may have a detrimental effect on any breeding programme that requires the availability of pollen. The aim was to assess the viability and germination of stored pollen of four litchi cultivars.

Materials and Methods

The study was carried out in 2015 and repeated in 2016, using flower panicles that were collected from an orchard block at the ARC-TSC (Nelspruit). Pollen from four cultivars - 'HLH Mauritius', 'Fay Zee Siu', 'Kwai May Pink' and 'Third Month Red' - was extracted from the male flower panicles. This was repeated for both the first (M1) and second (M2) male blooms. The extracted pollen was stored at one of three different temperatures (4°C, -20°C and -82.5°C) for 98 days and was analysed for viability and germination every 7th day during this storage period. Aceto-carmine was used to determine the viability of pollen and a pollen germination medium was used for germination analysis. For each combination of cultivar and storage temperature, twelve different fields of view were microscopically observed and photographically recorded on each slide for pollen viability and on each Petri-dish for germination analysis.

Results and Discussion

The effect of storage period on viability shows that pollen stored for a day had the highest viability percentage, compared with pollen stored for 98 days. M2 pollen was found to be the most viable pollen type in both flowering seasons. The results also showed a decline in the germination rate of pollen at all three storage temperatures over time; however, pollen stored at 4°C had the lowest germination rate in both seasons with less than 50% germination after 28 days. The interaction between cultivar, pollen type, storage temperature and storage period was found to be significant at $P < 0.05$. An increase in storage period resulted in a decline in pollen viability.

Conclusions

The study indicated that pollen can be stored for longer periods at temperatures below 0° C to ensure availability of viable pollen when fresh pollen is not available.

References

Photosynthesis and chlorophyll concentrations in rooibos grown under high temperatures in the field

Presenter: D MacAlister (bscdun001@myuct.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
D.	MacAlister	Department of Biological Sciences, HW Pearson Building, University of Cape Town, Private Bag X3, Rondebosch, 7701
A.M.	Muasya	Department of Biological Sciences, HW Pearson Building, University of Cape Town, Private Bag X3, Rondebosch, 7701
O.	Crespo	Climate System Analysis Group, Environmental and Geographical Science department, University of Cape Town, Private Bag X3, Rondebosch, 7701
S.B.M.	Chimphango	Department of Biological Sciences, HW Pearson Building, University of Cape Town, Private Bag X3, Rondebosch, 7701

Introduction

Aspalathus linearis, rooibos tea, is enjoyed in over 37 countries around the world and is one of the most important commercially cultivated crops in South Africa. The perennial shrub grows in the Cedarberg, with hot, dry summers and cool, wet winters (Lötter et al. 2014). The Intergovernmental Panel on Climate Change (IPCC) has documented substantial and distressing climate change impacts on agriculture. At present, there is not much known about the effects of high temperatures on rooibos and its tolerance mechanisms.

Materials and Methods

Four farms in the Cedarberg region, Aurora, Citrusdal, Clanwilliam and Uitsig, were located along a temperature and rainfall gradient. The farmers germinated seeds in their nurseries in February 2016 and planted seedlings in the fields in June 2016. At each site, four plots of 30 plants each were marked off with poles and were left to grow naturally. These plants were used for gas exchange measurements and chlorophyll concentration determination in summer and winter, 2017. One-way ANOVAs were used to determine statistical significance between sites ($p < 0.05$).

Results and Discussion

Net photosynthesis was higher in summer across sites, while chlorophyll and carotenoid concentrations were significantly lower during the summer months. Plants also exhibited higher chlorophyll a/b ratios during summer. Plants had higher stomatal conductance and subsequently higher transpiration in summer most probably to aid in leaf cooling. These results indicate some of the rooibos adaptation mechanisms to high light and temperature by the plants decreasing their leaf absorbance and therefore reduce the damaging effect of high solar radiation.

Conclusions

These characteristics will enable us to understand how *A. linearis* is affected by higher temperatures and whether it is possible to breed, or select, a more heat and drought tolerant species to use in rooibos cultivation.

References

IPCC (2007) Climate change synthesis report. In: Pachauri, R.K., Reisinger, A. (eds), Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, p. 104
Lötter D, Valentine AJ, Van Garderen EA, Tadross M (2014) Physiological responses of a fynbos legume *Aspalathus linearis* to drought stress. *S Afr J Bot* 94:218-223
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Eddy covariance techniques to quantify dry matter production and evapotranspiration in potato-maize system

Presenter: ATB Machakaire (allan.machakaire@mccain.co.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
ATB	Machakaire	McCain Foods SA, Hasset Road, Nuffield, Springs, South Africa
AC	Franke	University of Free State, PO Box 339, Bloemfontein, 9300
GM	Ceronio	University of Free State, PO Box 339, Bloemfontein, 9300

Introduction

Eddy covariance (ECV) techniques allow for direct and continuous measurements of vertical fluxes of gasses such as water vapour and CO₂, over a surface. We used these techniques to estimate photosynthesis and evapotranspiration in potato-maize systems in the western Free State.

Materials and Methods

Trials were conducted over 2 seasons (2016 – 2017) in potato - maize rotations nearby Christiana. Every season, two Irgason open path CO₂/H₂O gas analyzers were installed on two fields. The flux data was processed using EddyPro 6.1.0 and EasyfluxDL software. Crop coefficient (Kc) values were calculated as the ratio of the ECV measured ET_c to the reference crop evapotranspiration (ET_o) calculated through the Penman-Monteith equations.

Results and Discussion

In potato, the average net CO₂ flux over the season was equivalent to 220.9 kg CO₂ day⁻¹ ha⁻¹ or 60.3 kg C day⁻¹ ha⁻¹. This represents 150.6 kg of glucose day⁻¹. The estimated total DM production, based on measurements of CO₂ fluxes, was 13.7 t ha⁻¹. Using a HI of 68 % for potato tubers, this was equal to 9.3 t tubers ha⁻¹ which compared well to the 9.1 t ha⁻¹ measured. The net CO₂ flux in maize was equivalent to 182.4 kg CO₂ day⁻¹ ha⁻¹ or 49.8 kg C day⁻¹ ha⁻¹. The calculated glucose production was 124.4 kg glucose day⁻¹ ha⁻¹. For the 141 day growing season, calculated total glucose production was 17.5 t ha⁻¹. Total fresh maize grain yield (13 % moisture) was 9.6 t ha⁻¹. Estimated Kc values for potato were 0.79 for the vegetative stage, 0.99 for the tuber initiation stage, 0.74 for the tuber bulking stage and 0.25 for the maturation stage. For maize, it was 0.32 for the initial stage, 0.65 for the developmental stage 0.83 for the middle stage and 0.68 for the late stage. The maximum daily ET_c recorded for potato was 10.6 mm per day measured in the tuber initiation stage and a total of 509 mm for the season. For maize it was 8.0 mm in the silking stage and total of 567 mm for the season. 26.9 kg of glucose was produced per mm of ET_c in potato compared to 30.9 kg in maize.

Conclusions

Maize has a higher water use efficiency than seed potato when either derived from ET_c or rainfall and irrigation inputs. Kc values for potato grown under conditions of intense radiation in South Africa are relatively low when compared to potato grown in North America and India.

References

Allen, R. G., Pereira, L. S., Raes, D. & Smith, M. (1988). Crop evapotranspiration – Guidelines for computing crop water requirements. FAO Irrigation & drainage paper 56. Parent, A. and Anctil, F. (2012). Quantifying evapotranspiration of a rainfed potato crop in South-eastern Canada using eddy covariance techniques. *Agricultural Water Management*, 113(0), pp. 45-56.

INFLUENCE OF NEMARIOC-AL PHYTONEMATICIDE ON SURVIVAL OF ENTOMOPATHOGENIC NEMATODE STEINERNEMA FELTIAE

Presenter: JT Madaure (jacquelinemadaure@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
J.T.	Madaure	University of Limpopo, Private Bag X1106, Sovenga 0727, Republic of South Africa
P.W.	Mashela	University of Limpopo, Private Bag X1106, Sovenga 0727, Republic of South Africa
D.	De Waele	(1) University of Limpopo, Private Bag X1106, Sovenga 0727, Republic of South Africa, (2) Laboratory of Tropical Crop Improvement, Department of Biosystems, Faculty of Bioscience Engineering, University of Leuven (KU Leuven), Willem de Croylaan 42, 3001 Heverlee, Belgium

Introduction

Post-withdrawal of hazardous synthetic chemical nematicides from the agrochemical markets, research focus shifted to botanical products and biocontrol agents as safer alternatives in managing plant-parasitic nematodes (PPN). Cucurbitacin-containing Nemarioc-AL phytonematicide, had been consistent in managing root-knot (*Meloidogyne* species) nematodes on various crops. Alternatively, biocontrol agents comprising bacteria, fungi, entomopathogenic nematodes and other less-known effective microorganisms (EM), had shown some promising efficacies in managing PPN. However, there is limited empirically-based information on how phytonematicides could affect biocontrol agents. The objective of this study was to determine the effects of Nemarioc-AL phytonematicide on survival of infective juveniles (IJ) of entomopathogenic nematode, *Steinernema feltiae*.

Materials and Methods

Approximately 50 *S. feltiae* IJ/petri dish were separately exposed to 0.0, 1.5, 3.0, 4.5, 6.0, 7.0 and 9.0% Nemarioc-AL phytonematicide for 24-, 48- and 72-hours, arranged in completely randomised design, with 10 replicates. After each exposure period, live and dead IJ were counted under a stereomicroscope, where percentage data were arcsine-transformed and subjected to analysis of variance. Significant treatment means were subjected to lines of the best fit.

Results and Discussion

Nemarioc-AL phytonematicide had significant effects on IJ viability at 48- and 72-h exposure periods, with 91% and 93% associations, respectively. A substantial number of IJ survived exposure to the test phytonematicide due to their ability to adapt to adverse environment conditions (Vashisth et al. 2013). The dead IJ population could have partially succumbed to high concentrations of cucurbitacin in the test phytonematicide (Mashela et al. 2017).

Conclusions

Nemarioc-AL phytonematicide had negligible effects on survival of *S. feltiae* IJ at lower and higher concentrations than those recommended for most crops. This suggested that Nemarioc-AL phytonematicide and *S. feltiae* could be used together in integrated pest management systems.

References

Mashela PW, De Waele D, Dube Z, Khosa MC, Pofu KM, Tefu G, Daneel MS, Fourie H. 2017. Alternative nematode management strategies. In: Fourie H, Daneel MS, De Waele D (ed.), *Nematology in South Africa: A view from the 21st century*. Heidelberg: Springer International Publishing. Vashisth S, Chandel YS, Sharma PK. 2013. Entomopathogenic nematodes-A review. *Agricultural Reviews* 34:163-175.

PRODUCTION CHALLENGES TO WHEAT SYSTEMS IN SEMI ARID NAROK COUNTY, KENYA

Presenter: MC Mahagayu (malesicler@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MC	Mahagayu	Kenya Agricultural & livestock Research Organization, PO Private Bag Njoro 20107, Kenya
G	Keya	Kenya Agricultural & livestock Research Organization, PO Private Bag Njoro 20107, Kenya
G	Mbanda	Kenya Agricultural & livestock Research Organization, PO Private Bag Njoro 20107, Kenya

Introduction

Wheat (*Triticum aestivum*) is the second most important cereal crop in Kenya after maize. Narok county of Kenya is one of the leading counties in wheat production, contributing over 80% of total produce, however the crop has been threatened by low yields and reduced acreage in the high potential areas. There has been a very slow adoption or none at all of the new varieties developed for dry areas. Farming communities in Narok are predominantly pastoralists who rear sheep. Some of the areas of Narok County are relatively dry and 60% of the area receive low rainfall.

Materials and Methods

This study was carried out in two sub counties of Narok that is Narok south and Narok east which comprises of farmers who predominantly produce wheat. A baseline study to establish constraints was done where information on land-sizes, education level, yields, varieties of wheat planted, marketing, gender and group membership was captured. Sampling was mainly purposive and a total of 60 farmers were interviewed by use of both a structured and open ended questionnaire. Five new wheat varieties were introduced to the farmers.

Results and Discussion

It was noted that 93.2% of the farmers in both subcounties complimented sheep rearing with wheat production, with the rest either planting wheat or rearing sheep alone. Selling of wheat was mainly done by the farmers individually at the farm gate, with sheep being sold in open air markets on specific market days of the week.

Conclusions

Adoption of the agronomic packages was very low leading to reduced yields. Wheat farming and livestock rearing was mainly done by the male household head (MHH) with only 2% of interviewed females owning livestock.

References

EFFECT OF DIFFERENT LEVELS OF NITROGEN APPLICATION AND PLANT DENSITY ON YIELD OF BASIL AND ROCKET

Presenter: RIS Mahlangu (rmahlangu@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
RIS	Mahlangu	Agricultural Research Council-Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001, South Africa
MM	Maboko	Agricultural Research Council-Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001, South Africa
FN	Mudau	University of South Africa, College of Agriculture and Environmental Science, 28 Pioneer Ave, Florida Park, Roodepoort, 1709

Introduction

Rocket (*Diplotaxis tenuifolia* L. DC.) and basil (*Ocimum basilicum* L.) are the most important species of herbs, grown in many countries of the world as medicinal and seasoning plants. They are grown commercially and are important component of ready to eat salads with different spicy flavour (Nurzyńska-Wierdak et al., 2012). Increasing plant density and nitrogen application has the potential to increase yield and profit on herbs. Therefore, the study was to investigate the effects of nitrogen (N) application and plant density on the growth and yield of rocket and basil.

Materials and Methods

The study was conducted at the Agricultural Research Council- Vegetable and Ornamental Plants (VOP) in a sandy clay loam soil during November 2016 to March 2017. Four-week old leafy rocket and basil seedlings were transplanted on raised beds, and plants were irrigated with drip irrigation system. The experiment was laid out as a 6 x 3 factorial with six N levels of 0, 60, 90, 120, 150 and 180 kg/ha, and three plant density of basil at 93 750, 62 500 and 40 000 plants/ha, and three plant density rocket at 133 333, 80 000 and 40 000 plants/ha. Treatment combinations were replicated three times in a randomised complete block design. Parameters recorded were leaf fresh and dry mass, leaf number, leaf area, leaf chlorophyll content, and shoot fresh and dry mass. Data were subjected to analysis of variance (ANOVA) and the polynomial model procedure using Genstat 64-bit, Copyright 2016, VSN International Ltd, Hemel Hempstead, UK.

Results and Discussion

Nitrogen application increase from 90 to 180 kg/ha contributed to an increased leaf fresh mass of rocket and basil. An increase in plant density resulted in an increase in leaf fresh mass, leaf dry mass, leaf area, shoot fresh mass, and shoot dry mass of rocket and basil at the plant density of 133 333 plants/ha and 93 750 plants/ha, respectively. Leaf area and shoot fresh mass was significantly improved at 60 to 180 kg N/ha on basil. Leaf chlorophyll content was significantly high at 60 kg N/ha on rocket and 150 kg N/ha on basil.

Conclusions

Results indicate that the application of N at 90 kg N/ha at the plant density of 93 750 basil plants/ha and plant density of 133 333 rocket plants/ha can be recommended for improved marketable leaf yield. However, further studies need to be conducted to identify the optimal plant spacing of rocket and basil for improved yield and quality

References

Nurzyńska-Wierdak, R, Rożek, E, Dzida, K & Borowski B. 2012. Growth response to nitrogen and potassium fertilization of common basil plants. *Acta Scientiarum Poloniarum Hortorum Cultus*, 11(2): 275-288.

ACCUMULATION OF PROANTHOCYANIDIN CONCENTRATION LEVELS IN CLEOME GYNANDRA LEAFY VEGETABLE

Presenter: M.Y. MAILA (yvonne.maila@ul.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M.E.	Ramphele	university of Limpopo, Private bag x1106, Sovenga, 0727
M.Y.	Maila	University of Limpopo, Private bag x1106, Sovenga, 0727
M.S.	Mphosi	University of Limpopo, Private bag x1106, Sovenga, 0727

Introduction

Cleome gynandra is characterised by its inherent bitter taste, attributed to proanthocyanidins (Kutsukutsa et al., 2014). Proanthocyanidins (PAs) are found in various parts of leafy vegetable acting as a defence mechanism against pests and herbivores (Mathooko and Imungi, 1994). The PAs comprise a group of polyhydroxy-flavan-3-ol oligomers and polymers, linked by carbon-carbon bonds between flavanol subunits. Bitterness in *C. gynandra* limits consumption as a nutritious leafy vegetable. The objective of the study was to investigate the concentration levels of PAs in *C. gynandra* shoots and leaves at various harvesting times.

Materials and Methods

Tender shoots and leaves of greenhouse-grown *C. gynandra* were harvested at 4 (control), 6, 8, 10 and 12 weeks. The harvesting weeks denoted treatments. Cleome gynandra samples were oven-dried for 24 hrs and ground to fine powder prior to chemical analysis. The PAs concentration were determined using the Butanol-HCl method and calculated as percentage (%) in dry matter, leucocyanidin equivalent (Makkar, 2000), in a CRD arranged in triplicates. Data was subjected to analysis of variance through Statistix 10.0, while means were separated through LSD at 5% probability level.

Results and Discussion

Harvesting time had significant ($P \leq 0.01$) effect on PAs concentration of *C. gynandra*, contributing 99% of the total treatment variation. Relative to the control, PAs concentration levels increased at 6, 8 and 10 weeks by 343, 398 and 446%. However, at maturity (12 weeks) the concentration was reduced by 206%. Generally, PAs concentration in *C. gynandra* shoots and leaves tend to accumulate with age of the plant and then reduce when the plant's photosynthetic rate is low due to aging of the plant. The highest PAs concentration (446%) was achieved at week 10.

Conclusions

In conclusion, for consumption purposes harvesting should be conducted between week 4 and 9 when the PAs concentration is not at its peak.

References

Kutsukutsa, R.T., Gasura, E., Mabasa, S. and Ngadze, E. 2014. Variability in condensed tannins and bitterness in spider plant genotypes. *African Crop Science Journal* 22:275–280. Makkar, H.P.S., Dawra, R.K. and Singh, B. 2000. Determination of both tannin and protein in a tannin-protein complex. *Journal of Agricultural and Food Chemistry* 36:523–525. Mathooko, F.M. and Imungi, J.K. 1994. Ascorbic acid changes in three indigenous Kenyan vegetables during traditional cooking. *Ecology of Food and Nutrition* 32: 239–245.

Influence of harvesting time and rhizobium inoculation on primary and secondary metabolites of Cancer bush (*Lessertia frutescens* (L.) R.Br.).

Presenter: MJ Makgato (MakgatoM@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MJ	Makgato	Vegetable and Ornamental Plants (ARC-VOP), Private Bag X293, Pretoria, 0001
HT	Araya	Vegetable and Ornamental Plants (ARC-VOP), Private Bag X293, Pretoria, 0001
NS	Mokgehe	Vegetable and Ornamental Plants (ARC-VOP), Private Bag X293, Pretoria, 0001
CP	du Plooy	Vegetable and Ornamental Plants (ARC-VOP), Private Bag X293, Pretoria, 0001
FN	Mudau	Department of Agriculture and Animal Health, University of South Africa, UNISA Science Campus, Florida, 1709, South Africa

Introduction

Extensive research is taking place on the identification of medicinal compounds, testing of toxicology and efficacy, quality control and product development (Joy et al., 1998). One of the most important and widely used medicinal plant species is cancer bush (*Lessertia frutescens*), which is used both traditionally and pharmaceutically for amelioration of many diseases, including internal cancers and HIV (Makunga et al., 2010). Several studies have reported on antioxidant activities, phenolics and flavonoids of Cancer bush (Tobwala et al., 2014), but not on cultivation effect on simple sugar accumulation, total flavonoid, total phenolic contents and antioxidant activities.

Materials and Methods

The experiment was conducted at the experimental site of the Agricultural Research Council-Vegetable and Ornamental Plants, Pretoria, South Africa (25°59'S 28°35'E). A Latin square, with four treatments of commercial rhizobium inoculant per 100 seeds of *L. frutescens* was used where T0=Control, T1=100 grams, T2=200 grams and T4=400 grams of commercial rhizobium replicated four times. Destructively sampling was done during stage 1 (150 d.a.p.), stage 2 (240 d.a.p.) and stage 3 (330 d.a.p.). Plants were separated and the shoots were oven-dried (50 °C) then weighed, milled (0.045 mm), and stored in vials for analysis. About 0.2 g of *L. frutescens* shoots were extracted with 10ml of methanol and standardized using Ultra-Turrax (Model T25D, IKA, and Germany) vortexed for one minute. The mixture was shaken overnight at room temperature using an orbital shaker (Model 361, Germany) and extracts were filtered and stored analysis of simple sugars accumulation and antioxidant activities.

Results and Discussion

There was variation in sucrose content during all stages of harvests. At 330 d.a.p high sucrose content in combination with 200 grams of rhizobium inoculum. There was an increase in fructose accumulation at 330 d.a.p with 400 grams of rhizobium inoculum. The, highest antioxidant activities (3.43 ± 0.98 Fe (II)/g dry mass) was recorded at 240 d.a.p when 100 grams was applied and the lowest was at 330 d.a.p with 200 grams of rhizobium inoculum (0.94 ± 0.19 Fe (II)/g dry mass).

Conclusions

The present study evident not only that *L. frutescens* as an important medicinal but also that it constitutes essential chemical components such as simple sugars of carbohydrates namely; Fructose, Glucose and Sucrose flavonoids. Harvesting time and rhizobium inoculation showed to have a significant effect on the accumulation of sugars as they increase with plant maturity.

References

JOY, P.P., THOMAS, J., MATHEW, S., AND SKARIA, B.P. 1998. Medicinal Plants. Tropical Horticulture. BOSE, T.K., KABIR, J., DAS, P. AND JOY, P.P. (Editors). MAKUNGA, P., COLLING, J., STANDER, M.A. AND NOKWANDA, P. 2010. NITROGEN Supply and Abiotic Stress Influence Canavanine Synthesis and the Productivity of in vitro Regenerated *Sutherlandia frutescens* microshoots. Journal of Plant Physiology, 167: 1521 - 1524.

RESISTANCE MECHANISM TO MELOIDOGYNE INCOGNITA RACE 2 IN SWEET POTATO CULTIVAR 'BOSBOK'

Presenter: M.M Makhwedzhana (makhwexm@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M.M	Makhwedzhana	University of Limpopo, Private Bag X 1106, Sovenga 0727, South Africa
K.M	Pofu	Agricultural Research Council – VOPI, Private Bag X293, Pretoria 0001, South Africa
P.W	Mashela	University of Limpopo, Private Bag X 1106, Sovenga 0727, South Africa

Introduction

Two forms of nematode resistance, namely, pre- and post-infectious nematode resistance have been identified in plant parasitic nematodes. Only post-infectious nematode resistance can be introgressed in nematode-susceptible cultivars for nematode resistance through molecular plant breeding technologies (Ramatsitsi et al., 2017). A previous host-status and host-sensitivity study suggested that cultivar 'Bosbok' was resistant to *Meloidogyne incognita* race 2. Generally, should post-infectious nematode resistance be available in sweet potato cv. 'Bosbok', the information would be relayed to plant breeders for use as a source of introgression in various commercial cultivars where nematode-resistant genotypes do not exist. The objective of this study was to determine whether nematode resistance in cv. 'Bosbok' to *M. incognita* race 2 had pre- or post-infectious mechanism of resistance.

Materials and Methods

Cuttings of sweet potato cv. 'Bosbok' were transplanted into 250 mL polystyrene cups containing 200 ml steam-pasteurised fine sand. A week after transplanting, established cuttings were each infested by 100 *M. incognita* second-stage juveniles. Cuttings were fertilised once with 2 g Multifeed and irrigated every other day with 40 mL water. Starting from two days after inoculation, four plants were removed every second day for 30 days and their roots severed, cleaned, stained and then destined for assessment of necrotic spots, giant cells and rootlet interference.

Results and Discussion

At each sampling time, roots were assessed for necrotic spot, giant cell formation, rootlet interference and root galls. The presence of necrotic spots suggested that J2 penetrated the root system of cv. 'Bosbok'. Failure in the development of giant cells as denoted by numbers and sizes, suggested that nematodes failed to establish feeding sites in cv. 'Bosbok'. Rootlet interference showed that the cultivar resisted nematode infection and the establishment of the feeding site. Absence of root galls was also an indicator for resistance to infection by *M. incognita* race 2 in cv. 'Bosbok'.

Conclusions

The hypersensitivity indicators observed in cv. 'Bosbok' all suggested that post-infectious nematode resistance to *M. incognita* race 2 was in place including plant genes with attributes for use in introgression.

References

Ramatsitsi, M.N., Pofu, K.M. and P.W. Mashela. 2017. Bioactivities of *Meloidogyne incognita* and *Meloidogyne javanica* in *Cucumis myriocarpus* and *Cucumis africanus* seedlings. National combined congress. 23-26 January. P 96. South Africa

Physiological traits for identifying drought tolerant genotypes in Chickpea (*Cicer arietium* L.; Fabacea)

Presenter: G.M Makonya (givemoremakonya@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
GM	Makonya	University of Cape Town, Department of Biological Sciences, Private Bag X3 Rondebosch 7701, South Africa
JBO	Ogola	Department of Plant Production, University of Venda, Private Bag X5050, Thohoyandou 0950, South Africa
M	Muasya	University of Cape Town, Department of Biological Sciences, Private Bag X3 Rondebosch 7701, South Africa
O	Crespo	3University of Cape Town, Climate System Analysis Group, Environmental and Geographical Science Department, Rondebosch, Cape Town 7701, South Africa
SBM	Chimphango	University of Cape Town, Department of Biological Sciences, Private Bag X3 Rondebosch 7701, South Africa

Introduction

Chickpea (*Cicer arietinum*) is an important food security crop for smallholder low-resource farmers in the tropics and semiarid tropics. Drought stress is documented as one of the major stresses hampering chickpea production in tropical and sub tropical regions. Identifying ecophysiological parameters for chickpea genotype drought tolerance screening under South African conditions would prove invaluable.

Materials and Methods

In the current study, a glasshouse experiment was set up to assess the physiological and growth response of 4 chickpea genotypes to drought stress induction at vegetative and flowering stages and impact of acquired tolerance, if any. Data on net photosynthesis, stomatal conductance, transpiration, vapor pressure deficit, soil moisture content, chlorophyll concentration, relative water content (RWC) and biomass yield at flowering were collected

Results and Discussion

There was a significant ($p < 0.001$) genotype * stress interaction effect on stomatal conductance, relative water content and total biomass at both growth stages. The water stress had a significant effect ($p < 0.001$) on photosynthesis and chlorophyll concentrations. Genotype accession 7 was moisture conserving when exposed to drought stress at both vegetative and flowering growth stages. It is evident that plants stressed at vegetative growth stage in all genotypes tend to withstand further stress at flowering growth stage better compared to plants that were only stressed at flowering growth stage.

Conclusions

Use of chlorophyll concentration and photosynthesis gaseous exchange may help in the identification and development of chickpea varieties better adapted to drought environments in South African

References

Kashiwagij, Krishnamurthy L, Gaur PM, Upadhyaya HD, Varshney RK, Tobita S. 2013. Traits of relevance to improve yield under terminal drought stress in chickpea (*C. arietinum* L.). *Field Crops Research* 145: 88-95

EFFECT OF UVASYS SO₂ IMPREGNATED SHEETS AND PERFORATED PACKAGING MATERIALS ON QUALITY AND SHELF-LIFE OF LITCHI CULTIVARS

Presenter: HK Malahlela (malahlelaharold@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
HK	Malahlela	University of Limpopo, P/Bag X1106, Sovenga 0727, South Africa
N	Mathaba	Agricultural Research Council-ITSC, P/Bag X11208, Nelspruit, 1200, South Africa
TP	Mafeo	University of Limpopo, P/Bag X1106, Sovenga 0727, South Africa

Introduction

Export constraints such as inherent short postharvest life, fungal decay and pericarp browning are forcing the litchi industry to rely on SO₂ fumigation as the sole legal postharvest treatment for South African litchi fruit. However, the importing countries require an SO₂ aril MRL of ≤ 10 ppm. The current SO₂ fumigation method delivers high SO₂ levels. The objective of this study was to investigate efficacy of Uvasys SO₂ impregnated sheets and perforated packaging materials on quality retention and shelf-life extension of 'Mauritius' and 'McLean's Red' litchi cultivars.

Materials and Methods

Commercially SO₂ fumigated and untreated (SO₂ free) litchi fruit of 'Mauritius' and 'McLean's Red' were used. Before storage (10 day period), fruit were packaged into punnets and tomato plastic bags, then different SO₂ Uvasys sheets placed on top of the packaging materials. After storage fruit were evaluated daily for 4 days. The experiments were conducted in a CRD, with 2 cultivars, 6 SO₂ treatments, 4 evaluation days and 3 replicates. Data collected included pericarp colour, weight loss, firmness loss, fungal decay, TSS, TA and Brix.

Results and Discussion

Results showed that an interaction of cultivar, SO₂ treatments and evaluation day significantly ($P \leq 0.05$) affected all visual qualities of both cultivars, with an exception of the tomato plastic bag experiment. Uvasys SO₂ impregnated sheets were effective in reducing pericarp browning in both cultivars when compared with SO₂ fumigation and the control. However, browning index of control and Uvasys SO₂ impregnated sheets was higher when compared with SO₂ fumigated fruit. Perforated bags resulted in the lowest fungal decay for both cultivars when compared with perforated punnets. Moreover, Uvasys SO₂ impregnated sheets resulted in the highest TSS in the 'Mauritius' cv. when compared with 'McLean's Red' in perforated punnets. Nonetheless, TA of both cultivars decreased with increasing storage. The highest TA was observed in SO₂ fumigated fruits due to direct penetration of SO₂ through the pericarp into the aril, altering taste (Sivakumar et. al., 2010).

Conclusions

Combinations of Uvasys SO₂ impregnated sheets and perforated punnets showed acceptable results in terms of reducing pericarp browning. Perforated bags and Uvasys SO₂ impregnated sheets were more effective in reducing fungal decay, with no effect on shelf-life.

References

Sivakumar D., Terry L.A., Korsten L. 2010. An overview on litchi fruit quality and alternative post-harvest treatments to replace Sulfur dioxide fumigation. Food Reviews International 26: 162-188.

Subsistence farmers in Msinga Municipality use conservation agriculture to mitigate climate change in KwaZulu Natal

Presenter: TC Mapumulo (Dlaminic@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
TC	Mapumulo	ARC-ISCW PO Box 11114, Marine Parade, Durban, 4056

Introduction

The majority in rural communities of KwaZulu Natal are largely dependent on farming as a livelihood strategy and for food security. Recently, these livelihoods are threatened by climate change especially due to marginal soils. Perceived by practitioners as a valid tool for sustainable land management, conservation agriculture concept supports the broader idea of an integrated or systems (holistic) approach to natural resource management. Conservation agriculture (CA) aims to achieve sustainable and profitable agriculture and subsequently aims at improved livelihoods of farmers (FAO, 2000).

Materials and Methods

In this qualitative inquiry of mitigating climate change through implementation of conservation agriculture, action research methodologies and tools were used and include experiential and social learning. Adapted from the use of multiple methods which combines action research, grounded theory and soft systems methodology (SSM), systems model for sustainable land management by (Smith, 2006) was employed in this study and has proved to be much more pragmatic, as it is based on the action research cycle of planning, acting, observing and reflecting, with an additional stakeholder analysis phase at the start of the project and an exit strategy at the end. During the 2012/13 to 2014/15 seasons ten sites of 5Ha plots were sprayed with Round-up herbicide to destroy all existing vegetation in the establishment of trials. Maize (PAN SC701 hybrid) with plant density (26 667 plants ha⁻¹) was intercropped with dry beans and cowpeas (living mulch). Only the maize grain yield was measured at 12.5% moisture. Home gardens with a variety of vegetables were established for all beneficiaries. At the rate of 200kg/Ha [2:3:4 (38)] NPK fertilizer was applied at planting in the field plots whilst vermicompost 2.5kg m⁻² was used in home gardens for soil fertility management.

Results and Discussion

In pursuit of action to bring about change in the farming communities, research outcomes of this model provided means to create a culture of learning that allowed people to be innovative, interactive and change among changing climatic circumstances, where groups with similar goals and values were brought together, to change behavior to collectively care and manage the highly threatened and degraded, in some cases underutilized natural resources. Soil mineral and yield improvements were evident on both grain crops. Social learning results showed that food security is a multifaceted concept affected by climate change through food accessibility, availability, utilization and affordability.

Conclusions

Sustainable agriculture is not a simple model or a package to be imposed rather a process of learning for all involved.

References

FAO 2000. Guidelines and reference material on integrated soil and nutrient management and conservation for Farmer Field Schools. FAO Report No. AGL/MISC/27/2000. Smith HJ 2006. Development of a systems model facilitating action research with resource-poor farmers for sustainable management of natural resources. PhD Thesis. University of the Free State, Bloemfontein.

INTERCROPPING: Taro, cowpea and wild mustard with addition of vermicompost to improve yield

Presenter: TC Mapumulo (Dlaminic@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
TC	Mapumulo	ARC-ISCW PO Box 11114, Marine Parade, Durban, 4056
JM	Green	UKZN School of Agriculture, Earth and Environmental Sciences, /Bag X01, Scottsville, 3209

Introduction

Taro (*Colocasia Esculenta* (L.) Schott) known locally as amadumbe, is considered an important food security crop in many rural areas of South Africa as well as a staple for the majority of the populations in Asia and Africa. Generally, taro crops grown by farmers in their yards are characterized by dryland production with low soil fertility levels as a result of the lack of access to organic manures that in turn impact on the growth and yield of taro. An alternative organic material that can be used for fertilizer is vermicompost. This is made up of C, H and O and contains nutrients such as NO₃, PO₄, Ca, K, Mg and S which have similar effects on plant growth and yield as chemical fertilizers applied to the soil. In addition, humic substances (humic acids, fulvic acids and humin) contained in vermicompost provide sites for chemical reactions when applied to the soil (Mehta and Kanrwall 2013). Also the microbial content of vermicompost is well known to enhance plant growth (Edwards 1998).

Materials and Methods

The trial was conducted over two summer seasons (2006/07 and 2007/08) in two villages of the Umbumbulu KwaZulu-Natal. Experiments were arranged in a randomized complete block design, replicated three times. Component crops were taro and cowpeas with wild mustard organic fertilizer. Treatments included taro and cowpea sole crops each, and the 1:1 (taro:cowpea) intercrop combination. Based on local practice of kraal manure application at planting, vermicompost from earthworms (*Eisenia fetida*) was applied at the rate of 2.5 kg m⁻² and wild mustard planted at 50% as a living mulch between the crop rows. Fresh taro corm yield was determined at harvest after 9 months of the growing cycle. This yield was recorded by counting the total number of corms per plant and weighing the total fresh corm mass per plant in a plot. In determination of intercrop performance and land use efficiency land equivalent ratio (LER) was calculated.

Results and Discussion

An advantage commonly claimed for intercropping systems of greater yield stability than monocropping was observed when all treatments with and without vermicompost added showed above unity (1) values for land equivalent ratio (LER). Land use efficiency determined was found to be highest (2.21) under vermicompost followed by wild mustard and control treatments.

Conclusions

Taro production is significantly improved by farming system alteration to intercropping involving a legume, as well as soil mineral improvement from living mulch and soil amendment with vermicompost.

References

Edwards CA. 1998. The use of earthworms in the breakdown and management of organic wastes. In: Edwards, C.A. (ed.): Earthworm ecology. CRC Press, London, pp 327-354. Mehta N, Karnwall A. 2013. Solid waste improvement with the help of vermicompost and its applications in crop improvement. Journal of Biology and Earth Sciences 3: B8-B16.

ASSESSMENT OF PHYTO-TOXICITY AND PHYSICO-CHEMICAL PROPERTIES OF CO-COMPOSTED WINERY SOLID WASTE USING EFFECTIVE MICROORGANISMS INOCULANT

Presenter: MM Masowa (masowamanaremaxsonm1@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MM	Masowa	Food Security and Safety Niche Area Research Group, Department of Crop Science, Faculty of Natural and Agricultural Sciences, School of Agricultural Science, North-West University, P/Bag X2046, Mmabatho, 2735
FR	Kutu	Food Security and Safety Niche Area Research Group, Department of Crop Science, Faculty of Natural and Agricultural Sciences, School of Agricultural Science, North-West University, P/Bag X2046, Mmabatho, 2735
OO	Babalola	Food Security and Safety Niche Area Research Group, Department of Crop Science, Faculty of Natural and Agricultural Sciences, School of Agricultural Science, North-West University, P/Bag X2046, Mmabatho, 2735
R	Mulidzi	ARC-Infruitec/Nietvoorbij, P/Bag X5026, Stellenbosch, 7599

Introduction

The use of commercial microbial inoculants to improve the quality of composted microbially degraded wastes has received attention in many countries. In South Africa, report on the use microbial inoculants such as effective microorganisms (EM) during compost production is scanty. This study aims to assess the quality of winery solid waste (WSW) composts produced from the co-composting of WSW materials with EM inoculant.

Materials and Methods

Various WSW compost types were produced through thermophilic process with and without EM inoculation with an initial heap height of either 1 m or 1.5 m. Winery waste materials used for the co-composting included (i) filter materials (FM) that comprised of diatomaceous earth (DE) and perlite, and (ii) chopped grapevine pruning canes (GPC), grape stalks (GS) and grape seeds and skins (MSS) mixture collectively described as waste plant materials (WPM). Each compost heap was prepared by mixing the FM and WPM at a mix ratio of 40: 60 on percent volume basis of dry matter. The 40% FM comprised of 90% perlite and 10% DE while the 60% WPM consisted of 80% GPC, 10% GS and 10% MSS on volume basis. Cured compost samples were evaluated for seed germination index (GI) and detailed physico-chemical properties. The GI test was done at varied concentrations (0, 10, 25, 50 & 100%) using seeds of cowpea, maize and tomato. Data collected were analysed using SAS software version 9.4 while differences between treatments mean were tested at $P < 0.05$.

Results and Discussion

There was significant EM inoculation x heap size x extract concentration interaction effects on maize and tomato seed germination percentage, and the root growth and GI of all three crops. The GI of the three crops was significantly reduced at compost extract concentration greater than 50% indicating the presence of phyto-toxic compounds that influenced the seed germination and root growth. Phyto-toxicity effect was however much lower on cowpea. EM inoculation exerted a significant ($p < 0.05$) effect on compost Bray-P2 content while EM inoculation x compost heap size interaction similarly had significant effect on ammonium-N content. The variation in bulk density, volatile solids content, water holding capacity and chemical properties of pH, salinity, nitrate-N and exchangeable K contents among various compost types were not significant.

Conclusions

The study revealed possible existence of phyto-toxicity of WSW compost at very high extract concentration that may be reduced through lower WSW compost application rate.

References

EFFECT OF HEALING PERIOD ON ROOTING RESPONSE OF ROSE-SCENTED GERANIUM CUTTINGS

Presenter: N Matafeni (200704124@ufh.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N	Matafeni	Department of Agronomy, University of Fort Hare, Alice 5700, South Africa
B.K	Eiasu	University of Fort Hare, Alice, 5700
S	Amoo	ARC-Roodeplaas Vegetable and Ornamental Plants Private Bag X293, Pretoria, 001, South Africa

Introduction

Wound healing period is the survival time that the cutting can take before it is propagated. After wounding the stem, cuttings were exposed to the room temperature and dried up to heal the wound until it was stuck in the rooting media. To explore a way of enhancing rooting of rose-scented geranium cuttings, effects of different healing durations and rooting hormone were evaluated.

Materials and Methods

The experiment was conducted to assess the effect of different times of wound healing period and varied concentrations of IBA hormone on a 4 x 4 factorial experiment laid out in a randomised complete block design (RCBD) with three replicates. The treatments consisted of four groups of healing duration intervals of 24 hours (Days 1, Day 2, Day 3 and Day 4) and four rooting hormones (auxins, types of IBA) [(1) Dynaroot (1 - 1g/kg), (2) Dynaroot (2- 3g/kg), (3) Dynaroot (3-8g/kg) and (4) control (untreated with hormone)]. Cuttings were assessed on the following; root number; root length; root fresh mass; plant height (measured with a ruler); leaf number (counting); shoot number and stem circumference. The root ability to hold medium was determined by visual observation and rated at 1-5 scale: 1 (very loose, not acceptable); 2 (loose, not acceptable); 3 (medium, marginally acceptable); 4 (tight, acceptable); 5 (very tight, acceptable).

Results and Discussion

Results of this study revealed that rose-scented geranium gave the highest number of roots and the longest roots length when planted on Day 3 of the healing period. Root holding ability was also at its highest on cuttings that have been healing for 3 days. Stem circumference and shoot number, however, tended to decrease with increase in healing duration. The study recommends that rose-scented geranium can be propagated using cuttings that have enough time to heal their wound, that is Day 3 cuttings. IBA hormone concentration showed good response to rooting and other arial parameters except for stem circumference which was favoured by application of control.

Conclusions

Rose-scented geranium requires a wound healing period of about three days at room temperature and with application of IBA hormone before sticking cuttings into a growing medium. Instead, of Dynaroot 3 or 2, Dynaroot 1 can also be used because it is cheaper and as effective as Daynaroots 3 and 1 in inducing roots on the cuttings that have been healing for three days.

References

Hartmann , H.T., Kester , D.E., Davies, F.T., Geneve, R.L. ,2002.

ROOTING OF ROSE-SCENTED GERANIUM CUTTINGS AS AFFECTED BY GROWING MEDIA AND ROOTING HORMONES

Presenter: N Matafeni (200704124@ufh.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N	Matafeni	Department of Agronomy, University of Fort Hare, Alice 5700, South Africa
B.K	Eiasu	University of Fort Hare, Alice, 5700
S	Amoo	ARC-Roodeplaat Vegetable and Ornamental Plants Private Bag X293, Pretoria, 001, South Africa

Introduction

Growing media and rooting hormones play an important role in rooting of stem cuttings. This can either be through their direct effect on the cuttings or through their interaction. To maximize rose-scented geranium production, effect of growing medium and rooting hormone on successful rooting and shoot development of stem cuttings of rose-scented geranium was investigated.

Materials and Methods

A factorial experiment (seven of growing media combinations and four formulations of rooting hormone) was conducted. The growing media tested were (1) control (a mixture of pine bark 8 bags + sand 2 bags + lime 4kg + coconut 10 blocks + talborne 6.25 kg + bone meal 2 kg); (2) river sand; (3) pine bark; (4) Hygrotex (commercial rooting media); (5) pine bark + river sand (at1:1 ratio on volume basis); (6) pine bark + Hygrotex (at 1:1, ratio on volume basis), and; (7) Pine bark + river sand + Hygrotex (at 1:1:1 ratio on volume basis). The rooting hormones (auxins, types of IBA) applied as treatments were (1) Dynaroot 1 (1 g/kg), (2) Dynaroot 2 (3g/kg), (3) Dynaroot 3 (8 g/kg) and (4) Control (untreated with hormone). The experiment was laid-out as a complete randomized design (CRD), each treatment combination replicated three times.

Results and Discussion

Cuttings established in Hygrotex had the highest mean number of roots, root length, fresh mass and shoot number. Hygrotex + pine bark (v/v 1:1) promoted leaf production, plant height and other shoot growth parameters. Dynaroot 3 gave the highest rooting and root length regardless of growing media used. A combination of Dynaroot 2 and pine bark + Hygrotex (at 1:1 v/v) promoted root holding ability (RHA).

Conclusions

It is recommended that rose-scented geranium cuttings should be rooted in a commercial growing medium - Hygrotex and IBA rooting hormone, Dynaroot 3. A combination of Dynaroot 2 and pine bark + Hygrotex (at 1:1 v/v) may be a suitable alternative, especially where Dynaroot 3 and Hygrotex is in short supply or due economic constraints.

References

Hartmann , H.T., Kester , D.E., Davies, F.T., Geneve, R.L. ,2002. Hartmann and Kester's Plant propagation : Principles and practices. -7th ed.p

Avocado 'Hass' fruit skin colour change conundrum: A South African fruit case study

Presenter: N Mathaba (mathaban@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N	Mathaba	Agricultural Research Council – Institute for Tropical and Subtropical Crops, Private Bag X11208, Nelspruit, Mpumalanga Province, South Africa
ZM	Nthai	Department of Plant Production, Soil Science and Agricultural Engineering, University of Limpopo – Turfloop Campus, Private Bag X1106, Sovenga, 0727, Limpopo Province, South Africa
S	Mathe	Discipline of Horticultural Sciences, School of Agricultural, Earth and Environmental Sciences, Private Bag X01, Pietermaritzburg, Scottsville, 3209
K	Shikwambana	Department of Plant Production, Soil Science and Agricultural Engineering, University of Limpopo – Turfloop Campus, Private Bag X1106, Sovenga, 0727, Limpopo Province, South Africa
H	Sibuyi	Department of Plant Production, Soil Science and Agricultural Engineering, University of Limpopo – Turfloop Campus, Private Bag X1106, Sovenga, 0727, Limpopo Province, South Africa
TP	Mafeo	Department of Plant Production, Soil Science and Agricultural Engineering, University of Limpopo – Turfloop Campus, Private Bag X1106, Sovenga, 0727, Limpopo Province, South Africa
SZ	Tesfay	Discipline of Horticultural Sciences, School of Agricultural, Earth and Environmental Sciences, Private Bag X01, Pietermaritzburg, Scottsville, 3209

Introduction

In the last 5 years, countries importing South African 'Hass' avocado fruit have been complaining about poor skin colour change during ripening. 'Hass' avocado fruit are supposed to change skin colour from emerald green to purple to black during ripening as an indication of ripeness. A deviation from the quality parameter affects promised quality, thereby compromising market competitiveness. In response, the South African Avocado Growers' Association (SAAGA) commissioned the Agricultural Research Council – Tropical and Subtropical Crops (ARC-TSC) to investigate both pre- and postharvest factors causing such a conundrum. The aim of this study was to investigate several pre- and postharvest factors which could explain poor 'Hass' avocado skin colour development during ripening.

Materials and Methods

In the last 4 years, we have investigated the effect of harvest time, minerals, orchard topography (upper and lower slopes), production region, canopy position (inside and outside canopy fruit), branch girdling, tree load adjustment, 1-MCP and ripening temperature on 'Hass' avocado skin colour change.

Results and Discussion

The results confirmed that poor 'Hass' avocado skin colour change is predominantly an early to mid-season occurrence. The effect of skin minerals, orchard topography, production region and canopy position had a minimal role in improving 'Hass' avocado skin colour change during ripening, especially for early to mid-season fruit. Tree girdling significantly reduced 'Hass' avocado fruit skin quality (colour change) by increasing external chilling damage. Higher ripening temperatures (21 and 25°C) could only improve skin colour change for late season fruit when compared with lower temperatures (16°C). Ultimately, adjustment of crop load to 25-50% seems to improve 'Hass' avocado fruit skin colour change, especially for early to mid-season fruit.

Conclusions

We can conclude that early to mid-season fruit prioritize sugars towards the seed not the skin. Sugars (glucose) are a substrate in the synthesis of the pigment associated with purple colour in 'Hass' avocado viz. cyanadin-3-O-glucoside.

References

Soil Fertility Status of Eastern Cape soils analyzed at Dohne Agricultural Development Institute, Eastern Cape Province of South Africa

Presenter: M Matlabane (Mlungiseleli.Matlabane@drdar.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M	Matlabane	Private Bag X15 Stutterheim 4930
Z. B	Mzayiya	Private Bag X15 Stutterheim 4930

Introduction

Soil samples received at Dohne Agricultural Development Institute (DADI) come from different municipal districts in the Eastern Cape Province (ECP). DADI is affiliated to the Agriculture Laboratory Association of Southern Africa (AgriLasa) and provides soil testing and fertilizer recommendations for both commercial and subsistence farmers. Mandiringana et al, 2005, found that ECP soil fertility status were lower in selected cultivated lands of subsistence farmers than in home gardens and commercial farmers. Soil samples were analysed by DADI for Extractable Calcium (Ca), Magnesium (Mg), Potassium (K), Zinc (Zn) and Phosphorus (P) and pH (KCl) .

Materials and Methods

Extractable Ca, Mg, K, Zn and P were analysed by Ambic-2 method ,and pH(KCl)(1:2.5) was analyzed based on AgriLasa Soil Analysis Handbook.

Results and Discussion

The laboratory received 1840 and 753 soil samples in 2013 and 2017 respectively for fertility analysis. With the exception of Mg all other elements and pH were very low based on limits for assessing the fertility status of soils according to individual chemical properties outlined in (FSSA 1989). The percentage of samples with optimum amount of P, K, Mg and Ca for plant growth were from 38.7-16.6 % P, 30.6 -12.3% K, 21.1-13.9% Ca and 76.3-72.9% Mg in this period. The percentage of samples with optimum pH was 8.5-3.56% in 2013 and 2017 respectively. Samples with optimal soil fertility were about 56.3 in 2013 and 46.61 % in 2017; these soils were used in research trials and from commercial farmers.

Conclusions

The fertility status of soils of subsistence farmers is the lowest compared to commercial counterparts, these results agree with the findings of Mandiringana et al, 2005.

References

FSSA. (1989) Fertilizer Handbook, 3rd ed.; The Fertilizer Society of South Africa: Hennopthesmeer, South Africa. Agriculture Laboratory Association of Southern Africa, 2004. Soil Handbook O.T. Mandiringana, P.N.S. Mnkeni, Z. Mkile, W van Averbeke, E, Van Ranst & H. Verpalncke (2005) Mineralogy and Fertility Status of Selected Soils of the Eastern Cape Province, South Africa, Communications in Soil Science and Plant Analysis, 36:17-18, 2431-2446, DOI: 10.1080/00103620500253514

EFFECT OF SOIL AND FOLIAR APPLIED NITROGEN TOPDRESSINGS ON GRAIN YIELDS AND QUALITY PARAMETERS OF SPRING WHEAT (TRITICUM AESTIVUM L.)

Presenter: MM Mbangcolo (Mongezi.Mbangcolo@drdar.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MM	Mbangcolo	Dohne ADI, DRDAR, Private Bag X15, Stutterheim, 4930
PJ	Pieterse	University of Stellenbosch, Private Bag X1, Matieland 7602

Introduction

Nitrogen (N) is one of the most important plant nutrients but N use efficiency is low for most cereals. Compared to soil applied N, foliar-applied N is less subject to excessive N losses. In South Africa, reports on use of foliar applied N fertiliser are still limited. The aim of this study was to evaluate the effect of soil and foliar applied N fertiliser topdressings on wheat yield and quality parameters.

Materials and Methods

Response of spring wheat to soil and foliar applied N topdressing was investigated from 2013 to 2015 at Roodebloem (34°22' S, 19°52' E) and Langgewens (33°17' S, 18°40' E) in the Western Cape province, South Africa. A randomized complete block design with 12 treatments replicated three times was used. At planting, LAN (28) was applied at a rate of 30 kg.ha⁻¹. At early tillering stage, N was applied at a rate of 30 and 60 kg ha⁻¹ using granular soil applied (LAN and Urea) and liquid foliar applied (UAN and Urea) applications. At physiological maturity, plant dry mass (PDM) and grain yield (GY) was determined and harvest index (HI) were calculated. The 1000 kernel mass (TKM), hectolitre mass (HLM), grain protein content (GPC), and falling number (FN) were determined following standard procedures. Data was analysed using the Statistica software program (Version 13.2).

Results and Discussion

The effect of N treatment was inconsistent on GY, HLM, TKM, PDM and HI. Topdressing of spring wheat with 60 kg N ha⁻¹ significantly improved GY at Langgewens in 2013. At Roodebloem in 2014, GY was significantly improved when N was applied through foliage at 30 kg ha⁻¹ compared to other treatments. Large seasonal variations were observed both within the locality and between the two localities for the studied parameters. Over seasons, Roodebloem produced significantly higher mean GY (3 090 kg.ha⁻¹) compared to Langgewens (2 084 kg ha⁻¹). However, Langgewens produced the highest mean GY in 2013 due to favourable seasonal rainfall. Quality parameters were not significantly affected by N treatments.

Conclusions

The effect of N fertiliser topdressing treatments was inconsistent on studied parameters. Liquid N, however, performed better than solid N in terms of GY in two (2013 and 2014) of the three study years for both localities. Thus there is a potential to improve grain yield through foliage application of N. A combination of foliar applied N during the season and soil applied N at sowing could be beneficial. Further studies on the topic are recommended.

References

CARBON DIOXIDE AND WATER VAPOUR EXCHANGE OVER RAINFED MAIZE CANOPY

Presenter: N.C. Mbangiwa (nicholas.mbangiwa@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M.G.	Abraha	W.K. Kellogg Biological Station, Michigan State University, Hickory Corners, MI, 49060
M.J.	Savage	Agrometeorology Discipline, Soil-Plant-Atmosphere Continuum Research Unit, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209, South Africa
N.C.	Mbangiwa	Department of Physics, University of Botswana, Private Bag UB 0022, Gaborone, Botswana

Introduction

Carbon and water exchanges between the canopy and the atmosphere are critical to ecosystem net carbon assimilation and water-use characterization, and thereby water-use efficiency (WUE). We assessed CO₂ and H₂O fluxes to determine total carbon sequestration and WUE from maize (*Zea mays* L.) cropping system over a growing season.

Materials and Methods

We measured CO₂ and water vapour exchange using eddy covariance (EC) method from maize cropping system at Baynesfield Estate, South Africa in the 2010/11 growing season. We also measured net radiation (R_n), soil heat flux density (G), soil water content, soil and air temperatures and leaf area index (LAI). Half-hourly net ecosystem carbon exchange (NEE), latent (LE) and sensible (H) heat flux densities were analyzed as a covariance of the vertical wind speed and concentrations of CO₂, H₂O and sonic temperature, respectively. Evapotranspiration (ET) was computed from LE, and WUE was determined as the ratio of NEE to ET.

Results and Discussion

The slope of the turbulent fluxes (LE+H) vs. the available energy (R_n-G), reflecting the energy balance closure, over maize was 91%. Both NEE and ET trends followed those of solar irradiance, air temperature and vapour pressure deficit, and LAI (0–4.46 m² m⁻²) during the growing season. NEE and ET peaked in mid-season, with low carbon and water uptake early and late in growing season when plants did not fully cover the ground and when plants senesced, respectively. The total NEE absorbed and ET (water used) during the growing season were 680 g C m⁻² and 391 mm, respectively, with a WUE of 1.74 g C kg⁻¹ H₂O.

Conclusions

NEE, LE and H fluxes were mainly driven by weather variables. These results could help constrain carbon sequestration and total evaporation from maize cropping systems which in turn could help in modelling crop growth and development for strategic and tactical resource management in sub-tropical climates. Flux measurements should also be conducted during the non-growing season to better understand the impacts of cropping systems on carbon and water cycles and the climate.

References

QUANTIFYING THE SOIL ALTERATION RESPONSE FOLLOWING IRRIGATION WITH DILUTED WINERY WASTEWATER IN SOILS OF DISSIMILAR TYPES

Presenter: A.H. Meyer (meyera@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A.H.	Meyer	ARC Infruitec-Nietvoorbij, Private Bag X5026, Stellenbosch 7599, South Africa.
I.	Van Huyssteen	ARC Infruitec-Nietvoorbij, Private Bag X5026, Stellenbosch 7599, South Africa.
R.	Mulidzi	ARC Infruitec-Nietvoorbij, Private Bag X5026, Stellenbosch 7599, South Africa.

Introduction

The need to re-use treated winery wastewater for vineyard irrigation may be increasing due the severe water scarcity in the Western Cape. Sustainable water management, nevertheless, requires striking a balance between water use and the environment. Research is required to ensure irrigation with winery wastewater does not compromise soil fertility and sustainability. Furthermore, it is uncertain whether or not vineyard soils of dissimilar types may respond differently to wastewater irrigation, what the soil alteration response would be after multiple irrigation cycles, or what the effect on the soil may be with increasing soil depth. To obtain clarification, a pot trial was conducted to determine the soil alteration response after multiple irrigation cycles with diluted winery wastewater, and of irrigating with good quality (municipal) water, on differently textured vineyard soils, using an enzyme-based soil alteration index (AI3).

Materials and Methods

Soils originating from four vineyard areas were irrigated, in pots, over four simulated seasons with municipal water, and with winery wastewater diluted to a chemical oxygen demand of 3000 ml/L. The soils were: alluvial sand, aeolian sand, as well as shale and granite derived soils. Pot soil samples were taken from the 0-10cm and 10-20cm layers after each season. AI3 indices were generated using the formula by Puglisi et al. (2006). The pot trial followed a statistical design.

Results and Discussion

Soil enzyme activity was stimulated in treatments where wastewater was used for irrigation compared with irrigation with municipal water, possibly due to the supply of easily decomposable organic material in wastewater, through a priming effect. Differently textured soils responded differently to winery wastewater irrigation in accordance with their clay and organic matter contents. The AI3 also accurately reflected gradients in mineralizable substrates, with the top layer being consistently more fertile than the subsoil layer. The AI3 scores differed from season 3 to 4 implying that the soils had undergone an alteration due a temporal effect.

Conclusions

Vineyards may benefit from winery wastewater as an alternative source of water for irrigation. Winery wastewater inputs provide the added advantage of enhancing soil microbial enzyme activity and improves soil fertility, the extent of which may differ depending on the soil texture and on the irrigation cycles.

References

Puglisi E, Del Re AAM, Rao MA, Gianfreda L. 2006. Development and validation of numerical indices integrating enzyme activities of soils. *Soil Biology and Biochemistry* 38: 1673-1681.

Human urine and its derived products as fertilizers for crop production

Presenter: S Migeri (proudlymigeri@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S	Migeri	University of KwaZulu Natal Private Bag X 01 Scottsville 3209
A.O	Odindo	University of KwaZulu Natal Private Bag X 01 Scottsville 3209

Introduction

Poor and degraded soils limit agricultural productivity among many smallholder farmers in sub-Saharan Africa. The use of human-excreta derived products as potentially new fertilizer sources is being considered as a viable option to supply nutrients to farmers' fields. This study sought to understand the effect of using human urine derived fertilizers such as struvite, stored urine and nitrified urine concentrate (NUC) on soils, crop growth and biomass production.

Materials and Methods

A field study was carried out in Durban to investigate the response of maize (*Zea mays*) to the application of urine derived products as fertilizers. The trial was designed as a 5x3 factorial experiment with the following factors: Fertilizers - 5 levels (positive control, negative control, NUC x struvite, NUC and stored urine) and planting time - 3 levels (planting 1, planting 2 and planting 3), laid out using a Randomized Complete Block Design and replicated four times to give 20 experimental units (3 x 1m plots). Data collected was subjected to analysis of variance using GenStat (Version 18, VSN International, UK) and treatment means compared at 5% level of significance.

Results and Discussion

Significant differences ($P < 0.001$) were observed between the treatments with respect to plant height at all plantings. The negative control had the highest plant height (70.2 cm) while the lowest was observed in the stored urine (46.3cm) at planting 1. Highest plant height was obtained in the positive control at planting 2 (85.1cm) and the lowest in the stored urine treatment (61.7cm). At planting 3 NUC x struvite had the highest plant height (88.2cm) while the lowest plant height was observed in the stored urine (46.3 cm). Dry mass obtained at the three plantings differed significantly ($P < 0.001$) with 6.09t ha⁻¹ attained at planting 1, 4.82t ha⁻¹ at planting 2 and 3.32t ha⁻¹ at planting 3. A significant difference between treatments in terms of dry mass was observed, with 6.02t ha⁻¹, 4.93t ha⁻¹, 4.88t ha⁻¹, 4.59t ha⁻¹ and 3.3t ha⁻¹ in the positive control, NUC, NUC x struvite, negative control and stored urine treatments respectively. Initially the chemical commercial fertilizers outperformed the urine based fertilizers but with time the urine based fertilizers were comparable to the chemical commercial fertilizers with respect to maize biomass production.

Conclusions

Human urine derived products are a viable source of nutrients for crop production, however, research is required on fate of undesired products (pharmaceuticals, antibiotics and sodium chloride) in these products.

References

Heisey PW, Mwangi WM.1996 "Fertilizer use and maize production in sub-Saharan Africa."

TRANSLATING SOIL TYPE INTO MILLIONS: A SWEET SUCCESS STORY IN A RURAL SUGARCANE COMMUNITY IN SOUTH AFRICA

Presenter: FJ Mitchell (felicity.mitchell@kzndard.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
FJ	Mitchell	KZN Department of Agriculture and Rural Development, P/Bag X9059, Pietermaritzburg, 3200 , South Africa
WA	Gillespie	South African Sugarcane Research Institute, P/Bag X02, Mount Edgecombe, 4300

Introduction

A rural District in the KwaZulu-Natal Midlands, home to a number of struggling communities, was introduced to an innovative approach to soil management, crop production, business and agrarian skills in 2006. Using a demonstration plot, soil classification was used as the starting point on which to base all other production decisions, including variety choice, production of seedcane, farmer training and improved income.

Materials and Methods

The methodology follows a 9 point progression through the agronomic cycle, primarily focussing on (1) soil potential assessment in fields used for establishing and operating demonstration plots (Gillespie et. al. 2009) (2) transferring technologies developed according to best management sugarcane farming practices and (3) establishing and maintaining biosecurity awareness about pests, diseases and weeds (Cockburn et. al. 2014) to sustain yield and related socio-economic stability in the long term. Yield, area under sugarcane, income, disease incidence, adoption of technologies and production options were monitored and evaluated over the ten year period, as a measure of the effectiveness of the demonstration plot methodology.

Results and Discussion

Each soil type had a modelled yield potential per varieties, and these yields were exceeded both in the demonstration plots, as well as by outgrowers in the area. Local growers had never classified their soils prior to this project. Grower numbers have more than doubled and deliveries to the mill have tripled. The area under sugarcane has increased to more than 600 hectares and income exceeded R30.79 million in 2017. In addition, the new growers are part of the regulated biosecurity scheme of the industry and disease incidence is almost zero. Highly technical scientific research results have been translated into appropriate technologies for small-scale use and a continuous training methodology throughout the agronomic cycle has ensured their adoption. This project methodology has been documented in an international publication (Gillespie and Mitchell, 2014) and has been adopted as the sugarcane industry norm.

Conclusions

The KZN Midlands small scale growers have attained commercial yields and met international standards for production. Knowledge of soil type and its translation into income has been clearly demonstrated since this program has led to a multi-million rand industry for these communities. The 10 year journey to establish a methodology for successful and sustainable small scale sugarcane projects in South Africa, has been achieved.

References

Cockburn, J.J; Coetzee, H.C, Van Dev Berg, J, Conlong, D.E & Witthoft, J., 2014. Exploring the role of sugarcane in small-scale farmers livelihoods in the Noodsberg area, KwaZulu-Natal, South Africa. South African Journal of Agricultural Extension. Vol 42: 80-97. Gillespie WA and Mitchell FJ. (2014). Manual for the Successful Implementation of Small-Scale Grower Projects. SASRI Publication. ISBN 1-874903-39-5. South Africa Gillespie, WA, Mitchell, FJ, Way, M and Webster, T. 2009. Demonstration plots double as seedcane nurseries for small-scale growers in the Noodsberg area. Proc S Afr Sug Technol Ass 86. Poster communication, Durban South Africa

Genetic Diversity Of Selected Drought Tolerant Wheat Genotypes Assessed Through Simple Sequence Repeat Markers

Presenter: S.S Mkhabela (slindilentekeati@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S.S	Mkhabela	University of KwaZulu Natal
H.A	Shimelis	University of KwaZulu Natal
A.O	Odindo	University of KwaZulu Natal

Introduction

Genotypes that are able to produce high yield under a wide range of environmental conditions are highly preferred by growers. Knowledge of the genetic diversity and relationship of genetic resources is fundamental in genetic improvement and conservation programs. Developing drought-tolerant crops is one of the major objectives in plant breeding programs. Genetic diversity and population structure studies are prerequisites to optimize and conserve germplasm for breeding and cultivar development. Genetic enhancement of wheat and other crops is dependent on the availability of superior and diverse genes, which helps in cultivar development

Materials and Methods

Fifteen wheat genotypes were selected from CIMMYT for evaluation based on their differential response to drought stress. Seeds of the tested wheat genotypes were planted in 5L plastic pots at the Controlled Environmental Facility (CEF), University of KwaZulu Natal, Pietermaritzburg, South Africa. The leaf samples were sent to INCOTEC PROTEIOS Laboratory (Incotech South Africa Pty Ltd, Mkondeni, Pietermaritzburg, South Africa) for SSR analysis. DNA extraction was done following the CTAB (mixed alkyltrimethyl ammonium bromide) method (DNA extraction buffer). The concentration of the extracted DNA was determined using 0.7% Tris-borate ethylene diamine-tracetic acid agarose gel. Extracted DNA was standardized using a working concentration of 10 ng- μ L⁻¹. The samples were bulked and used in SSR amplification.

Results and Discussion

Fifteen wheat genotypes were genotyped using 10 selected SSR markers. The number of alleles identified ranged from 3 to 11, with a total of 59 putative alleles being amplified. Number of effective alleles (N_e) varied from 2.32 to 8.49, with a mean value of 4.24. Expected heterozygosity (H_e) values varied from 0.59 to 0.91, with a mean value of 0.75. The mean polymorphic information content (PIC) ranged from 0.57 to 0.72, with a mean value of 0.72 suggesting that the studied markers were highly informative. Jaccard's coefficient of similarity classified the wheat genotypes into three major clusters according to their desirable morphological traits. Analysis of molecular variance (AMOVA) indicated that 75%, 25% and 0% of the variation among wheat genotypes was attributable to within genotypes, among genotypes and between populations, respectively

Conclusions

In conclusion, the tested primers all showed high level of polymorphism and regarded as highly informative. The study selected genetically unique accessions including SM19, SM97, SM15 and SM45 belonging to cluster I. SM04 from cluster II and SM32 and SM29 from cluster III based on SSR data and desirable morphological traits. The selected wheat genotypes can be used in drought tolerance breeding programs.

References

EFFECTS OF FRUIT MATURITY STAGE AND TIME OF SOAKING ON SEED GERMINATION AND CROP ESTABLISHMENT OF HORNED MELON (*CUCUMIS METULIFERUS* E. MEY. EX. SCHRAD).

Presenter: N Mlambo (muzirit@staff.msu.ac.zw)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N	Mlambo	Department of Horticulture, Midlands State University, Bag 9055, Gweru, Zimbabwe
FN	Mudau	Department of Agriculture, Animal Health and Human Ecology, College of Agriculture and Environmental Sciences, University of South Africa, Private Bag X6 Johannesburg, Florida, South Africa.
T	Madanzi	Department of Agronomy, Midlands State University, Bag 9055, Gweru, Zimbabwe
I	Chagonda	Department of Agronomy, Midlands State University, Bag 9055, Gweru, Zimbabwe
M	Takawira	Department of Horticulture, Midlands State University, Bag 9055, Gweru, Zimbabwe
T	Muziri	Department of Horticulture, Midlands State University, Bag 9055, Gweru, Zimbabwe

Introduction

Consumption of wild fruit has grown in Zimbabwe in the past decade owing to unreliable weather and poor crop yields. Horned melon (*Cucumis metuliferus*) is one of the fruit whose consumption has been on the rise, mostly from wild collections. Very little information is available on its cultivation.

Materials and Methods

Laboratory germination and greenhouse trials were carried out to establish the effects of different fruit maturity stages on seed germination and crop establishment. The germination of seed extracted from the mature green (MG), break colour (B) and fully ripe (FR) maturity stages of horned melon were compared in a laboratory experiment. The experiment was arranged as a randomised complete block design with four replicates of 100 seed in each petri dish. The seed were placed in the incubator at 24°C and germination was monitored over a period of 14 days. Further, seed from the break colour (B) and fully ripe (FR) stages were compared in the greenhouse pot experiment.

Results and Discussion

Results from the laboratory experiment showed that seed from fully ripe fruit had the highest germination percentage, with germination occurring in a short period of time, comparable with that from the break stage. Soaking seed for four (4) days was found to be sufficient for uniform seed germination and establishment. Although soaking improved germination, the overall germination of horned melon seed is low compared to other crops, necessitating further studies on improving germination of the crop for sustainable production. Soil type had no effect on germination and emergence of horned melon. No differences in terms of plant vigour and crop establishment were observed between seed extracted from the break colour maturity stage and the fully ripe (yellow) stage in the greenhouse trials

Conclusions

The study managed to produce for the first time, information on seed germination and establishment of horned melon. Generally, horned melon seed has a low germination percentage. Further studies need to be done to improve seed germination of horned melon

References

USE OF LOCAL LANGUAGE WORDS IN A SEASONAL CLIMATE FORECAST ... SEPEDI

Presenter: MO Mmotong Obed (Phahlane@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MO	Phahlane	Agricultural Research Council - Institute for Soil, Climate and Water, Private Bag X 79, Pretoria, 0001
S	Walker	Agricultural Research Council - Institute for Soil, Climate and Water, Private Bag X 79, Pretoria, 0001
P	Maluleke	Agricultural Research Council - Institute for Soil, Climate and Water, Private Bag X 79, Pretoria, 0001

Introduction

In shaping the future development agenda for South African subsistence farming, it is important to acknowledge that for the country to meet its development challenges, especially the eradication of food scarcity. It is therefore essential to integrate indigenous languages in contemporary seasonal climate forecasting. Knowledge about the use of local words describing seasonal rainfall period and intensity is shared by word of mouth from one generation to another. However, many of the bearers of such knowledge are from the older generation who find it difficult to communicate their beliefs and practices to the scientifically educated younger generation. Therefore, there is a need to investigate how IK systems can be integrated into agricultural activities in order to minimise losses associated with extremes of climate and weather.

Materials and Methods

Farmer's information days in five districts of Limpopo province were organised during June and July 2017. A questionnaire was used to collect information about current preferred language to communicate seasonal climate information. Language as a means of weather climate information communication was classified according to first, second and third choice preference. Understanding of meteorological words such as "normal rainfall" was evaluated using Community-Based Participatory Research (CBPR) methods outlined by Minkler and Wallerstein (2003).

Results and Discussion

Questionnaires show that approximately 70% of smallholder farmers prefer to receive seasonal climate information in their local Sepedi language. In farmers information meetings smallholders participants indicated that they would use the seasonal climate forecast if it included local phrases like "Kgogolamooko". The inclusion of such phrases would be helpful in the application of seasonal climate forecast. More than 60% of farmers requested to receive a more specific forecast related to their agricultural activities. A platform like local radio and a cell phone app to present this information was indicated as an important issue to improve the use of seasonal climate information.

Conclusions

In order to communicate climate forecasts effectively so that value is derived from such information, basic training in the form of stakeholder interaction programmes is recommended. The results of the research could be useful in improving seasonal climate forecast information dissemination and thus improving food security activities and programmes.

References

Minkler, M. and Wallerstein, N., 2003. Community-based participatory research for health. San Francisco, CA: Jossey-Bass/Wiley.

Quality assessment of bush tea (*Athrixia phylicoides* DC.) subjected to different pruning levels

Presenter: K.C Mohale (mohalkc@unisa.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
K.C	Mohale	University of South Africa, Department of Agriculture and Animal Health, Private Bag X6, Florida, 1710, South Africa
A.T	Hintsa	ARC-Roodeplaat, Vegetable and Ornamental Plant Institute, Private Bag X293, Pretoria, 0001, South Africa
F.N	Mudau	University of South Africa, Department of Agriculture and Animal Health, Private Bag X6, Florida, 1710, South Africa

Introduction

Bush tea (*Athrixia phylicoides* DC.) is a South African indigenous herbal tea rich in secondary metabolites which have therapeutic effects and has been used for many decades (Padayachee, 2011). Although several studies have investigated bush tea phytochemicals, there is a lack of literature on the effect of pruning on accumulation of metabolites in bush tea. The aim of the study was to profile metabolites for quality assessment of bush tea subjected to different pruning levels.

Materials and Methods

The trial was conducted at the Agricultural Research Council Vegetable and Ornamental Plant Institute situated about 25 km north of central Pretoria on the Moloto/KwaMhlanga Road (R573), GPS coordinates 25° 59" S; 28° 35" E. The treatments include; no pruning or control, top-branch pruning, middle pruning and basal pruning, and 10 single trees (replicates) arranged in a randomized complete block design were sampled. Bush tea samples were analyzed using ¹H NMR and LC-QTOF-MS spectrometer and the multivariate data analyzed using principal component analysis, and the orthogonal partial least square performed using SIMCA-P and MetaboAnalyst.

Results and Discussion

The supervised comparison of bush tea pruned at different levels revealed distinct groupings among treatments. The dendrogram demonstrated two main clusters with the first group represented by basal and unpruned treatments that was dominated by 80% basal and 50% unpruned, with top pruning grouping (40%) with both basal and control, and 10% middle pruned. In the second cluster, there were four main sub-clusters with middle pruned dominating (60%), while the unpruned treatment was 50%. However, the top pruned bush tea samples grouped together in the fourth sub-cluster denoting a large proportion of chemical compositions. According to the variable importance on projection, the different pruning levels significantly affected accumulation of secondary metabolites. Metabolites accumulate more when plants are subjected to stresses for adaptation (Akula and Ravishankar, 2011). In this study, different pruning heights significantly enhanced of accumulation of secondary metabolites which are not only important in plant stress physiology for adaptation but also quality indicators of herbal teas.

Conclusions

The study successfully demonstrated that pruning bush tea plants has a significant effect on accumulation of metabolites and thus could enhance bush tea quality. Top pruning (apically-pruned) resulted in improved metabolites more so than the control (no pruning) and can be recommended in bush tea cultivation.

References

Akula, R. and Ravishankar, G.A. 2011. Influence of Abiotic Stress Signals on Secondary Metabolites in Plants. *Plant Signaling & Behavior*, 6, 1720-1731. Padayachee, K. 2011. The phytochemistry and biological activities of *Athrixia phylicoides*. MSc Dissertation. University of Witwatersrand, Johannesburg, South Africa.

Illumina sequencing and characterization of methylated regions in the cactus pear (*Opuntia ficus-indica*) genome

Presenter: K Mokgakala (kgothatsomokgakala@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
K.	Mokgakala	Department of Genetics, University of the Free State, Bloemfontein, 9301; Department of Soil, Crop and Climate Sciences, University of the Free State, Bloemfontein, 9301
A.	Allen	Department of Genetics, University of the Free State, Bloemfontein, 9301; Department of Soil, Crop and Climate Sciences, University of the Free State, Bloemfontein, 9301
M.F.	Maleka	Department of Genetics, University of the Free State, Bloemfontein, 9301
G.M.	Coetzer	Department of Soil, Crop and Climate Sciences, University of the Free State, Bloemfontein, 9301

Introduction

Cactus pear, *Opuntia ficus-indica*, is a drought tolerant plant that typically occurs in arid and semi-arid environments due to its ability to undergo CAM metabolism (Nobel, 1994). Thus, it can aid food production in such areas. Generally, cactus pear is propagated asexually as the benefits of this form of growth surpasses those of sexual reproduction. Inherently, asexual propagation results in clonal variation, which, in turn, has been linked to DNA methylation (Miguel & Marum, 2011). In line with this hypothesis, we first aimed to determine the levels of DNA methylation among cultivars of *O. ficus-indica* that demonstrate morphological diversity regarding weight and numbers of cladodes and fruit. Second, to identify and characterize genetic loci underlying methylated regions through sequence homology analysis at various bioinformatic databases. To better elucidate clonal variation and DNA methylation in *O. ficus-indica*, future studies will aim to profile the expression of methylation-related genes in different tissues and cultivars of the species.

Materials and Methods

Altogether, six *O. ficus-indica* cultivars – including Algerian, Berg x Mexican, Directeur, Ficus-indica, Malta and R1251 – were selected and one-year old cladodes harvested from the UFS Waterkloof orchard (29°1'S and 26°3'E). After DNA extraction, all samples were subjected to bisulphite treatment (except for Directeur) and sequenced on the Illumina HiSeq2500 platform. Raw sequence reads from each cultivar were quality filtered and mapped against a collection of reference scaffolds derived from Directeur. Methylated DNA regions were documented and identified by searching against the NCBI NR database using BLAST algorithms.

Results and Discussion

In all, we generated more than 200 million raw sequence reads from the six cultivars. But then, the cultivar Algerian was excluded from further analysis due to abundance of low quality reads. For Directeur, sequence assembly yielded over 680,000 scaffolds, ranging from 56 – 45,620 bp (mean length = 1,042 bp; N50 = 2,500 bp). Efficiency of read mapping against the reference scaffolds ranged from 73.9 – 77.5%. Interestingly, relative to a cultivar with average yield of cladodes and fruit (Berg x Mexican), high yield accessions from all cultivars contained more methylated C's than low yield accessions. Currently, methylated genomic regions are still being identified and characterized.

Conclusions

Our study is the first to report on sequencing of the cactus pear genome as well as the extent of methylation therein. Further, it appears that genomic methylation may be linked to cladode and fruit yield in different accessions of *O. ficus-indica*.

References

Miguel, C. and Marum, L. 2011. An epigenetic view of plant cells cultured in vitro: Somaclonal variation and beyond. *Journal of Experimental Botany* 62 (11), 3713 – 3725. Nobel, P.S. 1994. Remarkable agaves and cacti. Oxford University Press, New York, 166pp.

NEMAFRIC-BL PHYTOPESTICIDE AS ALTERNATIVE TO SYNTHETIC INSECTICIDE IN THE MANAGEMENT OF PSEUDOCOCCUS CITRI ON MIMUSOPS ZEYHERI

Presenter: F Mokhoelele (selbby777m@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
F	Mokhoelele	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa
Z.P	Dube	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa
P.W	Mashela	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa
T.P	Mafeo	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa

Introduction

Nemafric-BL phytonematicide containing cucurbitacin B produced from *Cucumis africanus* has been tested and found to be very effective under a wide range of *Meloidogyne* species at the University of Limpopo (Mashela et al. 2015). Its efficacy in the management of other pests and plant pathogens have never been established. The objective of this study was to determine the efficacy of Nemafric-BL phytopesticide in the management of mealybugs.

Materials and Methods

Treatment, namely, 3, 6, 9, 12, 15, 18, 21, 24 and 27 % Nemafric-BL phytopesticide were laid out in completely randomized design with six replications. Fresh *M. zeyheri* leaves were dipped in respect phytopesticide concentrations before placing them upside down in 9-cm diameter petri dish containing a moistened filter paper. Ten *P. citri* nymphs of the same size were then placed on each leaf and incubated at $25 \pm 2^{\circ}\text{C}$. Phytopesticide repellence and mortality were recorded at 12 and 48 h after incubation, respectively.

Results and Discussion

Pseudococcus citri mortality increased with increasing concentrations of Nemafric-BL phytopesticide. Prishanthini et al. (2009) also reported high mortality rate of *P. selenopsis* when exposed to other botanicals in vitro. At 48 hours, Nemafric-BL phytopesticide caused mortalities of between 20 and 84%.

Conclusions

Nemafric-BL phytopesticide was able to reduce the viability of *P. citri* hence it has potential for use as alternative to synthetic chemical insecticides

References

Prishanthini M, Vinobaba M. 2009. First record of new exotic Mealybug species, *Phenacoccus solenopsis* Tinsle, its Host range and abundance in the Eastern Sri Lanka. *Journal of Science* 6:88-100. Mashela PW, Dube ZP, Pofu KM. 2015. Managing the Phytotoxicity and Inconsistent Nematode Suppression in Soil Amended with Phytonematicides. In: Meghvansi, M.K. and A. Vorms (eds.). *Organic Biology*, vol.46. Heidelberg, Switzerland: Springer International Publishers.

RESPONSE OF TOMATO PLANT GROWTH TO DRIED CRUDE EXTRACTS OF *KLEINIA LONGIFLORA*

Presenter: MG Moremi (makgokamoremi@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MG	Moremi	University of Limpopo, Private Bag X 1106, Sovenga, 0727, South Africa
KG	Shadung	University of Limpopo, Private Bag X 1106, Sovenga, 0727, South Africa
PW	Mashela	University of Limpopo, Private Bag X 1106, Sovenga, 0727, South Africa

Introduction

Following the withdrawal of synthetic nematicides in the agrochemical market, the use of botanicals as effective alternative control to chemicals for plant nematode suppression has become crucial in the last decades in agricultural system (Agbenin 2011). Phytonematicides have been reported to be relatively low in terms of cost, ease of use and effectiveness. Therefore, crude extracts have potential of being used as phytonematicide, thereby the objective of this study was to determine whether crude extracts of *K. longiflora* will be phytotoxic to tomato plants when used as a phytonematicide.

Materials and Methods

The study was conducted at Green Biotechnologies Research Centre. A field study was initiated with seven treatments namely, 0, 2, 4, 6, 8, 10 and 12 g of granular formulation of *K. longiflora* arranged in randomised complete block design (RCBD) with 12 replications. Herbaceous material from *K. longiflora* was harvested, chopped and dried in air-forced oven. Uniform tomato seedlings cultivar 'Floradade' three weeks' old were transplanted. Tomato plants were planted at 60 cm for both inter-row and intra-row spacing. At 56 days after transplanting, data were collected on plant height, stem diameters and chlorophyll. Data were subjected to analysis of variance using Statistix 10.0 at 5% level of probability.

Results and Discussion

The data generated in this study shows that the crude extract of *K. longiflora* had significant ($P \leq 0.05$) on plant height, chlorophyll and highly significant ($P \leq 0.01$) on dry shoot and root mass. Plant height, chlorophyll, dry shoot mass and dry root mass contributed 55, 45, 71 and 72%, respectively on total treatment variation. This study demonstrates the phytotoxic activity of *K. longiflora* on plant height, chlorophyll, dry shoot mass and dry root mass. The sensitivity of the tomato plants toward crude extracts of *K. longiflora* compounds showed similar trends in all treatments. However, these results are in agreement with Pelinganga (2013) that phytonematicides at high concentration may be phytotoxic to the protected crop against target nematodes.

Conclusions

Dried crude extracts of *K. longiflora* had phytotoxic effects on growth of tomato plant and therefore, appears to be not applicable for use in plant protection.

References

Agbenin, N.O. 2011. Biological control of plant parasitic nematodes: prospects and challenges for the poor Africa farmer. *Plant Protection Science* 47: 62-67. Pelinganga, O.M. 2013. Developing phytonematicides using indigenous *Cucumis africanus* and *Cucumis myriocarpus* fruits for tomato production systems. PhD Thesis, University of Limpopo, Sovenga, South Africa.

Impact of insect host-background on virulence of *Beauveria bassiana* (Hypocreales: Cordycipitaceae) to Russian wheat aphid

Presenter: LF Motholo (MotholoL@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
LF	Motholo	Unit for Environmental Sciences, North-West University, Potchefstroom Campus
LF	Motholo	Agricultural Research Council – Small Grains, Bethlehem
N	Thiebaut	Agricultural Research Council – Biometry Department, Pretoria, South Africa
M	Booyse	3Agricultural Research Council – Biometry Department, Stellenbosch, South Africa
JL	Hatting	Agricultural Research Council – Small Grains, Bethlehem
TJ	Tsilo	Agricultural Research Council – Small Grains, Bethlehem
OMM	Thekiso	Unit for Environmental Sciences, North-West University, Potchefstroom Campus

Introduction

The Russian wheat aphid (RWA), *Diuraphis noxia* Kurdjumov (Hemiptera: Aphididae), is the most important aphid pest of bread wheat, *Triticum aestivum* L. (Poaceae) in South Africa. Although host plant resistance is now a key control strategy against RWA, the development of resistance-breaking aphid biotypes is a serious concern. The possibility of virulence-enhancement, through passage of an entomopathogenic fungus (EPF) through different insect hosts, was investigated as part of an IPM strategy being developed against RWA.

Materials and Methods

The EPF *Beauveria bassiana* (Balsamo) Vuillemin (Cordycipitaceae), was used in this study, with two strains, PPRI 7598 and PPRI 7861, pre-screened for pathogenicity against the two insect hosts, wax moth, *Galleria mellonella* (Lepidoptera: Pyralidae) and *D. noxia* under laboratory conditions. Strains re-isolated from the two insect hosts were designated as “GM” and “DN” backgrounds, respectively, and tested for pathogenicity against *D. noxia* under glasshouse conditions. Comparative assays were conducted with three treatments, i.e (1) 1×10^8 (High), (2) 5×10^7 (Low) conidia/ml per background and (3) 0.5 mL/L of Aphox (insecticide) and control. Controls were sprayed with 5ml aliquots of sterile water amended with 0.01% Break-Thru® surfactant. Assays were performed with 100 aphids per treatment (20 aphids per replicate x 5) using a Burgerjon precision spray tower. Each replicate batch of inoculated aphids was released and maintained on *T. aestivum* and incubated in the glasshouse at 25 ± 2 °C, 40 ± 5 % RH and 12:12 L:D for 7 days post-inoculation. Mortality was recorded daily for the duration of the assay and all dead aphids were placed on 1.5% water agar and incubated at 22 ± 3 °C to facilitate the development of overt mycosis.

Results and Discussion

Cumulative mortalities were 56% and 53% (PPRI 7598H), 40% and 37% (PPRI 7598L), 43% and 44% (PPRI 7861H), and 28% and 33% (PPRI 7861L) for DN and GM backgrounds, respectively. Increasing conidial concentrations affected mortality of aphids significantly ($P < 0.0001$). Percentage overt mycosis from the two backgrounds was 62% and 61% (PPRI 7598H), 52% and 50% (PPRI 7598L) 52% and 52% (PPRI 7861H) and 48% and 44% (PPRI 7861L) for DN and GM backgrounds, respectively.

Conclusions

Mortality of infected aphids with *B. bassiana* isolates increased with increasing conidial concentration and exposure time, but host background did not significantly affect aphid mortality

References

NODULATION OF TROPICAL GRAIN LEGUMES BY BACTERIAL SYMBIONTS FROM THE CAPE FYNBOS, SOUTH AFRICA

Presenter: T Mpai (tiisetsompai@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T	Mpai	Department of Crop Sciences, Tshwane University of Technology, Pretoria 0001, South Africa
SK	Jaiswal	Department of Chemistry, Tshwane University of Technology, Pretoria 0001, South Africa
FD	Dakora	Department of Chemistry, Tshwane University of Technology, Pretoria 0001, South Africa

Introduction

In Africa, a major challenge faced by grain legume small scale farmers is low yield. This affects the food security and consequently human health. The aim of this study is to test inoculation ability on selected grain legumes by trapping rhizobia nodulating *Polhillia*, *Wiborgia* and *Wiborgiella* species endemic to the Cape fynbos with the ultimate goal of bio-prospecting for bacterial symbionts that can serve as inoculants for improving food grain legume production in Africa.

Materials and Methods

In the glasshouse, three genotypes of cowpea and Bambara groundnuts were planted in pots containing sterile sand. Three days after emergence, the plants were inoculated with rhizosphere soil suspension from *Polhillia brevicalyx*, *Wiborgia obcordata* and *Wiborgiella sessilifolia*. Each treatment was replicated three times. The seedlings were supplied with N-free solution as a source of nutrients (Somasegaran & Hoben, 1985). Sixty days after inoculation plants were harvested and root nodules removed from the roots. Isolation of root nodule rhizobial strains was done under the laminar flow following standard procedures (Vincent, 1970). Amplification of the 16S rDNA, symbiotic and housekeeping genes is in progress.

Results and Discussion

Only Cowpea plants inoculated with soil suspension from Clanwilliam as well as Bambara groundnuts inoculated with soil suspension from Clanwilliam and Uitvlucht farm 1 formed effective root nodules. No nodules were observed on plants inoculated with soil suspension from the other locations. Studies of their single colony isolates showed different phenotypic characteristics. Although all isolates were ≤ 1 mm in diameter, they took between three and six days for colony to appear on YMA plates. All isolates turned BTB yellow except for two cowpea isolates which turned it blue after 14 days of incubation at 28 °C. The general shape of the isolate was round and flat. The rhizobial isolates studied consisted of a mixture of fast and some intermediate growers that differed in shape, appearance and size. Cowpea isolates generally showed an intermediate growth habit (between four and six days) while colonies of Bambara groundnuts isolates could be visualized on YMA within three and four days which qualifies as fast growers. Their alkali producing ability on BTB media may speculate that they belong to *Mesorhizobium* and/or *Rhizobia* spp.

Conclusions

Preliminary results show that rhizobia present at different locations of the cape fynbos is able to form effective nodulation on cowpea and Bambara groundnuts. Assessment of the diversity and phylogenetic positioning of isolates obtained from root nodules of studied grain legumes is currently in progress.

References

cis- and trans-Thujone compounds found in African wormwood (*Artemisia afra*) in different agro-climatic zones of the Eastern Cape, South Africa

Presenter: B Mpambani (Babalwa.Ntwana@drdar.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
B	Mpambani	Dohne Agricultural Development Institute, Private Bag X15, Stutterheim, 4930
B. K.	Eiasu	Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare, Private Bag X1314, Alice, 5700
M. A. T.	Poswal	Dohne Agricultural Development Institute, Private Bag X15, Stutterheim, 4930

Introduction

Main components of *Artemisia afra* essential oil vary extremely in plants collected from different geographical regions. Variations within the natural habitats were found when individual *A. afra* samples were collected from four regions in Southern Africa (Viljoen et al., 2006). α - and β -thujone (toxic compounds) were found to be the major constituents of Zimbabwean *A. afra* oil. In South Africa, only α -thujone (54.2%) was found to be the major constituent (Libbey and Sturts, 1989).

Materials and Methods

A study was conducted to determine cis and trans-Thujone levels in *A. afra* essential oils, collected from eight agro-climatic zones of the Eastern Cape Province. Essential oils were extracted from fresh shoots, using steam distillation to determine oil yield. Gas chromatography (GC), with mass spectrometry, was used for the separation of the chemical components of the essential oils. For quantification of the oil components, a flame ionization detector (FID) was used. The GC temperature was set to an initial temperature of 60 °C, and was increased at a temperature ramp of 3 °C/minute to 245 °C. Oil component identification was done using the National Institute of Standards and Technology (NIST) mass spectra library and confirmed by retention index, using the extensive essential oil identification dictionary of Adams (2007). Cross referencing with other oils containing the same compounds was done for confirmation. Data were subjected to analysis of variance using Statistica 11.

Results and Discussion

Significantly higher cis-thujone were found in samples from Sterkspruit (60.28%) and Indwe (51.42%) localities, while samples from Barkley East recorded a significantly lower cis-thujone of 2.12%. There were no significant differences between Ngqeleni (13.38%) and Centane (16.27%) samples for cis-thujone. A similar trend was also observed with trans-thujone, where the highest levels were obtained from Indwe (13.06%) and Sterkspruit (13.05%) samples. The levels of both cis-and trans-thujone were lower than α - and β -thujone (78.68 and 13.13%, respectively) compared to that recorded by Mangena and Muyima (1999).

Conclusions

Although cis- and trans-thujone have been reported as a major constituents of *A. afra* in South Africa, this study revealed that some locations have lower levels of this toxic constituent. Future studies should be conducted to determine the causes of high levels of thujone, which may be related to the chemotypic variations.

References

Adams, R.P., 2007. Identification of essential oil components by Gas Chromatography / Mass Spectrometry, 4th edition. Allure Publishing Corporation, Illinois, USA. Libbey LM and Sturtz G, 1989. Unusual essential oils grown in Oregon. I. *Artemisia afra* Jacq. Journal of Essential Oil Research, 1: 29-31. Mangena, T. & Muyima, N.Y.O., 1999. Comparative evaluation of the antimicrobial activities of essential oils of *Artemisia afra*, *Pteronia incana* and *Rosmarinus officinalis* on selected bacteria and yeast strains. Applied microbiology, 28 (4), 245 - 333. Viljoen AM, van Vuuren SF, Gwebu T, Demirce B, Baser K and Husnu C, 2006. The geographical variation and antimicrobial activity of African wormwood (*Artemisia afra* Jacq.) essential oil. Journal of essential oil Research 18: 19-25.

AGGRESSIVENESS OF ALTERNARIA SOLANI ISOLATES ON TWO SUSCEPTIBLE TOMATO CULTIVARS

Presenter: GH MPHAHLELE (gh.mphahlele@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
GH	MPHAHLELE	Bertie van Zyl (Edms) Bpk (ZZ2)
MA	KENA	University of Limpopo, Department of Plant Production, Soil Science and Agricultural Engineering

Introduction

Alternaria solani is one of the most aggressive pathogen of tomato causing serious yield losses. The control of early blight disease is mainly based on the use of tomato resistant cultivars (Chaerani et al., 2007). However in South Africa there is no cultivar available with complete levels of resistance to early blight. The objective of this study was to determine aggressiveness of *A. solani* Limpopo isolates on two susceptible cultivars of tomato (Money-maker and Rodade) under laboratory and greenhouse conditions.

Materials and Methods

The tested isolates were collected from four different areas across Limpopo Province and pathogen isolations were carried-out under laboratory conditions. The in-vitro (leaf disc) and greenhouse experiments were conducted to determine the aggressiveness of the isolates on both cultivars. The Final disease severity on both experiments was calculated using the formula: Disease severity (%) = [(Number of leave scored for each rating x the rating value) / Total plants scored].

Results and Discussion

Under laboratory and greenhouse conditions all tested isolates displayed a certain level of aggressiveness to both tomato cultivars. There was a significant ($P \leq 0.05$) difference among tested isolates based on collection area. The highest disease severity of 83.94 and 100% was recorded in the greenhouse and leaf disc experiments respectively, on isolate V11 isolate and the lowest disease severity of 20.01 and 56.70% was recorded in B2 isolate on both cultivars in the greenhouse and leaf disc experiments respectively. The results obtained in this study revealed that isolates from different areas different with their level of aggressiveness on both cultivars. The reason for our results could be due to the prevailing climatic conditions in different areas and different farming practices in different areas such as continues application of chemical fungicides and monoculture which could influence the evolution of new fungal strains which over time can become more aggressive to the cultivated tomato cultivars than pre-existing strains. Shahbazi et al. (2010) reported that different *A. solani* isolates from different geographical areas exhibited variation in aggressiveness to different tomato cultivars and these is caused by the different climatic conditions in those different areas.

Conclusions

Our findings demonstrate the possibility of the development of new *A. solani* strains that are more aggressive and virulent toward the commercial cultivars. However further collection of more *A. solani* isolates from multiple regions across multiple years is needed to confirm the aggressiveness and virulence statues of *A. solani* isolates within the Limpopo Province.

References

SHAHBAZI, H., AMINIAN, H., SAHEBANI, N. and D. HALTERMAN. (2010). Biochemical evaluation of resistance responses of potato to different isolates of *Alternaria solani*. *Phytopathology* 100:454-459. CHAERANI, R., GROENWOLD, R., STAM, P. and R.E. VOORRIPS. (2007). Assessment of early blight (*Alternaria solani*) resistance in tomato using a droplet inoculation method. *Journal of General Plant Pathology* 73:96-103.

TILLAGE AND CROP ROTATION EFFECTS ON WHEAT BIOMASS AND GRAIN YIELD AT THE ALICE JOZINI ECOTOPE, EASTERN CAPE, SOUTH AFRICA

Presenter: M Mtyobile (mtyobilemg@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M	Mtyobile	Private Bag X 5002, Mthatha, 5099
L	Muzangwa	Lmuzangwa@ufh.ac.za
P.N.S	Mnkeni	pmnkeni@ufh.ac.za

Introduction

Soil degradation resulting in depletion of soil fertility is an acknowledged problem which undermines crop production in the Eastern Cape. Activities such as conventional tillage and the removal of crop residues have led in the depletion of soil organic matter (SOM), rendering the soils susceptible to erosion forces. However, conservation agriculture (CA) is reported to reverse soil degradation and increase crop yields. Therefore, the objective of this study was to evaluate the effects of tillage and crop rotation on wheat biomass and grain yield.

Materials and Methods

This field trial was conducted from an ongoing trial in 2014 at the research farm in the University of Fort. The field trial was laid in a split split-plot design. The main plots were no-till (NT) and conventional tillage (CT); sub-plots were four crop rotations; maize-fallow-maize (MFM), maize-fallow-soybean (MFS); maize-wheat-maize (MWM) and maize-wheat-soybean (MWS). The sub sub-plots were allocated to residue management; residue removal (R-) and residue retention (R+). Biomass was determined at harvest by cutting all the plants in two middle rows at ground level. Wheat grain yield (kg/ha) was determined after threshing and removal of the straw. A Walkley-Black method (AGRILASA, 2004) was used to determine SOC. An Olsen method was used to determine extractable phosphorous. Statistical analysis was carried out using analysis of variance (ANOVA) techniques as outlined by Gomez & Gomez (1984) A JMP statistical package version 13.1 (SAS Institute Inc.) was used for the ANOVA. Means were separated using the Student's t test at 5% probability level. Correlation analyses were done to determine the relationships between yield and soil P as well against yield and SOC. Significant differences were identified at $p < 0.05$.

Results and Discussion

There was no significant ($p > 0.05$) interaction of main effects with respect to wheat biomass and grain yield. Tillage had a significant ($p < 0.05$) effect on wheat biomass. Tillage and crop rotation effects were not significant ($p > 0.05$) with regards to grain yield throughout the experimental period. Generally, higher wheat biomass and grain yield were found in the MWS rotation under NT with surface residue retention although not statistically significant. Soil organic carbon and P were positively correlated with grain yield.

Conclusions

The results of this short-term study have shown that, no tillage and crop rotation that included soybean with residue retention consistently favoured wheat biomass and grain yield. These positive benefits were attributed to improved moisture conservation, soil carbon sequestration and phosphorus availability.

References

AGRI LABORATORY ASSOCIATION OF SOUTHERN AFRICA (AGRILASA). 2004. Soil Handbook. Pretoria (South Africa): Agri Laboratory Association of Southern Africa. Pretoria, South Africa. GOMEZ K.A. & GOMEZ A.A. 1984. Statistical procedures for agricultural research. 2nd edition. A Wiley Inter-science publication, Singapore, pp. 1-627.

The effects of various wax treatments on 'Fuji' apples stem-end micro-cracking

Presenter: Mj Mudau (judym@tru-cape.co.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
Judy	Mudau	Tru-Cape fruit Marketing 36 St Jame street
Amanda	Fisher	Tru-Cape fruit Marketing 36 St Jame street
Henk	Griessel	Tru-Cape fruit Marketing 36 St Jame street

Introduction

One of the most widespread defects of 'Fuji' apples in South Africa is stem-end micro-cracking, this causes great economic loss due to the cracks increasing in size over time and turning black from secondary infection, thus, the affected fruit are cosmetically very unpleasing to the consumer. This is especially a problem on Fuji apples intended for the Far East, as their expectations are blemish-free superior quality fruit. The fruit's susceptibility to cracking is due to variable factors, including, but not limited to, environment, post-harvest handling, genetic factors (Kasai et al., 2007) and rapid fruit expansion (Opara et al., 1993). Waxing has been a common treatment method for preserving quality of fresh and minimally processed fruit (Vargas et al., 2008). In this trial, the effect of various waxes on stem end cracking on 'Fuji' was investigated.

Materials and Methods

'Fuji' apples were treated using three different waxes: FRUTCOAT® SGL-4 at 2 liter/ton fruit, NATRALIFE 4-5 liter/ton fruit, XEDASOL L 4-5 liter/ton fruit. After cleaning the fruit, a spray was used to apply the waxes without a drying tunnel. Fruit were packed as per normal and stored on polystyrene trays in cardboard cartons with a plastic liner bag. The fruit was stored at -0.5°C. After six weeks, the fruit was placed in humidity chambers at 85%+ humidity. After seven days, fruit was removed from chambers and evaluated for cracks and secondary infections.

Results and Discussion

Trials still underway and results will be reported fully.

Conclusions

Trials still underway and results will be reported fully.

References

Kasai S, Hayama H, Kashimura Y, Kudo S, Osanai Y (2008) Relationship between fruit cracking and expression of the expansin gene MdEXPA3 in 'Fuji' apples (*Malus domestica* Borkh.). *Sci Hort* 116:194-198
Opara, L. U. (1996). Some characteristics of internal ring-cracking in apples. *Fruit Varieties Journal*, 50, 260-2.
Vargas, M., Albors, A., Chiralt, A., & González-Marínez, C. (2006). Quality of cold-stored strawberries as affected by chitosan-oleic acid edible coatings. *Postharvest Biology and Technology*, 41, 164-171.

HOST-STATUS AND HOST-SENSITIVITY OF POTATO CULTIVARS BP1 AND BUFFELSPOORT TO MELOIDOGYNE JAVANICA AND MELOIDOGYNE INCOGNITA RACE 2 UNDER GREENHOUSE AND MICRO PLOT CONDITIONS

Presenter: N K Mulandana (mulandanan@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N K	Mulandana	Tshwane University of Technology, Pretoria, 0001
K M	Pofu	Agricultural Research Council
M M	Slabbert	Tshwane University of Technology, Pretoria, 0001

Introduction

The withdrawal of highly effective but environmentally hazardous chemicals such as methyl bromide has left a void in the management of plant parasitic nematodes, in particular the *Meloidogyne* root knot nematode species. Management of plant parasitic nematodes could rely on nematode-resistant cultivars to reduce nematode damage.

Materials and Methods

Two separate studies were conducted under greenhouse conditions. The greenhouse experiments were arranged in split plot design with seven treatments replicated six times, whereas micro plot studies were arranged in a randomized complete block design with seven treatments and replicated eight times. Potato cultivars BP1 and Buffelspoort were inoculated with seven different nematode levels of *M. javanica*, namely 0 (Control), 50, 100, 250, 500, 750, 1000 and 1250 eggs and juveniles and *M. incognita* race 2, namely 0 (Control), 35, 70, 175, 350, 875, 1750 and 4375 eggs and juveniles. Twenty-centimetre pots containing potato cvs. BP1 and Buffelspoort were placed on greenhouse benches with a spacing of 0.3m inter-row and 0.3m intra-rows. Potato plants were irrigated to field capacity prior to nematode inoculation and a further 250 ml every second day. Fertilizer (2:3:2 (22)) at a rate of 5g per pot was applied two weeks after transplanting and repeated after four weeks. A day temperature of 18-27 °C and a night temperature of 16-22 °C was maintained in the greenhouse. Pests and diseases were managed according to standard recommendations, whilst spotted whiteflies were managed using Mospilan™ 20 SP at 50g/100 L.

Results and Discussion

Reproductive factor (RF) values of above one were observed on both potato cultivars under greenhouse conditions, while RF values of above one were observed under micro plot conditions. However, no plant variables were reduced under green house conditions. In nematology, all RF values of above one indicate a host plant, whereas those below one indicate a non host (Windham & Williams, 1988).

Conclusions

In conclusion potato cultivars BP1 and Buffelspoort were tolerant to *M. incognita* race 2 and *M. javanica*. Tolerant potato cultivars act as a source of nematode dissemination. Under micro plot conditions potato cultivar BP1 was tolerant to *M. incognita* race 2, but slightly susceptible to *M. javanica*. The need exists for nematode management trials and assessment of yield losses on potato due to the two tested *Meloidogyne* species under various conditions.

References

WINDHAM, G. L., WILLIAMS. W. P. 1988. Reproduction of *M. javanica* on corn Hybrid and inbreeds. *Annals of Applied Nematology*, 2:25-28.

EMPIRICAL RESEARCH ON FOOD SUPPLY CHAIN MANAGEMENT: A BACKGROUND OF MOZAMBICAN AGRICULTURE AND CASE STUDIES IN JAPANESE AGRICULTURE

Presenter: A Mutatisse (amutatisse@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Mutatisse	Divisão de Agricultura - Instituto Superior Politécnico de Manica, Mozambique
B	Hu	Department of Resource and Environmental Policy – Faculty of Agriculture, Ehime University, Japan
E	Nakamoto	3Agricultural Economics and Farm Management Laboratory – United Graduate School of Agricultural Science, Japan

Introduction

In this research, Food Supply Chain Management (FSCM) approach is used as platform to generate agricultural alternative policies that could be used to enhance the Mozambican agri-food industry.

Materials and Methods

Secondary data on Mozambican production capacity, rates on small and medium farmers' (SMF's) access to market, food security and importation rates were used as a background. Japanese agricultural economy, farm household management and marketing costs were examined. Semi-structured questionnaires were used to conduct three case studies on market-oriented farmers, two FSC collaborators and a structured questionnaire used to conduct a survey of 50 consumers of local farmers' market. Excel 2010 and Ordinal Logistic Regression Model were used for statistical analysis.

Results and Discussion

Results showed that in Mozambique, only less than 10% of farmers have access to production inputs and facilities, and not more than 30% have access to market. These facts may suggest the main reasons behind the prevalent national food shortage. Nevertheless, much analysis suggested existence of an internal food supply capacity, which may mean that the reasons behind the referred problem may rely most probably on existence of a fragmented FSC, rather than on farmers themselves. The Japanese business farm households tend to demonstrate high production and marketing efficiency. The Japanese Government tends to protect national production, promote price stabilization through subsidy policies and support on collaboration. The case studies suggested that the small farmers uses local farmers' market and fairs while the medium and large farmers engages on large processing companies and restaurants as their marketing channels. Within the chain (including consumers), the stakeholders enhance strategic partnerships, customer relationship and consumer focus, information sharing, trust and commitment.

Conclusions

These findings suggest that, in Mozambique the FSC strategies should: emphasize and promote collaborative relationships among the stakeholders; be built and led by large farmers or processing companies, wholesalers or retailers and farmers' markets, as each one of them tends to understand the customer/ consumer needs.

References

Influence of tillage, crop rotation and residue management on soil microbial biomass carbon and selected soil enzyme activities in two ecotopes of the Eastern Cape Province.

Presenter: L Muzangwa (Lmuzangwa@ufh.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
L	Muzangwa	University of Fort Hare, Faculty of Science and Agriculture, P bag X1314, Alice 5700
PNS	Mnkeni	University of Fort Hare, Faculty of Science and Agriculture, P bag X1314, Alice 5700
C	Chiduzza	University of Fort Hare, Faculty of Science and Agriculture, P bag X1314, Alice 5700
DE	Stott	USDA-NRCS Soil Health Division 915 W. South Street West Lafayette, IN 47907-2054 USA

Introduction

Biological parameters are sensitive soil indicators used to assess management changes over a short-term. In this study, microbial biomass carbon (MBC) and activities of fluorescein diacetate hydrolysis (FDA), β -glucosidase, arylamidase and acid phosphates were used to assess the short-term effects of tillage, crop rotation and residue management at Phandulwazi and UFH experimental sites.

Materials and Methods

The field trials were laid in a split split-plot design. The main plots were no-till (NT) and conventional tillage (CT); sub-plots were four crop rotations; maize-fallow-maize (MFM), maize-fallow-soybean (MFS); maize-wheat-maize (MWM) and maize-wheat-soybean (MWS). The sub sub-plots were allocated to residue management; residue removal (R-) and residue retention (R+). Soil samples were taken at 0-5, 5- 10, and 10-20 cm depths from each plot in November 2014 after a full cycle of crop rotations for monitoring of soil biological parameters.

Results and Discussion

No-tillage significantly ($P < 0.05$) increased MBC, FDA, β -glucosidase and arylamidase compared to CT, with greatest differences occurring in the 0-5 cm soil layer. Similarly, retention of residues resulted in higher MBC, and FDA, β -glucosidase and arylamidase activities than CT. However, residue effects on MBC at 5-10 and 10-20 cm, β -glucosidase at all depths, and FDA at 5-10 cm significantly depended on the tillage method ($P < 0.05$). Tillage diminished the residue retention effects on FDA compared to NT and increased residue retentions effects on β -glucosidase under CT compared to NT, due to the effects of tillage in the distribution of residues in the soil. Crop rotation significantly influenced ($P < 0.05$) arylamidase activity at all depths and FDA in the 0-5 cm soil layer. The effect of crop rotation was however, influenced by tillage and residue management with respect to β -glucosidase in the 0-5 cm soil layer. The MWS and MFS rotations increased arylamidase activity whilst both MWM and MWS increased FDA activity, however, β -glucosidase activity was optimised with MFS under NT combined with residue retention. Besides site differences ($P < 0.05$), no main effects or interactions ($P > 0.05$) were observed with acid phosphatase.

Conclusions

The noted improvements in soil biological parameters show the potential for soil quality improvement with the adoption of NT, residue retention and crop rotation. There is, however, need to corroborate the effects of these interventions on specific soil mineral levels and crop yields.

References

REPRODUCTION OF POTATO CYST NEMATODES ON TISSUE CULTURE POTATO PLANTS

Presenter: JM Mwangi (james-maina.mwangi@julius-kuehn.de)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
JM	Mwangi	Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Field Crops and Grassland, Messeweg 11/12, 38104 Braunschweig, Germany; Kassel University, Nordbahnhofstr. 1a, 37213 Witzenhausen-Germany
B	Niere	Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Field Crops and Grassland, Messeweg 11/12, 38104 Braunschweig, Germany
D	Matthias	Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Field Crops and Grassland, Messeweg 11/12, 38104 Braunschweig, Germany
MR	Finckh	Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Field Crops and Grassland, Messeweg 11/12, 38104 Braunschweig, Germany
S	Kiewnick	Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Field Crops and Grassland, Messeweg 11/12, 38104 Braunschweig, Germany

Introduction

The potato cyst nematodes (PCN) *Globodera pallida* and *G. rostochiensis* are a major challenge for global potato production. Use of resistant potato varieties is a good management strategy. However, breeding for resistance is long, tedious and costly. This study assessed the use of tissue culture (TC) derived plants as a quick, easy and cost effective screening technique.

Materials and Methods

The susceptible variety Désirée were used. Three week old TC plantlets, tubers and eye-plugs were planted into 200 cm³ containers filled with loess soil amended with Osmocote® fertilizer. Fourteen days after planting each plant was inoculated with 5 eggs+J2/cm³ with 10 replicates per treatment. After 12 weeks, the experiment was terminated and cysts extracted. Recovered cysts were enumerated and crushed to estimate the number of eggs and J2 per cyst. The experiment was repeated with TC and eye-plug derived plants using 500 cm³ pots. The PCN reproduction using 200 cm³ containers was compared to reproduction rates in 500, 1000 and 1500 cm³ pots. Three week old TC plants were planted in the four types of pots with 8 replicates. Inoculation and evaluation of reproduction were done as described above. Initial (Pi) and final population (Pf) data was used to calculate the reproduction factor (Rf) as; $Rf = Pf/Pi$. The mean Rf values were log₁₀ transformed prior to ANOVA at P=0.05. Tukey's HSD test was used to separate means.

Results and Discussion

Eye-plug potato plants showed highest number of cysts (181.3) followed by tuber (141.5) and TC plants (111.2), respectively. Eye-plug plants revealed an Rf value of 51.15 which was significantly different from TC plants (31.13), but not from tuber plants (39.89). However, when the experiment was repeated, no significant differences were observed for the Rf. However, the overall achieved Rf values are above the recommended standard ($Rf \geq 20$). When different pot sizes were compared, 200 cm³ pots had the lowest Pf of 109 cysts/pot, but highest Rf value (26.6) compared to 272 cysts and a Rf of 11.28 in 1500 cm³ pots. Consequently, a significant positive correlation was found between the Pf and the pot size ($r^2=0.61$) while the Rf was negatively correlated ($r^2=0.54$). The difference in Pf and Rf among the treatments could be attributed to differences in size of the root systems.

Conclusions

The Rf achieved using TC derived plants in 200 cm³ containers met the recommended standard ($Rf \geq 20$) for resistance testing of potato and could therefore be used for screening breeding material for PCN resistance.

References

SUNBURN INCIDENCE AND POLYPHENOL PATTERNS AS INFLUENCED BY BORON PLUS CALCIUM FOLIAR APPLICATIONS IN 'CRIPPS PINK' APPLE

Presenter: A Mwije (elotze@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Mwije	Stellenbosch University, Private Bag X1 7602, South Africa, Makerere University, PO Box 7062, Kampala, Uganda.
EW	Hoffman	Stellenbosch University, Private Bag X1 7602, South Africa
E	Lötze	Stellenbosch University, Private Bag X1 7602, South Africa

Introduction

Post full bloom foliar applied boron plus calcium (B+Ca) reduces apple sunburn (Lötze & Hoffman, 2014). However, the mode of action is still unknown, impending deployment of this novel approach on South African apple farms. It was hypothesized that B+Ca influences apple polyphenol patterns, thereby subduing fruit sunburn development.

Materials and Methods

For two seasons and in RCBD experiment design with five replicates, six types of B+Ca formulations, were applied at 28 to 30 days after full bloom (DAFB) on 'Cripps Pink' trees at Welgevallen farm, Stellenbosch University. Total phenolics, flavonoids and ratio (percentage) of flavonoids to phenolics in the fruit peels were determined bi-weekly. The data was treated to ANOVA (0.05). The seasonal trends of each respective biochemical parameter per B+Ca treatment were illustrated with graphs in XLSTAT. The total sunburn damage observed at fruit harvest was matched to the seasonal trends of biochemical parameters and to ANOVA results.

Results and Discussion

In 2014 season, the B+Ca treatment with the highest boron and calcium composition at 0.02 and 1.29 g/l respectively was the best sunburn reducing treatment. The flavonoid content and percentage showed increasing trend with DAFB and showed significant differences among B+Ca treatments at DAFB 49 to 56 when weather conditions could induce sunburn on the apples. In 2015 season, sunburn damage was again less severe in active B+Ca treatments compared to control treatment. Sunburn was lowest in fruits that received 0.08 g/l of B combined with 1.24 g/l of Ca followed by 0.02 g/l of B and 1.24 g/l of Calcium. These two treatments had the highest phenolic contents and flavonoids at DAFB 136 where sunburn inducing weather conditions occurred. Importantly, the B+Ca treatments and DAFB yielded significant ($P < 0.05$) interactions for the fruit peel total flavonoids. The fruit peels of treatment with 0.08 g/l of B and 1.24 g/l of Ca had the highest percentage flavonoid content increasing with DAFB as seen in other B+CA treatments. Flavonoid content increase could be related to increasing anthocyanins with fruit maturity, a phenomenon known in 'Cripps Pink', although abetted by appropriately formulated B+Ca post full bloom foliar treatments.

Conclusions

The B+Ca applications influenced 'Cripps Pink' apple polyphenol patterns and reduced sunburn. Amidst the increasing risk apple sunburn damage due to climate changes, this new B+Ca foliar approach can potentially and cost effectively increase pack-outs for the profitable markets and also the nutrient profile of the fruits.

References

Lötze, E. & Hoffman, E.W. 2014. Foliar application of calcium plus boron reduces the incidence of sunburn in "Golden Delicious" apple. *Journal of Horticultural Science and Biotechnology*. 89(6):607-612.

INVESTIGATING MODE OF ACTION BY WHICH BORON PLUS CALCIUM FOLIAR APPLICATIONS REDUCE APPLE SUNBURN

Presenter: A Mwije (anthonymwije@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Mwije	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa
E W	Hoffman	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa
E	Lötze	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa

Introduction

Boron plus calcium (B+Ca) foliar applications reduced sunburn incidence significantly in 'Golden Delicious' apple (Lötze & Hoffman, 2014). Mitigating sunburn in other cultivars with this approach is limited by inadequate understanding of the mode-of-action. In this study, it was hypothesized that B+Ca reduces sunburn by modifying fruit peel phenolic levels.

Materials and Methods

In 2015/2016, five B+Ca treatments (control - no B+Ca) were applied on 'Cripps Pink', 'Golden Delicious' and 'Granny Smith' apples for six consecutive weeks at two climatically different sites, starting between 30 to 40 days after full bloom (DAFB). A randomized complete block design was used, with single trees as experimental units. Fruit samples were picked bi-weekly for peel phenolics analyses. Total phenolics (TP), flavonoids (TF) and TF: TP ratio were determined from one week after the last foliar application until two weeks before commercial harvest. The data was subjected to statistical analyses and seasonal trends of each parameter determined. Sunburn browning (SBB) incidence at harvest was related to the biochemical trends.

Results and Discussion

Sunburn browning was higher in the control than B+Ca treatments. TP and TF decreased with increasing DAFB amongst treatments. There were significant interactions between DAFB and B+Ca for both TP and TF, suggesting physiological influences of the latter as the fruit matures. In 'Cripps Pink' and 'Golden Delicious', TF: TP ratio and trends increased with DAFB progress. Significant differences in SBB occurred in 'Cripps Pink' and 'Golden Delicious' amongst treatments. The photoprotection and antioxidant physiological functions of TF in fruit peels were enhanced by B+Ca treatments. Treatments with a high B content (0.08 and 0.17 g/l) gave the best results in 'Golden Delicious'. In 'Granny Smith', TP, TF and trends declined amongst treatments, possibly indicating insufficient B supply in this cultivar. This study demonstrates that foliar applications of B+Ca is a phytochemical farming technique to adopt as an alternative practice to reduce SBB incidence in apples.

Conclusions

Foliar B+Ca applications enhanced peel TF content in 'Cripps Pink' and 'Golden Delicious' towards the time of sunburn manifestation. The SBB reduction observed seems to be due to photoprotection and antioxidant capacity of the sustained TF. These results suggest different cultivars will require particular B+Ca formulations for significant SBB reduction, as the mode of action of the B+Ca formulations differ between cultivars.

References

Lötze E, Hoffman EW. 2014. Foliar application of calcium plus boron reduces the incidence of sunburn in 'Golden Delicious' apple. *Journal of Horticultural Science and Biotechnology*. 89(6):607-612.

An investigation into the combined use of an entomopathogenic fungus and botanical insecticide for control of the Russian wheat aphid on wheat

Presenter: N.P Mzimela (mzimelan@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N.P	Mzimela	ARC-Small Grain Institute, P/Bag X29, Bethlehem, 9700, South Africa
J.L	Hatting	ARC-Small Grain Institute, P/Bag X29, Bethlehem, 9700, South Africa
M.D	Laing	School of Agricultural, Earth and Environmental Sciences, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg, South Africa
N	Thiebaut	Agricultural Research Council - Central Office, 1134 Park Street, Hatfield, Pretoria 0001, South Africa

Introduction

Russian wheat aphid (RWA), *Diuraphis noxia* (Kurdjumov) (Hemiptera: Aphididae), is one of the most destructive aphid pests of wheat grown under dryland conditions. When the entomopathogenic fungus (epf) *Beauveria bassiana* (Vuillemin) is used to manage aphids as a single control agent it the nature of the aphid's reproduction. However, the biocontrol efficiency of *B. bassiana* can be improved if it is combined with other products such as botanical insecticides, for example, pyrethrum. Detailed studies of the compatibility of commercial formulations of *B. bassiana* with pyrethrum-based insecticides would help to choose the optimal combination for the control of RWA.

Materials and Methods

Beauveria bassiana Strain R444 was obtained from the ARC-PPRI. Biogrow Pyrol EC and Xterminator TM (SC) are two pyrethrum-based insecticides that were used in the study. These insecticides were tested at six concentrations (1%, 5%, 10%, 25%, 50% and 100%), added to Sabouraud dextrose agar (SDAY), cooled to about 400C. Three parameters were evaluated as a measure of compatibility: germination%, radial vegetative growth and sporulation intensity of the epf in the presence of the insecticides. Germination percentage was evaluated 24 hours post inoculation, radial vegetative growth was measured 7 days post inoculation and sporulation intensity was assessed nine days after inoculation. The trials were repeated three times.

Results and Discussion

Sporulation intensity (typexconcentration) ($P < 0.001$, $F = 19.77$, $LSD_{0.05} = 2.82 \times 10^6$) and radial vegetative growth ($P < 0.001$, $F = 69.26$, $LSD_{0.05} = 1.34$) conidia.ml⁻¹) (typexconcentration) were significantly reduced at the 50% concentration and above. Germination percentage was not affected at any given concentration of either insecticides, but radial vegetative growth ($P < 0.001$, $F = 22.01$, $LSD_{0.05} = 1.3404$) and sporulation intensity ($P < 0.001$, $F = 140.98$, $LSD_{0.05} = 2.82 \times 10^6$ conidia.ml⁻¹) were significantly reduced at 50% concentrations and above. A 10% suspension of Pyrol EC enhanced the sporulation intensity of the epf. In an efficacy trial in the glasshouse a 10% suspension of Pyrol EC enhanced the mortality of RWA caused by *B. bassiana* Strain R444.

Conclusions

This confirmed the hypothesis that pyrethrum insecticides can be integrated with *B. bassiana* for the enhanced control of RWA and results will be confirmed in the glasshouse.

References

NITROGEN FIXATION AND UREIDE PRODUCTION UNDER DROUGHT CONDITIONS IN LOW PHOSPHORUS TOLERANT COMMON BEAN GENOTYPES

Presenter: M Namugwanya (namugwanyam@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M	Namugwanya	Department of Agricultural Production, Makerere University, Kampala, Uganda, Department of Agriculture, Kyambogo University, Kampala, Uganda,
JS	Tenywa	Department of Agricultural Production, Makerere University, Kampala, Uganda,
E	Otabbong	Department of Soil and Environment, Swedish University of Agricultural Sciences, C/O Sorbyvagen 24, Lgh 1004, SE-89161, Ornskoldsvik, Sweden

Introduction

Biological nitrogen fixation (BNF) is a cost-effective method of enhancing soil fertility in Sub-Saharan-Africa. BNF is sensitive to drought in ureide producing legumes such as beans. The response of BNF to drought is genotypic specific. This study evaluated the BNF and ureide production of low phosphorus common bean genotypes occasioned by drought

Materials and Methods

A field experiment was conducted in Central Uganda; Mukono District representing non-drought-stress (NDS) site and Nakasongola district representing a drought-stress (DS) site in 2014 (two seasons). Treatments included two drought-stress conditions (NDS and DS): and four test bean genotypes: AFR 703-1, AFR 708, JESCA, and MCM 2001 against a local check, K131. ARCBD was used with three replicates. The variables measured included rainfall, stem ureide-N concentration and its relative abundance (RU-N %), plant N derived from N₂ fixation (%Ndfa) and N₂ fixed. A mixed effects model analysis was used with StataSe Statistical Package (11th edition). Means were separated by Dunnett's test.

Results and Discussion

The drought-stress site received <400 mm rainfall, while the non-drought-stress received >400 mm. There was a significant ($p < 0.05$) influence of the drought conditions x genotypes interaction on all measured variables. The notably higher ureide concentration in the stem extract and relative abundance of ureide-N [RU-N (%)] recorded in DS than in NDS for all genotypes is in agreement with previous studies in common beans. Though all the P tolerant common bean genotypes were not significantly affected by drought stress condition, when the local check (K131) was grown in DS, it fixed 41% less N₂ than when it was grown in NDS condition ($p < 0.001$). The current results suggest that N₂ fixation by the low P-tolerant common beans was fairly tolerant to drought stress compared to the local check. The amount of N₂ fixed significantly depended on RU-N and %Ndfa, yet it was independent of the ureide production in the stem extract under both DS and NDS conditions.

Conclusions

Though this study revealed that all P-tolerant beans produced higher ureide concentration in DS than in NDS condition, it was independent of the amount of N₂ fixed. The ability of test genotypes to fix N was fairly tolerant to drought stress.

References

COMPARATIVE EFFECT OF DESMODIUM ON MAIZE GROWTH AND YIELD AFTER FIFTEEN YEARS OF EXPERIMENTS

Presenter: PC Ndayisaba (pierrec.ndayisaba@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PC	Ndayisaba	icipi, P.O. Box 30772-00100 Nairobi, Kenya; JKUAT, P.O. Box 62,000 – 00200 Nairobi, Kenya; Rwanda Agriculture Board (RAB), P. O. Box 5016, Rwanda
S	Kuyah	JKUAT, P.O. Box 62,000 – 00200 Nairobi, Kenya
PN	Mwangi	JKUAT, P.O. Box 62,000 – 00200 Nairobi, Kenya
LE	Drinkwater	Department of Horticulture, Cornell University, Ithaca, New York 14853 USA
CAO	Midega	icipi, P.O. Box 30772-00100 Nairobi, Kenya
ZR	Khan	icipi, P.O. Box 30772-00100 Nairobi, Kenya

Introduction

Desmodium is used as a 'push' crop in push-pull technology developed to fight stem-borers in maize cropping systems, and is efficient. However, farmers prefer to intercrop maize with food legumes to Desmodium. Here, we compared the growth and yield of maize under Desmodium and food legume intercrops.

Materials and Methods

We measured the maize height, ear-leaf length and width, dry matter, grain and stover yields from a fifteen years old experiment at icipi – Mbita, in Western Kenya. Treatments were maize – Desmodium, maize – bean, maize – ground nut, maize – cowpea, maize – crotalaria, maize – green gram, and maize monoculture, replicated four times in a completely randomized design. Maize was planted at 60cm x 30cm. Legumes were planted in the middle of maize inter-row spacings. The ANOVA and SNK test were used respectively, to detect differences and separate means at $P = 0.05$.

Results and Discussion

The maize height from intercrops with food legumes varied between 107 and 144cm, was 90cm from maize monoculture, and taller ($P < 0.001$) by 100cm from intercrops with Desmodium compared to intercrop with crotalaria (the second-best). The ear-leaf was longer ($P < 0.001$) by 30cm and wider by 3.5cm ($P < 0.001$) compared to maize intercropped with crotalaria. The dry matter per plant was 24.5g from maize monocrop, ranged between 24 and 72g from intercrops with food legumes, and was three times higher ($P < 0.001$) from intercrops with Desmodium compared to intercrops with crotalaria. Maize grain yield from monoculture was 0.5t ha⁻¹, ranged between 0.4 and 1.2t ha⁻¹ from food legumes intercrops, and was more than 4 times ($P < 0.001$) the yield from crotalaria intercrop. The stover yield from Desmodium intercrop was two times the yield from crotalaria intercrop (the second-best). Desmodium sustained maize growth and yield. Such services are provided by proper addition of manure, mineral fertilizers, and crop rotation (Reeves, 1997). Desmodium, a perennial legume, fixes nitrogen, builds soil organic matter through roots and leaves shading, provides the soil cover and maintains the soil moisture (Khan et al. 2011), which result in sustained crop production.

Conclusions

In a long-term crop production, intercropping Desmodium with maize under push – pull technology provides better maize grain yields than common beans, cowpea, crotalaria, groundnut, green gram, and monocrop. Differences in yield observed from this study are large enough to compensate food legumes.

References

Khan Z, Midega C, Pittchar J, Pickett J, Bruce T. 2011. Push-pull technology: a conservation agriculture approach for integrated management of insect pests, weeds and soil health in Africa. *International Journal of Agricultural Sustainability*, 9(1), 162-170. <https://doi.org/10.3763/ijas.2010.0558> Reeves DW. 1997. The role of soil organic matter in maintaining soil quality in continuous cropping systems. *Soil and Tillage Research*, 43(1-2), 131-167.

DEVELOPING NITROGEN FERTILISER MANAGEMENT STRATEGIES FOR WHEAT UNDER CONSERVATION AGRICULTURE PRACTICES IN THE WESTERN CAPE, SOUTH AFRICA

Presenter: PJ Neethling (pjneethling@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PJ	Neethling	Stellenbosch University
J	Labuschagne	Western Cape Department of Agriculture
PA	Swanepoel	Stellenbosch University

Introduction

The adoption of conservation agriculture (CA) practices will influence the physical, chemical and biological properties of soils. It is expected that these changes will influence the amount of available nitrogen (N) to crops during the growing season. The aim of this study was to evaluate wheat N requirement and determine optimal N topdress rates under CA practices.

Materials and Methods

Wheat (SST 056) was planted at a rate of 80 kg ha⁻¹ at five different locations that differ in soil properties and climatic conditions. Cropping systems tested included wheat after canola, wheat after medics and wheat after lucerne. Nine sites were laid out in a randomised block design with eight N topdress treatments and four replicates. The N topdress treatments comprised of planting with 25 kg ha⁻¹ N and different N rates (0, 25, 50, 75, 105, 135 and 165 kg N ha⁻¹), applied as top-dressing. The control treatment was planted without any N and received no further N. Crops were managed according to best practices. Grain yield and quality were recorded for all sites.

Results and Discussion

A gradual increase in grain yield, sometimes significantly so ($P < 0.05$), was observed where topdressed N rate was increased between 0 and 50 kg N ha⁻¹. Increasing topdressed N rate to 75 kg N ha⁻¹ and higher, did not influence grain yield at most sites. In the wheat after legume systems, no yield response ($P < 0.05$) were recorded where N was increased to rates higher than 25 kg N ha⁻¹, except at Darling. At most sites increasing the topdressed N rate lead to a steady increase in grain protein content and a decrease in hectolitre mass, sometimes significantly so ($P < 0.05$).

Conclusions

Preliminary results showed that the optimum topdressed N rate will be specific to site and cropping system. It is expected that the recommended topdressed N rate will be within the 25-50 kg N ha⁻¹ range for wheat after canola and between 0 and 25 kg N ha⁻¹ topdressed for wheat after annual medics. Final recommendations will be formulated on completion of at least 3 years of data capturing.

References

EFFECT OF DISEASE SUPPRESSIVE COMPOST COMBINED WITH SOLARISED SOIL ON ONION WHITE ROT INCIDENCE, SEVERITY AND PLANT GROWTH

Presenter: N NETSHITHUTHUNI (ndivhudzan@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
N	NETSHITHUTHUNI	Goodplas stand No BE 0133, Khapane, Greater Letaba 0826
M.A	KENA	University of Limpopo, Private Bag X1106, Sovenga 0727

Introduction

Onion white rot, caused by *Sclerotium cepivorum* Berk. is an economically important disease of onions and other *Allium* spp. The disease is normally managed by the application of soil pesticides. However, their negative effect on the environment has resulted in the need for development of alternative control measures. The potential of disease suppressive compost and soil solarisation in the control of soil borne diseases has been recognized. However, their integration has not been acknowledged. Therefore, the main aim of this study was to determine the effect of combined application of disease suppressive compost and solarised soil on plant growth, onion white rot incidences and severity.

Materials and Methods

The experiments were carried-out under greenhouse and micro-plot conditions at the University of Limpopo, Turfloop campus during May-December, 2015. Both experiments were arranged in RCBD with 6 replications and they comprised of seven treatments, namely: negative and positive controls; solarised soil combined with five rates of disease suppressive compost (722 g, 770 g, 818 g, 866 g and 914 g). Two white rot susceptible onion varieties (Red-wave and Crystallina) were used in the study. Disease incidence on infected plants was determined by calculating the total number of symptomatic plants whilst severity was assessed using the scoring scale of 0 to 5 at harvest. Plant height; shoot length, fresh leaves weight, fresh bulb weight and bulb diameter as yield variables were also measured at harvest.

Results and Discussion

Results showed that treatments were significantly different ($P \leq 0.05$) under both sites for disease incidence and disease severity. The highest disease incidence and severity were recorded in Red-wave cultivar under both sites in all combination rates. Results further showed that treatments differ significantly ($P > 0.05$) under both sites for plant height and shoot length. However, treatments did not differ significantly ($P \leq 0.05$) under micro-plots for root length, bulb diameter and fresh bulb weight as compared to control treatment under micro-plot condition. Also, treatments did not differ significantly ($P \leq 0.05$) under greenhouse for fresh leaves weight. In agreement with our findings, Abada et al, (2014) reported that solarised soil amended with compost reduced *Fusarium oxysporum* incidence and severity on strawberry.

Conclusions

The tested treatments displayed a positive effect on plant growth and yield of onion under greenhouse and micro-plot condition regardless of rates combinations Therefore, their combination application can be used as a cheap and environmentally friendly method in the management of onion white rot.

References

Abada, K. A., Faten, M. and Hala A.M.E. Effect of Combination among Bioagents, Compost and Soil Solarization on Management of Strawberry *Fusarium* Wilt. American Journal of Life Sciences. Special Issue: Role of Combination Between Bioagents and Solarization on Management of Crown-and Stem-Rot of Egyptian clover. 2 (6-2):39-46.

THE INFLUENCE OF EXTRACTION TECHNIQUES ON THE CHEMICAL COMPOSITION AND YIELD OF ESSENTIAL OILS FROM PELARGONIUM CV ROSE

Presenter: B A Ngcangatha (Bulelwa.Ngcangatha@drdar.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
B.A	Ngcangatha	Dohne Agricultural Development Institute, Private bag X 15, Stutterheim, 4930
D	Katwire	Department of Chemistry University of FortHare Alice 5700
A.M	Ras	Dohne Agricultural Development Institute, Private bag X 15, Stutterheim, 4930

Introduction

In this study hydro-distillation, steam distillation and solvent free microwave extraction techniques were used to extract oil from Pelargonium cv.rose as they are advocated in literature. Techniques normally utilized (Guenther, 1972) for extracting essential oils include hydro-distillation, steam distillation and solvent free microwave extraction. Components of a few segments are contained in the oil, thus separation was done by using chromatography and spectroscopy. Gas Chromatography and spectroscopy detection have been used to certify quality and purity of most essential oils.

Materials and Methods

Pelargonium cv.rose were collected from the following places (keiskammahoeck, University of FortHare and Dohne ADI. Three extraction methods were used which was steam distillation, solvent free microwave extraction and hydro-distillation. 6.7kg of wet plant was weighed and placed in hydro-distillation with a Clevenger type apparatus (1980) according to the British Pharmacopeia and distilled with 2 L of water for 3 hours. Same mass was weighed and placed in steam distillation unit and distilled with 2L of water for 1.5 hours and in Solvent Free Microwave Extraction no solvent or water was added and extraction took 30 min. Distillates were collected and separated from water and oil composition was determined by Gas Chromatography-Mass Spectroscopy .

Results and Discussion

Solvent Free Microwave Extraction had high yield oil of (0.2854%) than Steam distillation (0.0927%) and Hydro-distillation (0.1014%). A total of 24 oil components in each extraction methods were identified. Significant differences were obtained in these components linalool and citronellol .In Hydro-distillation linalool was high (2.28%), (1.64 %) in Steam distillation and (0.95%) in Solvent Free Microwave Extraction because of degradation of linalyl acetate (when in contact with water) form linalool. Citronellol was higher in Hydro-distillation (24.88%) than Steam distillation (20.84%) and Solvent Free Microwave Extraction (20.71%). Citronellol and geraniol is the major component in geranium oil.

Conclusions

Solvent Free Microwave Extraction is an efficient method for essential oil extraction due to the short extraction time, high yield, low costs and yielded oil with same composition as Hydro-distillation and Steam distillation.

References

Guenther. E, 1948, the production of essential oils. In Guenther, E the essential oils, ch3, 85-187 D.Van Norstrand Company Inc., New York. USA

EFFECTIVENESS OF POLYETHYLENE CONTAINER AND AIRTIGHT BAGS ON MAIZE GRAIN STORAGE FOR SMALLHOLDER FARMERS IN MOZAMBIQUE

Presenter: R Nguenha (rafaelnguinha@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
R	Nguenha	UEM/FAEF, Universidade Eduardo Mondlane, Faculdade de Agronomia e Engenharia Florestal, PO Box 257, Av. Julius Nyerere 3543, Maputo, Mozambique
L	Tivana	UEM/FAEF, Universidade Eduardo Mondlane, Faculdade de Agronomia e Engenharia Florestal, PO Box 257, Av. Julius Nyerere 3543, Maputo, Mozambique
S	Chemane	UEM/FAEF, Universidade Eduardo Mondlane, Faculdade de Agronomia e Engenharia Florestal, PO Box 257, Av. Julius Nyerere 3543, Maputo, Mozambique
P	Viola	UEM/FAEF, Universidade Eduardo Mondlane, Faculdade de Agronomia e Engenharia Florestal, PO Box 257, Av. Julius Nyerere 3543, Maputo, Mozambique
I	Monjana	Instituto de Investigação Agrária de Moçambique, PO Box 3658, Av. das FPLM 2698 Maputo, Mozambique
K	Nswana	Zambia Agriculture Research Institute -ZARI, Mochipapa-Choma, Zambia

Introduction

Maize is the most important staple food and the basis of the diet of the majority of the population in Mozambique. However, in small farm agriculture, storage insect pests are a major constraint to its utilization as they cause high physical and economic losses reducing food availability and farmers' income (Njoroge, 2014). Aimed at contributing to the reduction of losses in stored maize grain, trials were carried out to compare the effectiveness of traditional raffia bags (TRB) and of hermetic storage using GrainPro Super grain bags (SGB) and polyethylene container (PEC) concerning quantitative losses.

Materials and Methods

To evaluate the effectiveness of Super grain bags (SGB) and polyethylene container (PEC), on-station and on-farm trials were carried out using naturally infested maize grain. The on-station experiments were conducted in three sites in the maize production zones of Mozambique during six months, with three replications per treatment. On-farm were conducted in two districts namely Vanduzi and Sussundenga, and nine farmers were selected in each district. In on-station, all the structures were tested both with and without Actellic gold dust (pirimiphos-methyl 0.16% + thiamethoxam 0.036%). Pest identification, insect populations estimates, percentage of weight loss, grain damage and moisture content were monthly evaluated. The significance of observed differences among the data in each treatment was evaluated by two-way factorial ANOVA analyses. When significant differences were observed, Tukey's HSD test was performed under 0.95% confidence limits.

Results and Discussion

The results showed that, in descending order of density, maize/rice weevil (*Sitophilus zeamais* Mostch. and *Sitophilus oryzae* L.), Angoumois grain moth (*Sitotroga cerealella* Olivier), lesser grain borer (*Rhyzopertha dominica* F.), and red flour beetle [*Tribolium castaneum* (Herbst)] were the main insects infesting the maize grain. When compared to hermetic storage with both PEC and SGB, traditional storage presented statistically significant higher mean infestation density, from an initial 16 to 230 individuals/kg in traditional, while a mean density of 9 individuals/kg and 5 individuals/kg was observed in PST and SGB respectively, during the six months of storage. In TRB was observed a significant increase in grain damage from 20.78 to 73.11% (with a weight loss of about 29.9%), against 24.89% in SGB and 29.56% in PEC in the 6th month, considering the same initial level of damaged grain.

Conclusions

These results demonstrate that the use of PEC and SGB has resulted in a safe, pesticide-free, and sustainable storage method, suitable for maize grain, with advantages over traditional bagging.

References

Tolerance of South African wheat cultivars to post-emergence herbicide application

Presenter: H Nienaber (deweth@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
H	Nienaber	Private Bag X29, Bethlehem, 9700, South Africa

Introduction

An Australia study found that some wheat varieties are more susceptible to damage from certain herbicides than others. Yield reductions as high as 41% were recorded in some varieties with certain treatments. Variation in tolerance can be due to differences in morphological or physiological characters and/or internal ear development stages among varieties. Some of the herbicides that caused yield reductions in Australia are also used in South Africa. No information is available about the tolerance of South African wheat cultivars to post-emergence herbicides. The aim of this study was therefore to determine the phytotoxic effect of post-emergence herbicides on six different wheat cultivars in the Western Cape, South Africa.

Materials and Methods

During 2015/2016 and 2016/2017 field trials were planted in the Western Cape. Six cultivars (SST 015, SST 056, SST 0127, SST 087, PAN 3408 and Ratel) were planted at two locations [Tygerhoek - Rûens (2015 & 2016) and Moorreesburg (2015) & Wellington (2016) - Swartland]. Seven different herbicide treatments (including the control) were included in the trials. All herbicides were applied according to label recommendations at the highest recommended rate.

Results and Discussion

The Swartland trial, indicated that significant differences could be found among herbicide treatments in PAN 3408. PallasTM and Monitor[®] were the lowest yielding treatments. The highest yielding treatment was Cossack[®]. No significant differences among herbicide treatments were recorded with the rest of the cultivars. SST 056 was more sensitive to PallasTM than to any other herbicides. All herbicide treatments on SST 0127 showed an increase in yield when compared to the control. In this cultivar, PallasTM recorded the highest yield. Conversely, the lowest yielding treatment on SST 015, Ratel and SST 087, was PallasTM. The highest yielding treatment with SST 015 was Resolve[®] and the highest yielding treatment on Ratel and SST 087 was with MCPA & Buctril[®]. The Rûens trial indicated no significant differences among treatments on PAN 3408, Ratel, SST 056, SST 015 and SST 087. On SST 0127, results indicated that Glean[®] & Brush-Off[®] was the highest yielding herbicide treatment on four of the six cultivars (PAN 3408, SST 056, SST 0127 and SST 015). MCPA & Buctril[®] showed the highest yield on Ratel. Cossack[®] was the highest yielding treatment on SST 087.

Conclusions

PallasTM lowered yields in five of the six cultivars tested in the Swartland. Glean[®] & Brush-Off[®] was the highest yielding herbicide treatments in four out of six cultivars tested in the Rûens.

References

Zadoks, J.C., Chang, T.T. & Konzak, C.F. 1974. A Decimal Code for the Growth Stages of Cereals. Weed Research 14, pp 415-421.

CLIMATE SMART AGRICULTURE ADAPTATIONS TECHNOLOGIES TOWARDS DROUGHT TOLERANT CROPS ON CLIMATE CHANGE RESILIENCE IN KIRINYAGA COUNTY.

Presenter: PNM Njeru (njerupeterson@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PNM	Njeru	KALRO- Muguga South, P.O Box 30148-00100, Nairobi
J	Mugwe	Kenyatta University, P.O Box 43844, Nairobi
M	Mucheru-Muna	Kenyatta University, P.O Box 43844, Nairobi
I	Maina	KALRO Headquarters, P.O Box 57811-002004, Nairobi
K	Kimani	KALRO- Muguga South, P.O Box 30148-00100, Nairobi

Introduction

Soil fertility degradation remains the major biophysical cause of declining per capita crop production on smallholder farms in Central Kenya highlands. A study was conducted to compare farmers' perception and biophysical data on selected water harvesting and integrated soil fertility management technologies on sorghum (*Sorghum bicolor* (L.) Moench) and cowpea (*Vigna unguiculata* L.) production in Central highlands of Kenya.

Materials and Methods

Three hundred and seventy one smallholder farmers were invited to evaluate thirty six plots laid out in Partially Balanced Incomplete Block Design (PBIBD) replicated three times.

Results and Discussion

The treatment which was ranked best overall rated as 'good' by the farmers was farmers practice with a mean score of (2.78) and yielding 3.5t/ha under sorghum alone plus external soil amendment of 40 Kg P /ha + 20 Kg N /ha. This was closely followed by tied ridges and contour furrows overall rated as 'good' by the farmers under sorghum alone plus external soil amendment of 40 Kg P /ha + 20 Kg N /ha + manure 2.5 t/ha and 40 Kg P /ha + 40 Kg N /ha + manure 5 t/ha both with a mean score of (2.7) and yielding 3.0 t/ha and 2.9 t/ha respectively. Generally, all experiment controls were overall scored as 'poor' yielding as low as 0.3 t/ha to 0.6 t/ha.

Conclusions

Therefore, integration minimal addition of organic and inorganic inputs on highly valued traditional crops with adequate rainfall under normal farmers practice in semi-arid lands could be considered as an alternative option contribution to food security in central highland of Kenya

References

EFFECTS OF STEM RUST AND RUSSIAN WHEAT APHID ON WHEAT GRAIN YIELD AND QUALITY OF WHEAT IN KENYA

Presenter: MN Njuguna (michael.njuguna@kalro.org)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MN	Njuguna	KALRO-Njoro, Private Bag 20107, Njoro, Kenya
M	Macharia	KALRO-Njoro, Private Bag 20107, Njoro, Kenya
JN	Ndungu	KALRO-Njoro, Private Bag 20107, Njoro, Kenya
I	Koros	KALRO-Njoro, Private Bag 20107, Njoro, Kenya
G	Ngotho	KALRO-Njoro, Private Bag 20107, Njoro, Kenya

Introduction

Wheat is the second most important cereal after maize in Kenya. Domestic demand (1,750,000t) surpasses production (442,000t). Stem rust (SR) and Russian wheat aphid (RWA) are major constraints that currently threaten production in Kenya.

Materials and Methods

Field trials were carried out at Njoro (00 20' S, 350 56'E, 2,160 masl, 950 mm annual rainfall) and Mau Narok (00 39' S, 350 57' E, 2,835 masl, 1,300 mm rainfall) in 2015 and 2016 to evaluate effects on wheat yields. Trials were laid out in RCBD with three replications. Variety K Korongo was sown in 6.0 m x 1.5 m plots surrounded with spreader rows of Robin. Fertilizer (NPK, 18: 46: 0) was applied at sowing. Prosaro 250EC® was applied at 1.0 l/ha at GS 20 to control leaf rust. Plots were exposed to SR and RWA infestation. At or after ear emergence (GS 55), fortnightly applications of Folicur 250EC® at 1.0 l/ha were applied to control SR. RWA reared in the greenhouse were artificially inoculated into plots at GS 20. Thunder 145 OD® at 0.3 l/ha was sprayed at GS 55 to control aphids. Adjacent plots were shielded during spraying. Grain weights, and protein and gluten contents were measured after harvesting. Data were analyzed using SAS package.

Results and Discussion

The combination of SR+RWA attack caused the highest yield losses of 78.1 and 89.6 % at Njoro, and 82.3 and 88.4% at Mau Narok in the 2015 and 2016 seasons, respectively. Grain protein and gluten contents were also significantly ($P < 0.05$) lowered by the combination of SR+RWA infestation.

Conclusions

Clearly, these biotic stresses cause significant losses in both quantity and quality if uncontrolled.

References

Development and evaluation of an evaporative cooling system for storage of tomatoes (*Solanum lycopersicum*)

Presenter: NS Nkolisa (zandinkoli88@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
NS	NKOLISA	Dohne Agricultural Development Institute, Private Bag X 15, Stutterheim. 4930; School of Agricultural, Earth and Environmental Sciences, School of Engineering, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg, 3201
LS	MAGWAZA	School of Agricultural, Earth and Environmental Sciences, School of Engineering, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg, 3201
TS	WORKNEH	School of Agricultural, Earth and Environmental Sciences, School of Engineering, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg, 3201
A	CHIMPHANGO	Stellenbosch University, Process Engineering Department, Stellenbosch 7602, South Africa

Introduction

Tomato is an important vegetable crop, perishable in nature and highly affected by improper postharvest handling and storage. Cooling is the most traditional way of preserving horticultural products and the most common way of keeping quality whilst increasing shelf life of tomatoes (Munoz et al., 2017).

Materials and Methods

A study was conducted to evaluate the efficiency of a low-cost evaporative cooling system and its effect on postharvest storage potential and physico-chemical quality properties of tomatoes. The performance of the cooling system was evaluated in terms of temperature drop, increase in relative humidity and cooling efficiency. Two tomato cultivars (9065 jam and round) were harvested from a smallholder farmer fields at Umsinga. The tomatoes were used in a storage experiment laid out in a randomized complete block design with four replicates. Tomatoes were assigned one of the three storage conditions namely: cold room, room temperature and the evaporative cooling system. Quality parameters evaluated included mass loss, respiration rate, colour, firmness, total soluble solids and titratable acids.

Results and Discussion

Results obtained indicated that the evaporative cooler was able to reduce the temperature by 13% compared to room temperature. Relative humidity increased from 63.59 % at room temperature to 83.91% inside the evaporative cooler, and it had an average cooling efficiency of 67.17%. Storage condition and storage period had a significant effect on the quality parameters. As expected, the cold room storage maintained quality parameters of the tomatoes longer and showed that the produce would have kept longer after the experiment period with no visible colour changes. However, the evaporative cooler was able to preserve freshness of the mature green tomatoes for 20 days with negligible changes in the physical qualities compared with those stored at room temperature. This suggests that the developed evaporative cooler is capable of maintaining quality and increasing shelf life of the stored tomatoes. The evaporative cooler also had the prospect of being used for short term preservation of tomatoes soon after harvest and will be very beneficial for smallholder farmers.

Conclusions

The study showed that the evaporative cooler was able to decrease temperature, increase relative humidity and had a cooling efficiency of 67.17%. The results proved that the evaporative cooler was also able to maintain the investigated quality parameters of the tomatoes for 20 days compared to room temperature. Hence, it can be deduced that the evaporative cooler can be used as a storage option for smallholder farmers.

References

Munoz, E.R., Duico, L.T., Martinez, S.M.S., Oliveria, I.K.A., Quiroz, N.A. and Maria, D.J.R., 2017. Automated electronic evaporative cooler for fruits and vegetables preservation. *International Journal of Engineering Science and Research Technology*, ISSN: 2277-9655.

Amaranths: an alternative and perspective crop with special reference to nematode pests

Presenter: K.N. Ntidi (ntidin@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
K.N.	Ntidi	ARC-Grain Crops Institute, Private Bag X 1251, Potchefstroom, 2520, South Africa
M.	Daneel	ARC-Institute for Tropical and Subtropical Crops, Private Bag X11208, Mbombela, 1200, South Africa
H.	Fourie	Unit for Environmental Sciences and Management, Private Bag X6001, Potchefstroom

Introduction

Amaranthus spp., play a significant role in the traditional diets and food security of underprivileged people in both rural and urban areas. These vegetable crops also have medicinal properties and are rich in nutrients. Despite *Amaranthus* species having great potential to alleviate famine of particularly rural people, productivity of such crops is hampered by plant-parasitic nematodes (particularly *Meloidogyne* spp.). Nonetheless, genetic diversity in *Amaranthus* genotypes exists in terms of their host suitability to *Meloidogyne* spp. and therefore the objective of this study was to determine the host status of thirteen *Amaranthus* genotypes at three localities where natural root-knot nematode infestations exist.

Materials and Methods

Thirteen *Amaranthus* genotypes that were previously screened against *Meloidogyne incognita* and *M. javanica* in two glasshouses were further evaluated for their host efficiency in three on-farm experiments at Kuruman, Mbombela and Potchefstroom. Experiments comprised of randomised complete block designs with each entry replicated 6 times. A natural *M. incognita* population existed at the Potchefstroom site, *M. javanica* at Kuruman and a mixed population of *M. incognita* and *M. javanica* (80:20 ratio) at Mbombela.

Results and Discussion

Eight plant-parasitic nematode genera were identified from rhizosphere soil and roots of *Amaranthus* genotypes from the three sites, with *Meloidogyne* spp. being the predominant nematode pests in both root and soil samples. The outcomes of study indicated none of the *Amaranthus* genotypes evaluated was immune to the respective root-knot nematode species that prevailed in soils at the field sites because these pests reproduced in the roots of all genotypes. The results are in agreement with the glasshouse screening as well as the survey conducted during 2014/15 growing season.

Conclusions

Due to the importance of *Amaranthus* spp. and accessions as a food source to the local community, results generated in this study will not only serve as a baseline study but also capacitate researchers, extension officers and farmers with knowledge to optimise food security and income of households from nematode perspective.

References

- Abukutsa-Onyango, M. 2007. The diversity of cultivated African leafy vegetables in three communities in Western Kenya: African Journal of Food, Agriculture, Nutrition and Development, 7:3. Allenman, J., Van Den Heever, E. and Viljoen, J. 1996. Evaluation of Amaranthus as a possible crop. Applied Plant Science, 10:1-14. Baimey H., Coyne, D., Dagbenonbakin, G. and Jamesa, B. 2009. Plant-Parasitic nematodes associated with vegetable crops in Benin: Relationship with soil physico-chemical properties. Nematologia. Mediterranea, 37:227-236. Chweya, J.A. and Eyzaguirre, P.B. 1999. The biodiversity of traditional leafy vegetables. International Plant Genetic Resources Institute. Rome, Italy, pp.51-84. Coyne, D.L., Fourie, H. and Moens, M. 2009. Current and Future Management Strategies in Resource-poor Farming. In Perry RN, Moens M, Starr JL. (Eds.). Root-knot Nematodes. Wallingford, UK, CAB International, pp.444-476. Fourie, H., Spaul, V.W., Jones, R.K., Daneel, M.S. & De Waele, D (Eds.). Nematology in South Africa: A view from the 21st century. pp. 409-418. Springer International, Germany. Jansen van Rensburg, W.S., Venter, S.L., Netshiluvhi, T.R., Van Den Heever, E., Vorster, H.J. and De Ronde J.A. 2004. The role of indigenous leafy vegetables in combating hunger and malnutrition. South African Journal of Botany, 70(1):52-59. Nchore, S.B., Waceke, J.W. and Kariuki, G.M. 2013. Response of African leafy vegetables to *Meloidogyne* spp. in Kenya. Journal of Today's Biological Sciences Research and Review, 2:1-12. Ntidi, K.N., Fourie, H., Mc Donald, A.H., De Waele, D. and Mienie, M.S. 2012. Plant-parasitic nematodes associated with weeds in developing agriculture in South Africa. Nematology, 14(7):875-887. Ntidi, K.N., Fourie, H. and Daneel, M. 2015. Greenhouse and field evaluations of commonly

occurring weed species for their host suitability to Meloidogyne species. *International Journal of Pest Management*, 62(1):1-9. Ntidi, K.N., Bekker, S. & Fourie H. 2017. Nematodes of Grasses and Weeds. In Fourie, H., Spaull, V.W., Jones, R.K., Daneel, M.S. & De Waele, D (Eds.). *Nematology in South Africa: A view from the 21st century*. pp. 409-418. Springer International, Germany.

SOIL AGGREGATION UNDER A MAIZE BASED CONSERVATION AGRICULTURE SYSTEM IN THE CENTRAL EASTERN CAPE PROVINCE IN SOUTH AFRICA

Presenter: P Nyambo (201307679@ufh.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
P	Nyambo	Department of Agronomy, University of Fort Hare, Private Bag X1314, Alice, 5700, South Africa
C	Chiduzo	Department of Agronomy, University of Fort Hare, Private Bag X1314, Alice, 5700, South Africa

Introduction

INTRODUCTION The low (<1%) soil organic carbon (SOC) content in soils of the Eastern Cape Province is one of the main reasons behind the high levels of degradation (Hoffman et al. 1999) and stagnation of smallholder crop productivity. Even though other soil components such as clay particles, cations, oxides and carbonates bind soil particles (Brady and Weil 2008), soil organic matter (SOM) plays a greater role in aggregate stabilization (Bronick and Lal 2005). As a result, much research is focusing on the role of SOM in aggregate stabilization. This research is unique in that it includes biochar; a carbon stable compound; amongst other residue management strategies. The objective of this study was to determine the immediate interactive influences of tillage, crop rotation and residue management strategies on soil aggregation under a maize based conservation agriculture system.

Materials and Methods

MATERIALS AND METHODS The experiment was established in 2015 at the University of Fort Hare farm in the Eastern Cape (EC). The trial evaluated three factors, tillage, rotation and residue management strategies laid as a split-split plot. Tillage (T) [conventional (CT) and no-till (NT)] was the main plot factor. Rotations (R) {(maize-fallow-maize (MFM), maize vetch maize (MVM) and maize oat maize (MOM))} were the sub plots and residue management strategies (RM) {residue retention(R+), residue removal (R-) and biochar} were the sub-sub-plots. Samples were collected after harvesting each season depths of 0-5 and 5-10cm both in the winter and summer seasons (S) until 2017. Mean weight diameter (MWD) was determined following Le Bissonnais (1996).

Results and Discussion

RESULTS AND DISCUSSION After four rotations, (0-5 cm level), significant interaction effects of the MWD ($P>0.05$) were observed on the T X RM X R. Also, significant differences were observed ($P<0.01$) in the interaction of T X S X RM. Season and RM interaction was significantly different at ($P<0.01$), while RM X R interactive effects were significantly different at ($P>0.05$). Tillage and season effects were both significantly different at ($P>0.05$), however, RM, and R effects were not ($P>0.05$). The average seasonal MWD observed was 0.263 for the 0-5 cm level. The results show that soils at UHF are very unstable (Le Bissonnais (1996). It is however important to note that these are preliminary results as the study is ongoing.

Conclusions

We conclude that adoption of conservation tillage system, especially no-till combined with biochar application, can increase soil macro-aggregation. It is however recommended that studies that look at the application rate of biochar be done.

References

REFERENCES Bronick CJ, Lal R. 2005. Soil structure and management: a review. *Geoderma* 124: 3-22. Hoffman, M.T., Todd, S., Ntoshona, Z., Turner, S., 1999. Land Degradation in South Africa. National Botanical Institute, CapeTown. Le Bissonnais Y. 1996. Aggregate stability and assessment of soil crustability and erodibility: I. Theory and methodology. *European Journal of Soil Science* 47: 425-437.

VARYING STAKING LENGTH IN YAM PRODUCTION AND EFFECT ON GROWTH AND YIELD OF WHITE YAM VARIETIES

Presenter: JN Odedina (jodedina@yahoo.co.uk)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
JN	Odedina	Department of Plant Physiology and Crop Production, Federal University of Agriculture, Abeokuta, Ogun state, Nigeria.
SO	Adigbo	Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, Abeokuta, Ogun state, Nigeria
TO	Fabunmi	Department of Plant Physiology and Crop Production, Federal University of Agriculture, Abeokuta, Ogun state, Nigeria
SA	Odedina	Department of Agronomy, Federal College of Agriculture, Akure, Ondo state, Nigeria

Introduction

White yam (*Dioscorea rotundata*, Poir) is important in the socio-cultural lives of people in West Africa. Staking is a yam planters' main concern especially in the growing areas of the forest to guinea savannah; or transitional areas of yam belt zones of the world and accounts for an appreciable cost of production. The aim was to investigate the effects varying staking length on growth and yield of white yam varieties.

Materials and Methods

Two field trials were conducted in 2013 and 2014 cropping season at the Directorate of the University Teaching and Research Farms, Federal University of Agriculture, Abeokuta. The treatments consisted of two local yam varieties: 'efuru' (early maturing) and 'amula' (late maturing) and three staking length: 5 machetes (3.65 m), 8 machetes (5.32 m) and 11 machetes (7.65 m) and a control (no staking). The growth and yield parameters taken at 220 days after planting included: germination count (%), vine length (cm), number of branches/plant, number of leaves/plant, number of roots/plant, vine diameter (cm), branch length (cm), root length (cm), fresh shoot weight (tha-1), fresh tuber weight (tha-1), dry shoot weight (tha-1), dry tuber weight (tha-1), tuber length (cm), tuber diameter (mm), number of tubersha-1 and tuber weight (tha-1). Cost benefit analysis was used to analyse the profitability of the production. The experiment was a 2 x 4 factorial arrangement fitted into a randomised complete block design replicated three times. Data collected was analysed using analysis of variance (ANOVA) and significant means compared at 5% probability using Least Significance Difference.

Results and Discussion

Yam variety had effect on vine diameter and number of roots/plant in 2013 and 2014; with 'efuru' having wider significant vine diameter compared to 'amula'. The higher number of roots/plant of 'efuru' can be attributed to the morphology of the early maturing variety. 'Efuru' produced higher tuber weight (tha-1) in 2013 and 2014. Staking length of 3.65 m (5 matchetes) had highest value in tuber weight in 2013. Staking length of 5.32 m (8 matchetes) significantly influenced total dry weight (tha-1) of white yam in 2013. Interaction of 'efuru' x 5.32 m increased the total dry weight (tha-1) in 2013.

Conclusions

It is recommended that white yam 'efuru' be grown with staking length of 5.32 m for optimum yield

References

EFFECTS OF STORAGE METHODS ON SPROUTING AND NUTRITIONAL QUALITY OF GINGER (ZINGIBER OFFICINALIS) RHIZOMES IN DIFFERENT STORAGE PERIODS

Presenter: JO Olaniyi (olaniyikunle2005@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
JO	Olaniyi	Department of Agronomy, Ladoke Akintola University of Technology, Ogbomoso, Nigeria
SO	Olusoga	Department of Agronomy, Ladoke Akintola University of Technology, Ogbomoso, Nigeria
LA	Babatola	Department of Agronomy, University of Ibadan, Ibadan, Nigeria

Introduction

Harvested ginger rhizomes are highly vulnerable to damage during postharvest storage due to soil borne pathogens or pest attack. Experiments were conducted to evaluate the effects of storage methods required for sprouting and maintaining the nutritional quality of ginger rhizomes under different storage periods in the laboratory.

Materials and Methods

The rhizomes were stored using five different storage methods viz., refrigerator, clay pots, pit lined with sand, pit lined with sawdust and black polythene bag with twelve perforations at three different storage periods of one, two and three months. The experiments were laid out in a complete randomized design and randomized complete block design for laboratory and field experiment respectively, replicated three times. Data were collected on temperature, percentage weight loss of stored rhizomes, percentage sprouting, plant height, number of leaves and leaf area of ginger rhizomes. Data were subjected to analysis of variance using Statistical Analysis System Software (SAS, 2005). Differences among treatment means were compared using Least Significance Difference (LSD) at 5% probability level

Results and Discussion

The storage methods significantly ($P \leq 0.05$) influenced the percentage sprouting, weight loss, growth parameters and nutritional quality of ginger at various storage periods. The highest growth parameters were recorded from rhizomes stored for three months while the least value was recorded from rhizomes stored for one month. Highest percentage sprouting (94.90 %) was recorded from rhizomes stored inside pit-sawdust followed by polythene (85.25%) while least percentage sprouting (66.28 %) was recorded from refrigerator. Rhizomes stored inside clay pots recorded least percentage weight loss of 27.89% closely followed by pit-sawdust (28.45%) and retained the nutritional quality of ginger at various storage periods while rhizomes stored inside refrigerator recorded highest percentage weight loss of 62.78%.

Conclusions

In conclusion, storage of rhizomes inside pit-sawdust as well as clay pots for a period of three months before planting produced better ginger growth on the field and maintains the quality of stored rhizomes.

References

ROLE OF CANOPY POSITION ON PHYSICO-CHEMICAL PROPERTIES OF 'MARSH' GRAPEFRUIT DURING NON-CHILLING POSTHARVEST COLD STORAGE

Presenter: OO Olarewaju (oolarewaju1@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
OO	Olawaju	Discipline of Horticultural Science, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3209, Pietermaritzburg, South Africa
LS	Magwaza	Discipline of Crop Science, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3209, Pietermaritzburg, South Africa
OA	Fawole	Department of Horticultural Science, Faculty of AgriSciences, Stellenbosch University, Private Bag X1, Stellenbosch 7602, South Africa
SZ	Tesfay	Discipline of Horticultural Science, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville, 3209, Pietermaritzburg, South Africa
UL	Opara	Postharvest Technology Research Laboratory, South African Research Chair in Postharvest Technology, Department of Horticultural Science, Faculty of AgriSciences, Stellenbosch University, Private Bag X1, Stellenbosch 7602, South Africa

Introduction

Physico-chemical properties of citrus fruit play critical roles in fruit maturity and quality determination. This study investigated the effect of canopy position and production region on physico-chemical properties of 'Marsh' grapefruit at harvest and after storage at 7.5 °C for 3, 6, and 9 weeks. The study also evaluated the use of BrimA as an adoptable internal quality and maturity parameter for 'Marsh' grapefruit.

Materials and Methods

Fruit (600) were harvested from inside canopy (IC) and outside canopy (OC) of fruit trees planted in 1993 on Bolton Citrus Farm, KwaZulu-Natal (KZN) (31° 34' 44" S, 28° 44' 59" E) and Unifruitti Farm, Mpumalanga (MP) (24° 22' 24.39" S, 30° 42' 17.67" E) at maturity in the 2015/2016 harvesting seasons. Colour parameters were measured around the equatorial axis of each fruit using a colorimeter. The ratio of TSS to TA and BrimA indices were calculated using TSS/TA and TSS - k (TA), respectively. Sucrose, glucose and fructose were quantified using HPLC. Data were subjected to analysis of variance using individual fruit as replicates. Least significant difference at 5% level was considered significant.

Results and Discussion

Colour index, L*, ranged between 79.2 and 80.0 for OC fruit and between 78.9 and 81.8 for IC fruit from KZN. The a* and CI were similar, with a* values increasing towards the positive axis of the colour chart suggesting that the fruit colour were consistently changing from a green to yellow colour. The greener rind colour of IC fruit at harvest indicated a reduced expression of carotenoids. Canopy position influenced the TSS/TA ratio such that fruit from OC generally had higher TSS/TA than those from IC for both regions. Although IC fruit had higher TSS/TA (3.88%) than OC fruit (3.24%) at week 0 for fruit from KZN, differences shifted to a higher TSS/TA ratio in OC fruit compared to IC fruit as storage progressed. There was a strong positive correlation between TSS/TA and BrimA (r = 0.94). These results suggest the potential use of BrimA as a parameter for measuring fruit quality. Sucrose declined over the storage periods. At week 0, SI value for IC fruit (12.45, 12.50) was higher than OC fruit (11.50, 11.53) from KZN.

Conclusions

Overall, our results suggested that canopy position affects some physico-chemical properties of 'Marsh' grapefruit. However, fruit displayed high levels of maturity and quality over the period of cold storage. BrimA could potentially be used as an index of internal quality of grapefruit but further studies are suggested.

References

DEVELOPMENT AND EVALUATION OF READY TO EAT (RTE) EXTRUDED SNACK USING WHEAT-COCONUT COMPOSITE FLOUR

Presenter: OP Olatidoye (waleolatidoye@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
OP	Olatidoye	Department of Food Technology, Yaba College of Technology, Yaba, Lagos State, Nigeria
IO	Banjoko	Department of Food Technology, Yaba College of Technology, Yaba, Lagos State, Nigeria
IO	Ajibosin	Department of Chemical Engineering, Yaba College of Technology, Lagos State, Nigeria
OT	Oyelola	Department of Chemical Science, Yaba College of Technology, Yaba, Lagos State, Nigeria
FF	Akinwande	Department of Food Technology, Yaba College of Technology, Yaba, Lagos State, Nigeria

Introduction

The need for the use of locally available raw materials for production of high quality foods is receiving attention recently. This makes conversion of coconut into flour and the use to produce extruded snacks important. Coconut flour has been proven to have high amounts of soluble and insoluble dietary fiber (49%-60%) which is important in functional food development. Objective of this study is to determine nutritional and organoleptic quality of extruded snacks from wheat-coconut composite flour.

Materials and Methods

Coconut flour was produced from coconut fruit purchased alongside other ingredient at open market. Laboratory scale extruder was used to extrude snacks from five blends of wheat-coconut composite flour in proportion of 100:0; 95:5; 90:10; 85:15 and 80:20 inside Food Processing Laboratory of Yaba College of Technology. Proximate composition was determined by AOAC (2005) method. Functional properties: Bulk density was determined by Giami et al. (1992) method, water and oil absorption by Onwuka (2005) method; swelling index was determined by Okezie and Bello (1998) method. Textural properties, consumer acceptability and colour index were also determined

Results and Discussion

The result indicated that the moisture, ash, protein, fibre, crude fat and carbohydrate ranged from 8.6 to 13.96%, 0.33 to 3.59%, 7.02 to 19.85%, 0.54 to 5.50%, 0.83 to 1.92% and 77.32 to 57.92% respectively. Energy values ranged from 328.295 to 326.565Kcal. Functional properties indicated that BD range from 0.5987 to 0.7758 g/cm³; WAC from 0.901 to 1.861%; solubility from 17.485 to 26.554) and OAC from 1.665 to 1.180%. The sample containing 20% of coconut flour had the lightest colour and highest hardness value. The mean scores of organoleptic evaluation showed that all the extruded products were within the acceptable range.

Conclusions

Acceptable snacks of adequate nutritional and organoleptic quality were successfully produced by extrusion from wheat-coconut composite flour. This demonstrates the utilization of coconut flour as a potential ingredient to enhance the nutritional and organoleptic properties in the extruded snack.

References

PRELIMINARY RESULTS ON THE CHEMICAL ECOLOGY OF MAIZE, MAIZE STREAK VIRUS AND CICADULINA VECTOR INTERACTIONS

Presenter: S Oluwafemi (soluwafemi2000@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S	Oluwafemi	Department of Crop Production and Environmental Management, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria
B	Torto	International Center for Insect Physiology and Ecology, Nairobi, Kenya

Introduction

Maize, *Zea mays* L. (Poaceae), is the most important crop in sub-Saharan Africa. A farmer's entire crop can be wiped out by maize streak virus (MSV) (Geminiviridae: genus Mastrevirus). This virus is acquired and transmitted by nine species of leafhoppers in the genus *Cicadulina* (Homoptera: Cicadellidae), in a persistent manner. This study investigated behavioural responses of *C. mbila*, in laboratory bioassays, to volatile organic compounds (VOCs) released by MSV-diseased maize seedlings compared with healthy ones.

Materials and Methods

This work was carried out at the Chemistry laboratory of International Centre of Insect Physiology and Ecology (ICIPE), Nairobi, Kenya. Some adult *Cicadulina mbila* Naude were collected from Kenya Agricultural Research Institute (KARI) to raise a leafhopper colony at ICIPE. Gusau 81 Pool 16, that is susceptible to MSV, was from International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. A glass Y-tube olfactometer (8 cm length and 1 cm diameter for each arm and stem), in a slanting position, was used to test the behavioural responses of adult *C. mbila* to the volatile profile of live maize plants (at the five leaf stage) as the insects moved upwind within the tube (towards the odour source) and responded to odours by entering either arm of the tube. Adult leafhoppers were introduced singly at the base of the stem of the Y-tube and given 10 min period to respond to the test odours. The numbers entering each arm and the time spent were recorded, and analyzed via t-test.

Results and Discussion

Virus-free leafhoppers preferred VOCs from healthy maize to MSV-infected seedlings ($P= 0.028$). Virus-carrying insects however preferred VOC from MSV-infected maize than the VOC from healthy seedlings ($P= 0.010$). Virus-free insects preferred VOC from healthy plants to blank air ($P< 0.001$) and VOC from MSV-diseased plants to blank air ($P<0.001$). Virus-free leafhoppers spent significantly more time ($P= 0.014$) within arm with healthy odours compared to arm with MSV-infected odours. Virus-carrying insects however spent more time ($P= 0.015$) in arm with MSV-infected odours compared to arm with healthy maize odours.

Conclusions

Our work shows the presence of virus in the vector manipulates subsequent choice behaviours

References

FIRST REPORT OF ANTENNAL RESPONSES OF CICADULINA LEAFHOPPER-VECTOR TO VOLATILE PROFILES OF HEALTHY AND MAIZE STREAK VIRUS DISEASED PLANTS

Presenter: S Oluwafemi (soluwafemi2000@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S	Oluwafemi	Department of Crop Production and Environmental Management, Bowen University, P.M.B. 284, Iwo, Osun State, Nigeria
B	Torto	International Center for Insect Physiology and Ecology, Nairobi, Kenya

Introduction

Maize, *Zea mays* L. (Poaceae), is the most important crop in sub-Saharan Africa. A farmer's entire crop can be wiped out by maize streak virus (MSV) (Geminiviridae: genus Mastrevirus). This virus is acquired and transmitted by nine species of leafhoppers in the genus *Cicadulina* (Homoptera: Cicadellidae), in a persistent manner. Constraints to the current solutions of leafhoppers on maize production make the search for alternative control methods, such as use of semiochemicals (naturally-occurring behaviour and development-modifying chemicals), very urgent. We evaluated the release of volatile organic compounds (VOCs) during development of MSV disease and antennal responses of *C. mbila* to such VOCs in laboratory bioassays.

Materials and Methods

This work was carried out at the Chemistry laboratory of International Centre of Insect Physiology and Ecology (ICIPE), Nairobi, Kenya. Gusau 81 Pool 16, that is susceptible to MSV, was from International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. 24 h air entrainment was carried out on healthy and MSV-diseased maize seedlings at the five leaf stage, from which dichloromethane was used to elute the odours followed by Coupled Gas Chromatography- Mass Spectrometry (GC-MS) and Coupled gas chromatography electroantennographic detection (GC-EAD) of the odours by female *C. mbila*.

Results and Discussion

Healthy plants produced fewer VOCs compared to diseased seedlings, as previously reported, but the compounds were different from those induced by maize upon *C. storeyi* infestation (Oluwafemi et al 2010; 2012), except decanal and α -bergamotene. Female *C. mbila* antenna responded to one compound (toluene) from healthy maize but ten from MSV-diseased maize. Antennal active compounds from MSV diseased maize plants included decanal, tridecane, cycloisositivene, tetradecane, bergamortene, beta copaene, a-gurjuene and longifolene.

Conclusions

Volatiles induced by MSV-stressed maize differ from healthy plants. This is the first report of antennal responses of *Cicadulina* leafhoppers to maize host plants. Future work will seek how the antennal active compounds can be used to manipulate vectors in disease management.

References

CLIMATE SMART AGRICULTURE THROUGH CROPPING SEQUENCE TO ENHANCE WATER AND NUTRIENT USE EFFICIENCY OF WHEAT FOR FOOD SECURITY

Presenter: PA Ooro (paoro@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PA	Ooro	Kenya Agricultural and Livestock Research Organization (KALRO), Njoro, P.O. Njoro 20107
R	Birech	Department of Crops, Soils and Horticulture, Egerton University, P.O. Box 536, Egerton Kenya.
JN	Malinga	Food Crops Research Institute, P.O. Box 450 -30200 KITALE

Introduction

Understanding of complex relations between soils, crops, and management practices is necessary to develop sustainable agricultural systems. However, this has been complicated by climate variability and change. In spite of this, smallholder wheat and potato farmers in some areas of Njoro Sub-county in Kenya practice cereal – potato cropping sequence between seasons without considering sustainability of the natural resources. Practices used under such systems were developed many years ago and their continuous use results in depleted soils with low soil organic matter, and poor water retention

Materials and Methods

This study therefore was designed and conducted at the Kenya Agricultural and Livestock Research Organization (KALRO) in Njoro for three years mainly to enhance water use efficiency (WUE) and nutrient use efficiency (NUE) of wheat and potato in a cereal- potato cropping system. The trial consisted of three factors including (1) water harvesting (WH=No ridge and Tie ridge), (2) Crop rotation (CR) (Wheat-Dolichos-Wheat-Dolichos; Wheat-Greenpea-Wheat-Greenpea; Wheat-potato-Greenpea-Potato; Wheat-Wheat-Wheat-Wheat); and (3) Soil Fertility Management (SFM) = including four treatments such as untreated control; Calcium Ammonium Nitrate (CAN) at 25, 50 and 75 kg P₂O₅ ha⁻¹; Farm yard manure (FYM) at 5 t ha⁻¹; and Green manure (*L.eucaena triachandra*) at 2.5 mt ha⁻¹ for three seasons. The treatments were laid out in a randomized complete block design (RCBD) with split-split arrangement with three replications. Data was subjected to an analysis of variance (ANOVA) using SAS statistical package was performed.

Results and Discussion

The result exhibited a more significant ($P<0.05$) influence of Wheat-Greenpea-Wheat-Dolichos and Wheat-Greenpea-Wheat-Greenpea on both water and nitrogen use efficiency than the other two crop rotation systems. Organic sources of nutrients also resulted in a positive influence on the WUE and NUE of both wheat and potato however, the influence was greater in potato than wheat. The influence of inorganic sources was reduced with increase in the rate of nitrogen application.

Conclusions

It is important to note the importance of integrating cereal-legume cropping system and organic sources of nutrients in addressing WUE and NUE as a mitigating strategies under climate change scenarios.

References

STABILITY OF COWPEA GENOTYPES FOR YIELD POTENTIAL AND DISEASE RESISTANCE IN DIVERSE AGROECOLOGIES OF UGANDA

Presenter: M Orawu (orawum@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M	Orawu	National Semi-Arid Resources Research Institute, P.O. Box 56, Soroti, Uganda
P	Obuo	National Semi-Arid Resources Research Institute, P.O. Box 56, Soroti, Uganda
R	Omadi	National Semi-Arid Resources Research Institute, P.O. Box 56, Soroti, Uganda
D	Okwang	National Semi-Arid Resources Research Institute, P.O. Box 56, Soroti, Uganda
R	Amayo	National Semi-Arid Resources Research Institute, P.O. Box 56, Soroti, Uganda
E	Mbeyagala	National Semi-Arid Resources Research Institute, P.O. Box 56, Soroti, Uganda

Introduction

Diseases and unpredictable weather pattern are major constraints faced by cowpea farmers in Uganda. The objective was to identify cowpea genotypes for yield stability and disease resistance.

Materials and Methods

Eleven cowpea genotypes were evaluated in seven locations for four seasons from 2014 to 2015. The GGE biplots determined stability of genotypes for yield and partitioning of test locations into mega-environments and ideal environments based on their discriminating ability.

Results and Discussion

The results of combined analysis indicated that the effects of seasons, locations and season x location were highly significant ($P < 0.001$) for diseases (bacterial blight and yellow blister) and yield, while the effects of genotype and season x genotype were also highly significant ($P < 0.001$) for bacterial blight disease, which influenced on disease occurrence and yield performance. The GGE-biplot analysis gave good visual assessment of GE with PCA1 (34.19%) and PCA2 (28.36%), thus contributing 62.55% of the total GE sum of squares. Serere and Lira were identified as highly discriminating environments for the genotypes tested as having large vectors far from the point of origin and provided necessary information for selection of good genotypes. The high yielding and stable genotypes were SECOW5T x SECOW4W-31, Alegi x SECOW4W-42, ACC12 x SECOW2W-5, ACC23 x SECOW2W-8 and ACC2 x SECOW2W-15 with mean yield values greater than the grand mean of 1349.9kg/ha. The ideal genotype Alegi x SECOW4W-42 was closest to the inner most concentric centre and had high performance and stability. This was followed by SECOW5T x SECOW4W-31, ACC2 x SECOW2W-15, ACC12 x SECOW2W-5, SECOW5T x ACC12-6 and ACC23 x SECOW2W-8 because they were within the circles that surrounded the circle of the virtual ideal genotype. The most ideal test environment and representative was Kumi followed by Lira, Arua and Nakapiripirit, thus indicating greater stability of these environments. The GGE analysis revealed three mega environments with the main one represented three locations (Arua, Nakapiripirit and Lira) and winning genotypes ACC12 x SECOW2W-5 and ACC23 x SECOW2W-8, while two minor environments each represented two locations of Serere and Kumi with winning genotypes SECOW5T x SECOW4W-31 and Alegi x SECOW4W-42 whereas Kitgum and Abim had winning genotypes ACC23 x SECOW4W-4 and Alegi x ACC12-36.

Conclusions

The need for improved, disease-resistant, high yielding and stable cowpea genotypes for farmers to enhance their livelihoods has been clearly established with the most potential genotypes as SECOW5T x SECOW4W-31, Alegi x ACC12-36, ACC12 x Alegi-22, ACC12 x SECOW2W-5, SECOW5T x ACC12-6, ACC23 x SECOW2W-8 and Alegi x SECOW4W-42.

References

RHIZOBIAL SPECIFICITY AND NODULATION IN LEGUMES UNDER DROUGHT CONDITIONS IN THE SEMI-ARID COUNTY OF KITUI IN LOWER EASTERN KENYA

Presenter: CO Orek (oreksacademicsandresearch@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
CO	Orek	South Eastern Kenya University, P.O BOX 170 - 90200, Kitui, Kenya
M	Maluki	South Eastern Kenya University, P.O BOX 170 - 90200, Kitui, Kenya
B	Mweu	South Eastern Kenya University, P.O BOX 170 - 90200, Kitui, Kenya
S	Kisamuli	University of Nairobi, Upper Kabete Campus PO BOX 29053 - 00625, Nairobi, Kenya
TE	Akuja	South Eastern Kenya University, P.O BOX 170 - 90200, Kitui, Kenya

Introduction

Low crop yields in Kenya's arid and semi-arid regions have been attributed to poor fertility and low usage of unaffordable fertilizers. Amongst mitigation measures are legume-based biological nitrogen fixation. Ability of rhizobial strains to survive, nodulate and fix nitrogen varies widely and thus selection of rhizobia with specific symbiotic and competitive attributes suited for drought conditions must assume precedence. Given the high demand for legumes, there is a need to identify and select appropriate legume-rhizobium symbioses that can sustain production in Kenya's dry regions.

Materials and Methods

Two-season field-based drought trials with beans, cowpeas, dolichos lablab and green grams at Kenya's arid county of Kitui (1.4° S, 37.9° E) were conducted. Leaf surface area, root nodules, pods, dry mass and wilting were measured and ANOVA done through GenStat. Sampled root nodules were cultured in the lab to identify rhizobial species which were then inoculated with the legumes under greenhouse to determine their specificity.

Results and Discussion

Nodules exhibited pink coloration and formed raised, translucent and "milkish" colonies, an indication of active nitrogen fixation and non-contamination. All rhizobium species identified were fast growers. Under greenhouse, legumes exhibited species-specific nitrogen fixation. Dolichos lablab, green grams and cowpeas fixed nitrogen via *Rhizobium leguminosarum* and beans fixed nitrogen through *Rhizobium phaseoli*. All assessed parameters significantly varied at legume, treatment and seasonal levels enabling selection of best and least performing legumes. Green grams and dolichos lablab exhibited significantly higher yield compared to cowpeas and beans. Green grams also produced higher total root nodules than other legumes. The leaf surface area of green grams, dolichos lablab and cowpeas insignificantly varied from each other, while the leaf area of beans was substantially smaller. Based on the observed performance, green grams was considered drought tolerant, and beans drought susceptible. Coincidentally, the least and severe leaf wilting were respectively scored in green grams and beans under drought stress. Root nodules positively correlated with yield and negatively with wilting, potentially implying that nitrogen fixation might have contributed to better performance of green grams under water deficient conditions and hence drought tolerance relative to beans.

Conclusions

It can be hypothesized that *Rhizobium leguminosarum* associated with nitrogen fixation in green grams, dolichos lablab and cowpeas, contributed to better yield and performance of green grams under drought stress compared to nitrogen fixation in beans through *Rhizobium phaseoli*. Further research is however recommended to test the efficiency of nitrogen fixation by two rhizobium species.

References

Spatial variation, bias and experimental design in agronomic field trials: a case study of a farming systems trial in the Western Cape province of South Africa

Presenter: D. G. Osborne (devinoz93@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
D.G.	Osborne	Stellenbosch University
A	Rozanov	Stellenbosch University
C	Clarke	Stellenbosch University
J	Strauss	Western Cape Department of Agriculture, Elsenburg

Introduction

Detecting small statistically significant changes in an observed parameter (e.g. – yield) in response to applied treatments within field trials is a major challenge for modern agriculture, since we continue looking for smaller increments where spatial variability or trends may obscure results obtained (Van Es et al., 2007; Bertsimas et al., 2015). This study assesses the effects of spatial variation in yield and topographic properties within a long-term field trial on the possible outcome of field trial results.

Materials and Methods

The experiment was conducted at Langgewens research farm of the Western Cape Department of Agriculture, South Africa as an extension of the long-term trial initiated by the provincial government. The trial area was planted to wheat as a uniformity trial to assess the variability of wheat yield in 2015. A yield monitor mounted on a combine harvester, and remote sensing techniques using drone surveys were used to study the variability in wheat growth/yield, and topographic parameters within the field trial area. Statistical power of the experimental design was calculated and a method of optimization was compared against the conventional method of randomization of field trial designs.

Results and Discussion

A bimodal distribution in wheat yield was present, indicating that there were two distinct zones of yield within the trial area (trend). Although a visual difference was clearly noticeable between treatments, results from a one-way ANOVA showed that no significant difference exists. This suggests that in the presence of field trends, current statistical procedures fail to pick up statistical differences between treatments where a known difference exists. Results from the power analysis indicate that in order to achieve a power of 80%, the minimal detectable difference would be 314 kg·ha⁻¹. Quantifying and accounting for the spatial trend was achieved by optimization for within-treatment standard deviation. The combination of replications into ranked group's results in a significant reduction of within-group standard deviation and, subsequently smaller detectable differences. Results from a random forest regression model indicated that the use of spectral vegetation indices, in combination with topographic parameters could be used to accurately predict wheat yield in dry and in wet years ($R^2 = 0.974$ and $R^2 = 0.987$ respectively).

Conclusions

Results from the power analysis are worrying as modern day agronomic field trials aim at detecting the smallest differences possible. The optimization for within-treatment standard deviation should be further investigated in the time-series analysis as the current experiment progresses.

References

Bertsimas, D., Johnson, M., Kallus, N. 2015. The Power of Optimization Over Randomization in Designing Experiments Involving Small Samples. *Operations Research* 63, no. 4, pp.868–876. Van Es, H. M., Gomes, C. P., Sellmann, M., van Es, C. L. 2007. Spatially-Balanced Complete Block Designs for Field Experiments. *Geoderma* 140, pp.346-352.

SPATIAL VARIATION IN SOIL CHARACTERISTICS AND FIELD TRIAL DESIGN

Presenter: D. G. Osborne (devinoz93@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
D. G.	Osborne	Stellenbosch University
A.	Rozanov	Stellenbosch University
C.	Clarke	Stellenbosch University
J.	Strauss	Western Cape Department of Agriculture, Elsenburg

Introduction

Soil scientists have studied the spatial variability of soils for decades, however there is still a need for further understanding and synthesis of its effects on experimental design (Van Es et al., 2007; Venter et al., 2013). The aim of this study was to determine the potential effects of soils (soil type and condition of soil surface) on the possible outcomes of a long-term crop rotation trial.

Materials and Methods

The experiment was conducted on 11 ha of land at the Langgewens research farm of the Western Cape Department of Agriculture, South Africa as an extension of the long-term trial initiated by the provincial government. All the fields prior to the trial were uniformly sown to spring wheat and the yield was recorded using yield monitor mounted on a combine harvester to assess the magnitude of yield variation. Soils (22 profiles) were classified according to the binomial soil classification system of South Africa (Soil Classification Working Group, 1991) and sampled per diagnostic horizon. Soil core samples taken from a 0-5cm depth per experimental unit (120 in total) were analysed for some common soil parameters and statistically analyzed along with the yield data.

Results and Discussion

A camp with arguably a single soil type showed the smallest variation in yield. The three camps within the field trial area differed significantly with regard to measures soil properties. None of the topsoil properties showed high correlation with wheat yield. The only exception was the resistance measurements, which indicated that a high degree of leaching negatively correlated with wheat production. The highest yielding camp, was separable from the lower yielding camps based on K⁺, CEC, sand percentage, silt percentage and bulk density. Although a pattern in wheat yield could be noticed, the variability in yield cannot be captured by one soil property alone, and is a result of a complex interaction between many soil characteristics. Results from the statistical and geostatistical analyses indicate that the variability in soil conditions is introducing a strong spatial bias, which could lead to incorrect interpretation of trial results. The experimental design was optimized in a setup-wise manner to reduce the overall variance between treatments

Conclusions

The variation in routinely analysed soil properties across the field within the 0-5cm layer showed no effect on wheat productivity. Soil types were a better predictor of yield differences within the field than the topsoil conditions

References

Van Es, H. M., Gomes, C. P., Sellmann, M., van Es, C. L. 2007. Spatially-Balanced Complete Block Designs for Field Experiments. *Geoderma* 140, pp.346-352. Venter, A., Smith, M. F., Beukes, D. J., Claassens, A. S., Meirvenne, M. 2016. Spatial variation of soil and plant properties and its effects on the statistical design of a field experiment. *South African Journal of Plant and Soil*, 26(4), pp.231-236.

Opportunities for a knowledge led development strategy for Africa: RUFORUM's 2030 Strategy

Presenter: MO Osiru (m.osiru@ruforum.org)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MO	Osiru	Regional Universities Forum for Capacity Building in Africa (RUFORUM), 151 Garden Hill, Makerere University, Kampala, Uganda
E	Adipala	Regional Universities Forum for Capacity Building in Africa (RUFORUM), 151 Garden Hill, Makerere University, Kampala, Uganda
C	Owuor	Regional Universities Forum for Capacity Building in Africa (RUFORUM), 151 Garden Hill, Makerere University, Kampala, Uganda
P	Nampala	Regional Universities Forum for Capacity Building in Africa (RUFORUM), 151 Garden Hill, Makerere University, Kampala, Uganda
S	Mkandawire	Regional Universities Forum for Capacity Building in Africa (RUFORUM), 151 Garden Hill, Makerere University, Kampala, Uganda
S	Uwituze	Regional Universities Forum for Capacity Building in Africa (RUFORUM), 151 Garden Hill, Makerere University, Kampala, Uganda
A	Egeru	Regional Universities Forum for Capacity Building in Africa (RUFORUM), 151 Garden Hill, Makerere University, Kampala, Uganda

Introduction

Achieving agricultural led development and the sustainable development will require greater use of knowledge to support all stakeholders in African food systems. African universities have an important role to play in use of science, technology and innovation by building consortiums and networks of networks to contribute to community impact and achievement of the vision of the African Union Agenda 2063.

Materials and Methods

RUFORUM focuses its work on building connections between universities and communities. Over the last 13 years, RUFORUM has been successful at training graduate students with new skills sets (over 200 postgraduates trained), both technical and transversal. However, the need to engage with development goals at scale remains a challenge that RUFORUM wishes to respond to. RUFORUM initiated a consultative process that involved various stakeholder and expert consultations to develop a new vision and strategy to scale up lessons and support the achievement of the sustainable development goals in Africa.

Results and Discussion

RUFORUM has been successful at 1) developing quality human resources and capacity required to intensify and increase Africa's agricultural productivity, 2) ensuring the products, processes and knowledge developed through university research reach down to value chain actors in the agri-food system to catalyse transformation and 3) Marshalling resources and strategically allocating them to enable universities to transform into viable institutional entities responsive to national aspirations and conditions through intensive knowledge-sharing and collective action. Three core areas have been the focus of RUFORUM Strategic framework: strengthening university private sector and government interconnectedness; enhancing internal governance, and RUFORUM's resource base and enhancing academic mobility across Africa. The outcome of RUFORUM consultative process led to a new vision for RUFORUM building on its successful model for training the next generation of agricultural development stakeholders.

Conclusions

This new strategy and vision provides a means to leverage current capacity at African universities to respond to the development challenges and meet the sustainable development goals and the African Union Agenda 2063. The four flagship programs outlined are built to scale lessons from RUFORUM's over 10 years' experience in the higher agricultural education sector.

References

Properties of stockpiled soils on South African coal mines

Presenter: DG Paterson (garry@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
DG	Paterson	Agricultural Research Council - Institute for Soil, Climate and Water, Private Bag X79, Pta 0001

Introduction

When soils are removed in the process of open cast coal extraction, they are stored (stockpiled) for later rehabilitation, which is often problematic. Problems and incorrect practices in the stockpiling process can have direct and lasting effects on the long-term rehabilitation of such areas. A project has recently been completed for the Coaltech Research Association, which investigated some of the changes that coal mine soils undergo in the stockpiling phase, especially the many immediate detrimental effects, such as increased bulk density, loss of organic matter, acidification and physical mixing of horizons.

Materials and Methods

Four sites in the vicinity of Emalahleni (Witbank) were studied, and samples collected from the unmined soil, stockpiles and final rehabilitated areas.

Results and Discussion

The analytical results showed significant deterioration in all significant soil properties with the stockpiling process. On average, clay content increased by between 50% and 60% for both the topsoil and subsoil (probably due to mixing with wrongly stockpiled deeper materials), while surface bulk density (compaction-related) increased through the entire chain from stockpiling to rehabilitation. The stockpiled soils were so compacted that penetrometer insertion was not possible, with effective depths on rehabilitated areas being less than 17 cm in most cases. Chemically, CEC values showed only a slight increase compared to clay content, showing the effects of leaching after stripping, while pH values showed a large variation, again due to mixing effects (combining of original topsoils and subsoils) of stockpiling. Topsoil organic carbon declined by almost half through stockpiling and only showed a slight increase in the rehabilitated soils, while C:N ratios fell across the whole process.

Conclusions

The results of the project have led to several recommendations regarding soil stockpiling, including: using pre-mining soil survey results effectively, carrying out stripping and stockpiling properly under supervision, limiting the height and duration of soil stockpiles as well as the amount of vehicle traversing, and ensuring soil scientist participation in the whole process to identify potential problems timeously. The soil resource of South Africa is precious and needs to be protected, even during disruptive processes such as open cast coal mining.

References

Soil Classification: a revised system for Natural Soils

Presenter: DG Paterson (garry@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
DG	Paterson	Agricultural Research Council - Institute for Soil, Climate and Water, P/Bag X79, Pta 0001
DP	Turner	Agricultural Research Council - Institute for Soil, Climate and Water, P/Bag X79, Pta 0001

Introduction

There have been two previous editions of the South African Soil Classification System, published in 1977 (“Red Book”) and 1991 (“Blue Book”). Recent knowledge and changes in the way of thinking have led to the revision of the system, resulting in a new version being produced under the auspices of the Soil Classification Working Group.

Materials and Methods

While the basic structure of the system remains the well-known soil forms and families, the major change sees the introduction of an “open-ended” system, whereby horizons below the traditional soil profile depth of 1 500 mm can now be assessed as diagnostic horizons no matter what their position is in the profile, and the information of such horizons can be added to the profile description.

Results and Discussion

In addition, a section has been introduced to allow classification of anthropogenic soils that have resulted from human-induced activities, such as mining and industry. Other changes include the redefinition of some of the soil horizons, and the introduction of new horizons such as a new peat topsoil horizon as well as new gypsic, lithic, hard rock, and alluvium subsoil horizons. Recognition has been given to the role that hydropedology plays in subsoil water movement, as well as the need to accurately define the potential range of actual soils occurring in South Africa. To this end, the soil profile database at ARC-ISCW, containing around 15 000 soil profiles, was utilized to identify ranges and occurrence of such soils, as well as to help ensure that the revised edition is based on sound scientific principles that can be applied throughout South Africa. The number of soil forms has increased from 78 to 129, but the structure of the system makes it easy to adapt and introduce new forms if specific combinations and occurrences become evident as soil classification research progresses. Provision is made for the use of soil series, phases and qualifiers to be identified and used as and when required by a specific user.

Conclusions

It is also hoped that an electronic data library, containing such items as documents relating to soil classification, photographs of soil profiles, a comprehensive glossary and other files, will be created and maintained for wider general use.

References

Progress in understanding and addressing macadamia kernel discolouration

Presenter: MG Penter (mark@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MG	Penter	P/Bag X11208, Nelspruit, 1200
EM	Nkwana	P/Bag X11208, Nelspruit, 1200
KY	Nxundu	P/Bag X11208, Nelspruit, 1200

Introduction

Macadamia kernel discolouration manifests as a brown stain (a phenolic compound) possibly originating in the shell. It declines in severity as the season progresses and rainfall during kernel development affects its presence. Discoloured kernels tend to contain high levels of manganese and iron. This suggests that discolouration is related to nutrient uptake, which in Proteaceous species is affected by the extent of proteoid root development. Phosphorous status controls proteoid root development. High manganese uptake may interfere with calcium acquisition. Calcium status is known to affect polyphenol formation in other crop species. Hypothesis: 'kernel discolouration is associated with excessive proteoid root development and changes in mineral uptake'. Treatments altering root growth may ameliorate the disorder in the longer term, while calcium applications may offer a short term reduction in discolouration

Materials and Methods

Data mining of quality data from processors was analysed to determine whether there are trends over time which may provide further information about the etiology of the disorder. Four foliar applications of five calcium containing products were made to 'Beaumont' trees in KZN. Nuts evaluated for presence and intensity of discolouration. Phosphate applications of either 75g or 150g MKP per tree were made at flowering to control root development. An additional two soil-applied growth inhibitor treatments were also made either 2 ml/tree or 5 ml/tree of uniconazole. Nuts were again evaluated for presence and intensity of discolouration.

Results and Discussion

A significant correlation between shell thickness and discolouration was found during the data mining. Nuts with thinner shells tend to have more discolouration and this was more noticeable in KZN. This suggests that factors affecting shell development also play a role in discolouration. Application of foliar Calcimax resulted in reduced proportions of the most severely stained kernel. Calcium applications warrant further investigation. MKP applications to control root growth resulted in a reduction of severely stained kernel and the lower MKP application rate saw an increase in the amount of clean kernel. Uniconazole applications also significantly reduced kernel affected by discolouration. It is not known whether this was due to reduced root growth or an increase in nutrients partitioned to nut development due to reduced vegetative growth.

Conclusions

Calcium applications seem to have potential for reducing the extent of discolouration in the season of application. Treatments affecting root structure may offer more lasting solutions to the prevalence of the disorder.

References

EFFECTS OF POULTRY MANURE RATES ON SOME GROWTH ATTRIBUTES OF CUCUMBER IN OWERRI, SOUTH EASTERN NIGERIA.

Presenter: CP Poly-Mbah (pearlpolymba@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
CP	Poly-Mbah	Department of Agricultural Education, Alvan Ikoku Federal College of Education , Owerri , Nigeria.
EO	Obioma	Department of Agricultural Education, Alvan Ikoku Federal College of Education , Owerri , Nigeria.
J	Amajuoyi	Department of Agricultural Education, Alvan Ikoku Federal College of Education , Owerri , Nigeria.

Introduction

The effects of manure rates on some growth attributes of cucumber in Owerri , South eastern Nigeria, was studied under field conditions. Fruit vegetables are widely cultivated and produced in Northern Nigeria but greatly consumed in Southern Nigeria where it commands high demand and price, yet, minimally cultivated. Farmers in northern Nigeria incur lots of losses because cucumber is transported all the way from the northern Nigeria to Southern Nigeria. There is need therefore to evolve packages that will enhance Cucumber production in Southern Nigeria. The objectives of the study were to assess the effects of poultry manure rates on number of days to 50% seedling emergence, vine length/plant, leaf area per plant and the number of leaves produced per plant.

Materials and Methods

The experiment was conducted in the Teaching and Research Farm of Department of Agricultural Education, Alvan Ikoku Federal College of Education, Owerri, Nigeria. The design used for the experiment was Randomized Complete Block Design (RCBD) with three blocks (Replications). Treatments consisted of four rates of well decomposed poultry manure at the rate of 0 tons/ha, 2 tons/ha, 4 tons/ ha and 6 tons/ha. Data were collected on number of days to 50% seedling emergence, vine length per plant at two weeks interval, leaf number per plant at two weeks interval, leaf area per plant at two weeks interval. This experiment was repeated. Data collected were subjected to analysis of variance test at 5% probability level using SPSS software.

Results and Discussion

Results from the analysis of variance (ANOVA) showed that there were highly significant effects of poultry manure on growth parameters studied which include number of days to 50% seedling emergence, vine length per plant, leaf number per plant, leaf area per plant such that increase in poultry manure rates lead to increase in growth parameters studied. Manure rate of 6 tons/ha gave the best performance in the parameters studied.

Conclusions

Therefore, null hypothesis (Ho) was rejected, while the alternative hypothesis was accepted. Poultry manure rate of 6 tons/ha is therefore recommended for a good ground cover since it gave the highest performance in all the growth parameters studied.

References

The impact of 20 % white shade netting on the microclimate of a 'Nadorcott mandarin' orchard and the tree physiology

Presenter: MD Prins (mdtprins@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
MD	Prins	Department of Horticultural Science, University of Stellenbosch.
GH	Barry	XLnT Citrus, Helderberg, Cape Town
PJR	Cronjé	Citrus Research International (Pty) Ltd, Department of Horticultural Science, University of Stellenbosch

Introduction

Agricultural uses for shade nets as a technology to change the light quality and quantity is primarily focused to increase return on investment by reducing the occurrence of damaged to fruit. By constructing shade net over an orchard the microclimate is expected to be modified due to the reduction or increase of light, temperatures, relative humidity % (RH), wind speed, soil temperature and soil water content. Alteration of these parameters could also affect vapour pressure deficit (VPD) and evapotranspiration demand for the plant soil continuum. These changes in the microclimate of an orchard can affect the physiological processes of a citrus tree.

Materials and Methods

Changes in microclimate were quantified by using two Campbell scientific weather stations. One weather station was placed under the shade netted area and other in an open block above tree canopy. Logging occurred on an hourly basis of the following parameters: wind speed (m.s-1), ambient and soil temperatures (°C), relative humidity (%), soil water content (m³.m-3) and solar radiation (MJ.m-2). Within canopy air temperatures and RH was measured on an hourly basis using TinyTag data loggers and was used to evaluate the effect on physiological measurements done monthly with a Li-Cor infra-red gas analyser.

Results and Discussion

Solar radiation was reduced by 17%, in addition the shade netting reduced mean and maximum temperatures with an increase in minimum temperatures observed. Temperatures within the canopy was increased that lead to a significant increase of effective heat units. Increased relative humidity under the netting lowered VPD during the growth season (Nicolás et al., 2008). Average soil temperatures was higher under shade net resulting in less diurnal fluctuations between minimum and maximum temperatures. Soil water content was increased by 17 % over the two years. The average and maximum wind speed was reduced under shade nets acting as synthetic windbreak concurring with Tanny et al. (2008) and Wachsmann et al. (2008). Changes in micro climate had an increased significant effect on physiological measurements especially during summer months and concurred with results found by Jifon and Syvertsen (2003).

Conclusions

The 20 % white shade netting affected the orchard microclimate of a 'Nadorcott mandarin' orchard in Citrusdal and affected the tree physiology to a certain extent throughout the season.

References

Jifon, J.L., and Syvertsen, J.P. 2003. Moderate shade can increase net gas exchange and reduce photoinhibition in citrus leaves. *Tree physiol.* 23:119-128. Nicolás, E., Barradas V.L., Ortuño M.F., Navarro A., Torrecillas A., and Alarcón J.J. 2008. Environmental and stomatal control of transpiration, canopy conductance and decoupling coefficient in young lemon trees under shading net. *Environmental and Experimental Botany.* 63: 200-206 Tanny, J., Cohen, S., Grava, A., Naor, A., and Lukyanov, V. 2008, April. The effect of shading screens on microclimate of apple orchards. *Acta. Hort.* 807:103-108 Wachsmann, Y., Zur N., Shahak, Y., Ratner, K., Giler Y., Schlizerman, L., Sadka, A., Cohen, S., Garbinshikof, V., Giladi, B., and Faintzak, M. 2012. Photosensitive anti-hail netting for improved citrus productivity and quality. *Acta. Hort.* 1015:169-176.

DOES MARKET PRODUCTION AFFECT TECHNICAL EFFICIENCY? A FOOD-CASH CROP IN A SUBSISTENCE FARMING SYSTEM IN WESTERN UGANDA

Presenter: R Proscovia (ntakyop@yahoo.co.uk)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PR	Ntakyo	Development Economics group, P.O. Box 8130, 6700 EW Wageningen, Wageningen University, Netherlands., National Agricultural Research Organization, Mbarara ZARDI, P.O Box 389, Mbarara, Uganda
M	Van den Berg	Development Economics group, P.O. Box 8130, 6700 EW Wageningen, Wageningen University, Netherlands.

Introduction

Developing countries face the challenge of feeding their rapidly increasing population on limited productive land. To meet increasing food demand most countries cannot rely on expanding the crop area, but will need to stimulate yield growth arising from increased factor productivity. This can be achieved through more efficient utilization of inputs to produce maximum output given existing technologies. Low crop productivity arising from technical inefficiency negatively impacts on household income and food security by reducing food availability as well as economic access. It has been hypothesised that market-oriented crop production enhances productivity of staple crops through increased use of quality inputs and management technologies. We test this hypothesis using household survey data from western Uganda.

Materials and Methods

This study uses data from a household survey on market-oriented crop production and food security conducted in western Uganda. A multi-stage sampling procedure was used to select 1137 households. We use a stochastic production frontier model to estimate technical efficiency in production of key crops; rice as a food cash crop; and beans and sweet potatoes as major staples. A propensity score matching approach is used to compare technical efficiency of market-oriented and subsistence households in production of the staple crops.

Results and Discussion

Overall, we find low technical efficiency in production of both the food cash crop and the staple crops. Results show higher technical inefficiency in staple crops compared to the cash crop (rice) among the market-oriented households. We also find a significant negative relationship between cash crop production and technical efficiency in staple crops production. Results reveal that technical inefficiency in bean production is higher by 8.3% for market-oriented households compared to subsistence households. Similarly, in sweet potato production, technical inefficiency for market-oriented households is higher by 14.0 %. We attribute the negative association to withdrawal of critical resources particularly labour from staple crops to cash crops during peak periods of labour demand. A majority (61.2%) of households rely heavily on family labour for production, this means that during peak periods of labour demand, family labour is constrained thus affecting timely field operations and consequently technical efficiency.

Conclusions

There is significant potential for households to increase output in both cash and staple crops by increasing technical efficiency. However, for market-oriented households, increasing staple crop production may partly require withdrawing some inputs from the cash crop.

References

YIELD AND QUALITY OF SWEET MELON CULTIVARS GROWN IN HYDROPONICS SYSTEM

Presenter: L B Pulela (boitshepopulela@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
L.B	Pulela	Tshwane University of Technology, Private Bag X680, Pretoria, 0001
M.M	Maboko	Agricultural Research Council - Vegetable and Ornamental Plants, Private Bag X293, Pretoria, 0001
P	Soundy	Tshwane University of Technology, Private Bag X680, Pretoria, 0001

Introduction

Quality of sweet melons is determined by their external and intrinsic characteristics. Cultivars differ in sensitivity to temperature extremes, tolerance or susceptibility to pests and diseases, maturation, fruit quality, size and yield. The objective of the study was to evaluate the performance of hydroponically grown sweet melon cultivars in terms of yield, fruit quality, and mineral content.

Materials and Methods

The study was carried out at the Agricultural Research Council – Vegetable and Ornamental Plants, Roodeplaat, Pretoria, in a non-temperature controlled plastic tunnel. Plants were grown in open bag hydroponics system using 10 L planting bags filled with sawdust as a growing medium. Ten sweet melon cultivars (Majestic, Magritte, Divine, Honey Brew, Honey Star, Cyclone, MAB 79001, Adore, E25F.00075 and E25F.00185) were evaluated and the experiment was laid out in a randomized complete block design with four replicates. Yield and quality parameters (total soluble solids, pH and EC of the extracted juice) were measured at harvest. Fruit samples were freeze dried and analysed for ascorbic acid, total phenols, flavonoids, β -carotene and mineral elements (phosphorus, potassium, magnesium, calcium, and zinc) were determined using an aliquot of the digest solution for ICP-OES.

Results and Discussion

Cultivars differed significantly in unmarketable yield, with netted cultivar MAB 79001 and Magritte, and smooth skinned green fleshed Honey Brew and Honey Star recording the highest unmarketable fruits, because fruit are prone to cracking. Though quality and appearance of the fruits was reduced, the total yield was not affected by cracking. Cultivars differed significantly in total soluble solids as a key quality indicator in sweet melon, with E25F.00185 recording the highest brix %, though no significant difference was obtained amongst Majestic, Honey Brew, and Cyclone. Beta-Carotene recorded the lowest for Honey Brew and Honey Star probably due to less carotenoid pigments related to colour of the fruits. Fruit zinc content showed no significant difference amongst cultivars excluding the green fleshed cultivars. Though the results showed no significant difference in total yield amongst cultivars, Devine and Honey Star had the highest number of marketable fruits per plant.

Conclusions

The results suggest that Devine and Honey Star are the best yielding cultivars, with high number of fruits produced per plant, however E25F.00185 had high quality fruits with high brix %. The results emphasizes the importance of cultivar selection and that high yielding cultivars and quality sweet melon fruits can be obtained through selection of the correct cultivars for hydroponic system production.

References

THE EFFECT OF LIME APPLICATION ON SOIL PH AS WELL AS THE GROWTH AND YIELD OF QUEEN PINEAPPLE

Presenter: EC Rabie (erabie@mtuba.co.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
EC	Rabie	Hluhluwe research station, P.O. Box 194, Hluhluwe, 3960
BW	Mbatha	Hluhluwe research station, P.O. Box 194, Hluhluwe, 3960

Introduction

Standard nitrogen (N) fertilization practices on pineapples in the area consist of approximately 500 kg/Ha ammonium sulphate as a pre-plant N source, followed by up to 1500 kg/Ha ammonium sulphate as topdressing at various growth stages. This source of N is one of the most acidifying, especially in sandy soils. To balance the effect of ammonium sulphate application, a pre-plant lime application is applied about 3 months before planting. Due to the low pH of soils, the recommended lime dosage can sometimes be as high as 6t/ha. The effects of under or over application of lime were determined in this trial.

Materials and Methods

A pineapple field was divided into 5 blocks representing 5 replicates. Soil samples were taken in each replicate. Four treatments were randomized in each replicate. The dosages applied varied according to the analysis of each replicated block. Soil samples were taken at 2 different depths, namely at 0-20cm and 20-40cm in each block. A minimum of 10 subsamples for each block and for each depth were combined and a representative sample taken. These samples were analysed using routine methods. Lime application for each block was determined by the acid saturation analysed. The type of lime to be applied was determined by the Ca and Mg ratio in the soil. The treatments were selected representing a 0 dosage (Treatment 1), half the recommended dosage (treatment 2), the recommended dosage (treatment 3) as well as 1.5 times the recommended dosage (treatment 4).

Results and Discussion

Pre-application soil pH varied between 3.7 and 4.1 in the different replicated blocks and lime applications determined for the different replicates of each treatment varied between 1 to 2 ton/ha for the sub-optimum application, 2 to 4 tons/ha for the recommended dosage and 3 to 6 tons/ha for the higher than recommended dosage. Treatment 1 (no lime applied) gave the highest yield, while the lowest yields were found in the sub-optimum (treatment 2) and the higher than recommended dosage (treatment 4).

Conclusions

The results found in this trial questioned the necessity of lime applications to rectify soil pH in Queen pineapple cultivation. According to Py et al. (1987) the pineapple is well adapted to grow on acidic soils with a pH of 4.5 to 5.5. It seems from this work that an even lower pH does not have a significantly negative effect on yield.

References

Py, C., J.J. Lacoeylthe, and C. Teison. 1987. The pineapple, cultivation and uses. G.P. Maisonneuve et Larose. Paris

FROM LABORATORY TO FIELD - ASSESSING THE IMPACT OF TISSUE CULTURE PROPAGATION ON THE AGRONOMIC PERFORMANCE OF SUGARCANE

Presenter: S Ramburan (Sanesh.Ramburan@sugar.org.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S	Ramburan	1 South African Sugarcane Research Institute, Private Bag X02, Mount Edgecombe 4300, 2 University of KwaZulu-Natal, School of Agriculture, Earth and Environmental Sciences, Private bag X01, Scottsville, 3610
S	Snyman	1 South African Sugarcane Research Institute, Private Bag X02, Mount Edgecombe 4300, 3 University of KwaZulu-Natal, School of Life Sciences, Westville Campus, Private Bag X54001, Durban, 4000
S	Shezi	1 South African Sugarcane Research Institute, Private Bag X02, Mount Edgecombe 4300, 2 University of KwaZulu-Natal, School of Agriculture, Earth and Environmental Sciences, Private bag X01, Scottsville, 3610

Introduction

The NovaCane® tissue culture (TC) protocol involves rapid in vitro production of disease free sugarcane plants. Success of the TC protocol is dependent on the production of true-to-type plants with agronomic characteristics of the source genotype. This paper describes a series of investigations and mitigation techniques aimed at optimising the TC protocols and reports on results from recent field trials evaluating the success of such interventions.

Materials and Methods

In preliminary field assessments, TC plants of five genotypes were compared with conventional propagation (Con) in a replicated (4) split plot trial at Komatipoort, South Africa. Results from this experiment led to adjustments to the TC protocols, which included adjusting in vitro plant growth regulators and physical “splitting” of tillers during hardening off. In the second round of field assessments (with above adjustments to the protocols), a replicated field trial was conducted in Mt Edgecombe. Here, four genotypes (N12, N31, N41, N48) were planted using TC or Con plants, in a replicated (4), RCBD, rainfed experiment. The TC plants were planted at either 30 or 50 cm plant spacings. For genotypes N41 and N48, two variations of the TC process were evaluated: i) the use of cobalt chloride to limit ethylene induced tillering; and ii) a secondary meristem excision procedure. In all experiments, cane yield (TCANE), estimated recoverable crystal content (ERC%), ERC yield (TERC), stalk population (stalks/ha), and stalk diameter (mm) data were analysed.

Results and Discussion

Preliminary field assessments showed altered field performances of TC plants (significant reductions in TCANE, TERC, and diameter) compared with Con. In the follow-up experiments, subsequent to protocol adjustments, no significant differences were observed between the TC and Con treatments for TCANE, ERC% and TERC across two crops. The TC method significantly ($P < 0.05$) reduced diameter in three (N12, N31, N41) out of four genotypes, while stalk population was significantly increased through TC in N12 and N31. Plant spacing had no effect on the commercially important traits. The two variations to the TC protocol did not affect any trait in general.

Conclusions

The NovaCane® in vitro micropropagation technology does not compromise the agronomic performance of sugarcane in plant and first ratoon crops. Reductions in stalk diameter due to the TC process are variety dependant. Some varieties (e.g. N48) are insensitive to the TC process. It is recommended that propagation of new varieties through NovaCane® for commercial release continues, with simple screening for sensitivities to stalk diameter reduction, to sensitize growers to these effects.

References

EFFECT OF PROCESSING AND HEAT TREATMENT ON BETA CAROTENE AND TOTAL PHENOLIC CONTENT IN 'MONATE' SWEET POTATO

Presenter: T.M. Raphalalani (tmraphalalani@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T.M.	Raphalalani	university of Limpopo, Private bag x1106, Sovenga, 0727
M.Y.	Maila	University of Limpopo, Private bag x1106, Sovenga, 0727

Introduction

Sweet potato (*Ipomea batatas*) is a highly nutritious tuber crop, rich in antioxidants compared to the common white potato (Truong and Avula, 2010). However, processing and heat treatment (HT) methods used in sweet potatoes (SPs) had been reported to affect its nutritive value. Therefore, a study was conducted to investigate the effect of processing followed by HT on antioxidants (beta carotene and total phenolic content) of 'Monate' sweet potato (MSP) variety.

Materials and Methods

A 2 x 3 factorial experiment arranged in CRD was conducted, where Factor A represented processing methods (peeled and unpeeled) and Factor B denoted HT (raw, baked and boiled) in triplicates. Raw peeled and unpeeled MSPs represented the control. Peeled and unpeeled MSPs were baked and boiled until soft for consumption. All samples including the standards were dried for 24 hrs after HT and then grinded to fine powder prior to beta carotene (BC) and total phenolic (TP) determination. Beta carotene was determined using AOAC, (1980) method, whereas TP was analysed using Panda and Picha (2008) method. Data collected were subjected to ANOVA using Statistix 10.0.

Results and Discussion

Interaction of processing x HT significantly ($P \leq 0.05$) affected BC and TP, contributing 42% and 43% of total treatment variation in MSPs, respectively. Relative to the unpeeled raw MSPs, BC in baked MSPs increased by 40%, whereas in boiled MSP was equivalent to the control. In contrast, in peeled MSPs, baking and boiling reduced BC by 10% and 3%, respectively. Total phenolic in unpeeled baked and boiled MSP when compared to the control was increased by 262% and 267%, respectively. Similarly, in peeled MSP, baking increased TP by 10%, whereas boiling reduced TP by 25%.

Conclusions

Unpeeled baked MSPs retained higher BC and TP, whereas unpeeled boiled retained TP. It is recommended that MSPs should not be peeled when subjected to baking and boiling methods.

References

Association of Official Analytical Chemists (AOAC). 1980. Official Methods of Analysis. W. Horwitz (ed) 13th edition 233-234pp, Padda, M.S. and Picha, D.H. 2008. Phenolic composition and antioxidant capacity of different heat processed forms of sweetpotato cv. 'Beuregard'. International Journal of Food Science Technology 43:1404-1409. Truong, V.D. and Avula, Y.R. 2010. Sweet potato purees and powder functional food ingredients. Post-harvest food Aspect in food, ISBN: [978 (1) 6087-63436].

The effect of a low-density, white shade net on the phenology, production and postharvest fruit quality of 'Nadorcott' mandarin (*Citrus reticulata* Blanco.)

Presenter: N.J.R. Roets (nico@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
NJR	Roets	Agricultural Research Council Tropical and Subtropical Crops, Private Bag X11208, Nelspruit, 1200
IF	Ngwamba	University of Kwazulu Natal, Private Bag X01, Scottville, 3209
MEK	Ngcobo	Agricultural Research Council Tropical and Subtropical Crops, Private Bag X11208, Nelspruit, 1200
SZ	Tesfay	University of Kwazulu Natal, Private Bag X01, Scottville, 3209

Introduction

Shade nets are increasingly used by South African mandarin growers. Although benefits, such as protection against hail and sunburn and improved fruit quality were reported, there is still a lack of scientific evidence on the effect of these shade nets on tree performance, production and postharvest fruit quality of mandarins. The aim of this study was therefore to investigate the effect of a low-density, white shade net on tree performance, production and postharvest fruit quality of 'Nadorcott' mandarins.

Materials and Methods

The study was carried out over a three year period (2015 to 2017) in the Mbombela (Nelspruit) area of Mpumalanga on bearing 'Nadorcott' mandarin trees. Two treatments were applied in a randomised pseudo-block design with one treatment covered with a low-density (20%) white shade net and the other treatment left uncovered. Over the three year period data on orchard microclimate (temperatures and relative humidity), phenology (tree vigour and return bloom), and postharvest fruit quality (fruit size, colour, firmness, TSS, TA, juice and vitamin C content) were collected.

Results and Discussion

The shade net led to a reduction in day temperatures (0.39 degrees celcius) and an increase in night temperatures (0.41 degrees celcius), which provided some protection against extreme weather conditions. Relative humidity was increased by approximately 3% by the shade net. Tree vigour was increased by the shade net. Shoot length and leaf area was increased with 25 and 28% respectively. The effect of the shade net on yield was variable, while return bloom was not significantly influenced by the shade net. Fruit from trees under the shade net were larger with a higher juice content but lower TSS and TA contents. Fruit colour, firmness and vitamin C content were not affected by the shade net.

Conclusions

The low-density, white shade net provided some protection against adverse environmental conditions and can lead to improved marketability of fruit. However, increased tree vigour will necessitate more intensive pruning.

References

A participatory approach for exploring options for ecological intensification to improve food security and agricultural sustainability: A perspective of South African smallholder agriculture

Presenter: F Rusere (farirairusere@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
F	Rusere	Climate System Analysis Group, Department of Environmental and Geographical Science, University of Cape Town, P Bag X3 7700Rondebosch Cape Town South Africa
S	Mkuhlani	Climate System Analysis Group, Department of Environmental and Geographical Science, University of Cape Town, P Bag X3 7700Rondebosch Cape Town South Africa
O	Crespo	Climate System Analysis Group, Department of Environmental and Geographical Science, University of Cape Town, P Bag X3 7700Rondebosch Cape Town South Africa
J	Francis	The Institute of Rural Development, University of Venda, Thohoyandou South Africa
L	Zhou	Risk and Vulnerability Science Centre Faculty of Science & Agriculture University Of Fort Hare P Bag X1314 Alice 5700 Eastern Cape South Africa

Introduction

Appropriate ecological intensification (EI) is required in Sub-Saharan African agriculture to meet the increasing demand for food and agricultural sustainability to minimise environmental degradation. Many EI options are currently and widely being promoted in African smallholder farming systems. The interaction between EI to avoid environmental degradation, and the same approach to adapt to climate change has not been much explored in Sub Saharan Africa.

Materials and Methods

To assess the potential of these EI options to contribute to soil and water conservation, nutrient recycling, pest suppression ecosystem services and their potential in adapting and mitigating climate change effects in these smallholder farming systems, we evaluated 17 EI options published in literature which are common in South African smallholder agriculture. We explored the strengths, weaknesses and what needs be done to improve the uptake of EI options in 2 rural municipalities of Raymond Mahlaba and Thulamela in Eastern Cape and Limpopo provinces respectively in South Africa using participatory techniques

Results and Discussion

Results showed that although these options had potential to sustainably improve soil water conservation, soil fertility, pest suppression and adapting and mitigating the effects of climate change in smallholder farming systems. Their potential was limited due to lack of awareness, germplasm, land, labour, government and technical support related constraints. Mechanisms need to be put in place to enhance awareness of the options, avail germplasm, farmer training, improved government extension and technical support to make the options more attractive to the smallholder farmers in the area.

Conclusions

Only then when issues of EI options are effectively addressed, this will be a critical step toward successfully implementing EI in smallholder agriculture in sub Saharan Africa.

References

Calzadilla, A., Zhu, T., & Rehdanz, K. (2014). Climate change and agriculture : Impacts and adaptation options in South Africa. *Water Resources and Economics*, 5, 24–48. <https://doi.org/10.1016/j.wre.2014.03.001> Laan, M. Van Der, Bristow, K. L., Stirzaker, R. J., & Annandale, J. G. (2017). Agriculture , Ecosystems and Environment Towards ecologically sustainable crop production : A South African perspective. "Agriculture, Ecosystems and Environment," 236, 108–119. <https://doi.org/10.1016/j.agee.2016.11.014> Moswetsi, G., Fanadzo, M., & Ncube, B. (2017). Review Article Cropping Systems and Agronomic Management Practices in Smallholder Farms in South Africa : Constraints , Challenges and Opportunities. *Journal of Agronomy*, 16, 51–64. <https://doi.org/10.3923/ja.2017.51.64> Webb, N.P., Marshall, N.A., Stringer, L.C., Reed, M.S., Chappell, A., Herrick, J.E., 2017. Land degradation and climate change: building climate resilience in agriculture. *Frontiers in Ecology and the Environment*

PHYSIOLOGICAL CHARACTERISTICS AFFECTING WATER USE EFFICIENCY AND YIELD OF INOCULATED SOYBEAN IN SOUTHERN AFRICA

Presenter: CEN Savala (c.engoke@cgiar.org)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
CEN	Savala	International Institute of Tropical Agriculture, P.O. Box 709, Nampula, Mozambique;
SK	Boahen	International Institute of Tropical Agriculture, P.O. Box 709, Nampula, Mozambique;
AW	Nimo	International Institute of Tropical Agriculture, P.O. Box 709, Nampula, Mozambique;
G	Akinwale	P.O. Box 30258, Lilongwe, Malawi
G	Chigeza	Plot 32, Poplar Avenue, Avondale, Lusaka, Zambia
L	Phiphira	P.O. Box 30258, Lilongwe, Malawi
D	Chikoye	Plot 32, Poplar Avenue, Avondale, Lusaka, Zambia

Introduction

Soybean yield potential in several agroecologies within the southern Africa has not been attained. Although, there exists similarities in climatic conditions of some agroecologies, soybean yield is variable despite replicable agronomic management practices. Controlling biotic and abiotic stresses leads to physiological adaptations related to water utilization within soybean plants.

Materials and Methods

A field study is being conducted for two seasons (2016/2017 and 2017/2018) in two soybean growing agroecologies within each country (Malawi, Mozambique and Zambia). The study is evaluating the effects of inoculant and P on nodulation and nitrogen fixation of non-promiscuous (Safari) and promiscuous (TGx 1740-2F) soybean varieties through measuring the changes in physiological and water use efficiency (WUE) between beginning of seed formation and maturity. First season data on crop development, growth characteristics, physiology and phenological changes were collected and analyzed using PROC GLM (SAS 9.4).

Results and Discussion

Preliminary results indicate that, transpiration rate between beginning of seed formation and seed maturity varied considerably with interaction between location, stage of growth, variety and treatment. Inoculated soybean transpired less at these stages in Angonia at 6.7 mmol m⁻¹ s⁻¹ while those that received nitrogen (N) fertilizer were losing more water 7.3 mmol m⁻¹ s⁻¹. On the contrary, at the same location, photosynthesis rate was highest with inoculated soybean (23.2 mmol m⁻¹ s⁻¹) leading to better WUE of 3.6 which corresponded to a yield of 3161 kg ha⁻¹. Photosynthesis rate and water use efficiency on the other hand, was distinct with variety at each growth stage and also with treatment within locations. Photosynthesis rate for safari was high at 18.1 mmol m⁻¹ s⁻¹ for fields that received N fertilizer over the check plots with 16.0 mmol m⁻¹ s⁻¹. Water use efficiency was better in determinate variety when inoculated and in indeterminate variety when N fertilizer was applied. In most of the agroecologies, fields that received inoculant and phosphorus fertilizer gave higher yields ranging from 1875 kg ha⁻¹ at Lusaka in Zambia to 3395 kg ha⁻¹ at Angonia in Mozambique and corresponded to better WUE.

Conclusions

Safari a non-promiscuous variety had a better WUE when inoculated especially in ecologies that received somewhat low rainfall within the season. Results from this study will complement the efforts by breeders in developing varieties suited for a wide range of changing climatical conditions.

References

ANTIFUNGAL ACTIVITY OF MEDICINAL PLANT EXTRACTS AGAINST FUSARIUM SPECIES: ALTERNATIVE BIO-PESTICIDES FOR SMALLHOLDER FARMERS

Presenter: HA Seepe (seepeh@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
HA	Seepe	Agricultural Research Council, Vegetables and Ornamental Plants, Roodeplaat, Private Bag X 293, Pretoria, 0001
SO	Amoo	Agricultural Research Council, Vegetables and Ornamental Plants, Roodeplaat, Private Bag X 293, Pretoria, 0001
W	Nxumalo	University of Limpopo, Turfloop campus, Department of Chemistry, Private Bag X1106, Sovenga, 0727

Introduction

Small-holder farmers play an important role in the production of food crops, especially in rural communities. Their production is often affected by plant diseases such as wilting, root rot and head blight caused by *Fusarium* species. In small-holder farming, application of synthetic fungicides is restricted by the price of such chemicals and unavailability of application techniques. The objective of this study was to evaluate the antifungal activity of selected plant extracts against pathogenic strains (*F. equiseti*, *F. subglutinans*, *F. oxysporum*, *F. semitectum*, *F. solani*, *F. graminearum*) as affordable alternatives to control plant diseases.

Materials and Methods

Antifungal activity of leaf extracts from thirteen plant species was evaluated using micro-plate dilution method (Masoko et al. 2005). Solvent extracts from different plants with minimum inhibitory concentration (MIC) values less than 0.1 mg/ml when tested individually were combined (ratio 1:1) and evaluated further for their interaction effect against selected *Fusarium* species. Their fractional inhibitory concentration index was calculated to determine the nature of their interactions against the pathogens.

Results and Discussion

Out of 52 plant extracts tested individually, 27, 22, 18, 8 and 2 extracts exhibited antifungal activity with MIC values less than 0.1 mg/ml against *F. solani*, *F. subglutinans*, *F. graminearum*, *F. oxysporum* and *F. equiseti*, respectively. The combinations also showed very strong synergistic antifungal activity; although antagonistic and indifference activities were observed in some cases. Of the 68 extract combinations evaluated against *F. solani*, 54, 13 and 1 combination showed synergistic, indifference and antagonistic activities, respectively. In case of *F. subglutinans*, the total of 48 combinations were tested; 19, 9 and 20 combinations showed synergistic, indifference and antagonistic activities, respectively.

Conclusions

The study showed that medicinal plant extracts may be used to control plant diseases and food spoilage caused by *Fusarium* pathogens. Therefore, application of medicinal plant extracts individually or in combinations by small-holder farmers could present affordable, safe and sustainable form of alternative pesticides.

References

Masoko P, Picard J, Eloff JN. 2005. Antifungal activities of six South African Terminalia species (Combretaceae). *Journal of Ethnopharmacology* 99: 301-308.

Agronomic Efficiency and Partial Factor Productivity of *Amaranthus Tricolor* L. as affected by nitrogen application rates

Presenter: K.A Seetseng (kseetseng@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
K. A	Seetseng	Agricultural Research Council (ARC)- Roodeplaat, Vegetable and Ornamental Plant (VOP). Private Bag X293, Pretoria 0001, South Africa
H	Araya	Agricultural Research Council (ARC)- Roodeplaat, Vegetable and Ornamental Plant (VOP). Private Bag X293, Pretoria 0001, South Africa
S.O	Amoo	Agricultural Research Council (ARC)- Roodeplaat, Vegetable and Ornamental Plant (VOP). Private Bag X293, Pretoria 0001, South Africa
C.P	Du Plooy	Agricultural Research Council (ARC)- Roodeplaat, Vegetable and Ornamental Plant (VOP). Private Bag X293, Pretoria 0001, South Africa
F. N	Mudau	Department of Agriculture and Animal Health, University of South Africa,

Introduction

Partial factor productivity and agronomic efficiency are useful measures of nutrient use efficiency and they provide an integrative index that quantifies total economic output.

Materials and Methods

Field trials were conducted for two subsequent cropping seasons during summer 2013/14 and 2014/15 at ARC-Roodeplaat Research Station North East of Pretoria, South Africa. Selected soil was categorized as Bainsvlei form (Soil classification, 1991) and soil samples were collected before transplanting and at the end of the season in both years for the analysis of chemical content. Plots were irrigated to field capacity using drip irrigation, approximately when 30% of soil plant available water was depleted. Wetting detectors were installed to monitor soil plant water available and for the collection of leachate. Aerial plant parts (leaves + stems) were harvested biweekly to determine biomass accumulation and were sampled for the analysis of nitrogen concentration in the plant tissues. Nitrogen Use Efficiency (NUE) was described using indices including agronomic efficiencies; partial factor productivity (PFPN); N uptake efficiency (UtEN) as described by Delogu et al. (1998) and crop removal efficiency described by (Ellen, 1993). Data were subjected to analysis of variance (ANOVA), using the statistical program GenStat (2003). Treatment means were separated using Fisher's protected t-test least significant difference (LSD) at 5% level of significance.

Results and Discussion

A significant ($p < 0.001$) increase in fresh yield was observed with the total fresh mass increasing from 7.22 tons ha⁻¹ at 0 kg N ha⁻¹ to 20.4 tons ha⁻¹ at 300 kg N ha⁻¹. Dry mass increased linearly from 1.7 at 0 kg N ha⁻¹ to 6.3 tons ha⁻¹ at 300 kg ha⁻¹ N. Partial Factor Productivity decreased from 1183.2 at 0 kg N ha⁻¹ level to 204.6 kg kg⁻¹ N at 300kg N ha⁻¹. There was a decline in N uptake efficiency from 225.3 to 85.1 kg kg⁻¹ N of the control. Nitrogen application increased N content and accumulation in aerial parts but there was a decline in N uptake efficiency from 225.3 to 85.1 kg kg⁻¹ N of the control. Agronomic Efficiencies decreased from 2,29 at 75 kg N ha⁻¹ to 1,6 when N was applied at 150kg N ha⁻¹. Negative response in PFPN agrees to the results of Amanullah and Almas (2009) where both PFPN and AEN showed negative relationship with increased N rates application in maize experiment.

Conclusions

Agronomic efficiency of N can be increased by increasing plant uptake and use of N and by decreasing N losses from soil-plant system.

References

Amanullah and Lal Almas .2009. Partial Factor Productivity, Agronomic Efficiency, and Economic Analyses of Maize in Wheat-Maize Cropping System in Pakistan. Department of Agricultural Sciences West Texas A&M University. Delogu G, Cattiveli L; Pecchioni N; De Falcis D, Maggiore T and Stanca AM. 1998. Uptake and agronomic efficiency of nitrogen in winter barley and winter wheat. European journal of agronomy 9:11-22. Ellen J. 1993. Growth, yield and composition of four winter cereals. 11. Nitrogen and carbohydrate economy. Netherlands Journal of Agricultural Science 41:235-346 GenStat® for Windows® (7th edn.) - Introduction (Editor R.W. Payne) Published 2003 by VSN International, ISBN 1-904375-08-1. Soil Classification Working

Group, 1991. Soil Classification " A taxonomic system for South Africa." Memoirs on the Agricultural Natural Resources of South Africa No.15.Â Dept of Agricultural Development, Pretoria.

EFFECTS OF NEMARIOC-AG PHYTONEMATICIDE ON GROWTH OF POTATO AS PRE-EMERGENCE APPLICATION

Presenter: S.K. SEFEFE (khutsopeace71@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S.K.	SEFEFE	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa
P.W.	MASHELA	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa
K.M.	POFU	Agricultural Research Council-VOP, Private Bag X293, Pretoria, 0001, South Africa
T.P.	MAFEO	University of Limpopo, Private Bag X1106, Sovenga 0727, South Africa

Introduction

The application of cucurbitacin-containing phytonematicides in smallholder farming systems is through the ground leaching technology (GLT), which is highly effective in nematode suppression. Generally, products are applied at transplanting, but since potato (*Solanum tuberosum*) seeds are not transplanted, other application methods are necessary. A study was therefore conducted to determine whether pre-emergence application of phytonematicide would not be detrimental to growth of potato plants.

Materials and Methods

The study was conducted under field conditions, with 5 treatments, viz. 0, 2, 4, 8, 16 g Nemarioc-AG phytonematicide, arranged in a randomized complete block design, with 14 replications. Potato seed tubers were planted, with granules of Nemarioc-AG pytonmesticide placed above tubers and covered with soil. Irrigation was through drip irrigation system. Plant height, stem diameter, chlorophyll content, root galls, fresh root, potato tubers, fresh shoots and dry shoots were measured. Data was be subjected to analysis of variance using Statistix 10.0.

Results and Discussion

Treatment significantly affected plant height, stem diameter, fresh root mass and root galls, contributing 53%, 46%, 57% and 52% in total treatment variation (TTV) of the respective variables, respectively. Relative to untreated control treatments increased stem diameter and reduced other plant variables. Mashela (2002) confirmed observations in other plants.

Conclusions

Nemarioc-AG phytonematicide when applied in granular formulation as pre- emergence improved plant growth.

References

Mashela PW. 2002. Ground wild cucumber fruits suppress numbers of *Meloidogyne incognita* on tomato. *Nematropica* 32:13-19.

EFFECT OF DIFFERENT STORAGE CONDITIONS ON CUCURBITACIN A FROM CUCUMIS MYRIOCARPUS FRUIT OVER TIME

Presenter: KG Shadung (kagiso.shadung@ul.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
KG	Shadung	University of Limpopo, Private Bag X 1106, Sovenga, 0727, South Africa
PW	Mashela	University of Limpopo, Private Bag X 1106, Sovenga, 0727, South Africa

Introduction

Post-harvest processes play an important role in maintaining the quality and quantity of active ingredients in plants (Gobbo-Neto and Lopes, 2017.) Storage parameters may have a negative and/or positive effect on the quality of active ingredients, thereby affecting the end product. Nemarioc-AL phytonematicide was developed from dried fruit of *Cucumis myriocarpus*. Information on different storage conditions and storage times on cucurbitacin A concentration is scanty. The objective of this study was to determine the effect of storage conditions on phyto-inventories of Nemarioc-AL phytonematicide over a period of five months.

Materials and Methods

Five plots of *C. myriocarpus* were planted in the field and ten fruits per plot were harvested at maturity (110 days after transplanting) from each plot. Three separate experiments for frozen (-20°C), room temperature (25°C) and cold storage (4°C) were conducted. Treatments of 1, 2, 3, 4 and 5 months of storage were arranged in completely randomised design (CRD), with five replications. The samples were prepared and extracted for cucurbitacin A quantification using isocratic elution (Shimadzu HPLC Prominence).

Results and Discussion

The three storage temperatures had a significant effect on concentration of cucurbitacin A, contributing 93%, 86% and 75% in total treatment variation for cold storage, frozen storage and room temperature storage, respectively. Relative to the increase in storage time, the concentration of cucurbitacin A indicated a decreasing trend. Frozen storage and cold storage drastically decreased the concentration of cucurbitacin A by 51-70% and 9-57%, respectively, whereas room storage increased the compound by 38-105%. Cucurbitacin A concentration over five months storage period exhibited a quadratic relation, which explained 84%, 89% and 54% of frozen, cold and room temperature storage, respectively.

Conclusions

In conclusion storage time had an effect on the cucurbitacin A concentration of *C. myriocarpus* fruit and it is recommended to store phyto-inventories of Nemarioc-AL phytonematicide at room temperature.

References

Gobbo-Neto, L., Lopes, N.P. 2017. Medicinal plants: Factors of influence on the content of secondary metabolites. *Quimica Nova* 30:374–381.

THE EFFECT OF BIOSTIMULANTS ON ESTABLISHMENT OF NADORCOTT CITRUS TREES

Presenter: C Shereni (clydeshereni@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
C	Shereni	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland, 7602
E	Lotze	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland, 7602
E.W	Hoffmann	Department of Horticultural Science, Stellenbosch University, Private Bag X1, Matieland, 7602

Introduction

The global movement in agriculture is towards more environmentally friendly, sustainable production practices. Motivations for shifting from chemically intensive management strategies to more biologically based practices, include concern for protecting animal and human health from potential hazards of pesticides, protecting non-renewable resources, as well as the need to lower escalating production costs (Matson et al., 1997; Tilman, 1999; Velmourougane, 2016). Biostimulants with different modes of action were evaluated on their effectiveness in promoting root and top growth and their ability to alleviate biotic and abiotic stress on citrus trees.

Materials and Methods

The experiment was carried out on the Stellenbosch University experimental farm, South Africa. The experiment had five treatments (Compost, Terramax®, Afrikelp®, Super Wortel® and RootAktiv®). Treatments were only applied once at planting (October 2016). Super Wortel® was the only foliar based treatment, while the other treatments were soil applied. Nadorcott trees on 'Carrizo citrange' rootstock were treated at planting. Single trees were used in a random complete block design. Stem water potential (SWP) and photosynthesis measurements were recorded to indicate transplant stress. Stem diameter and shoot lengths of two shoots per tree were used to quantify top growth. A mini-rhizotron was used to quantify root growth.

Results and Discussion

The RootAktiv® treated plants had a significantly higher average shoot length (two shoots per tree) (265.75 mm) and photosynthetic rate (10.12 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) than other treatments. No significant differences between treatments were observed for stem diameter. However, Terramax® and Afrikelp® treatments had a significant lower SWP (-0.5 and -0.9 MPa) respectively than other treatments. There were no differences for root growth during the first season.

Conclusions

After the first season, the RootAktiv® treatment proved to be the best treatment after transplant. The response of trees on this treatment may be due to the various components in this treatment (auxins, cytokinins and seaweed extract *Ascophyllum nodosum*) which are effective in initiating top growth, root growth and alleviating stress after transplant.

References

Matson, P., Parton, W., Power, A. 1997. Agricultural intensification and ecosystem properties. *Science*. 277:504-509. Tilman, D. 1999. Global environmental impacts of agricultural expansion: The need for sustainable and efficient practices. *Proceedings of the National Academy of Sciences*. 96:5995-6000. Velmourougane, K. 2016. Impact of Organic and Conventional Systems of Coffee Farming on Soil Properties and Culturable Microbial Diversity. *Scientifica*. 2016:1-9.

PREDICTING SUGARCANE PRODUCTIVITY AND WATER USE IN SOUTH AFRICA UNDER A FUTURE CLIMATE

Presenter: A Singels (abraham.singels@sugar.org.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Singels	South African Sugarcane Research Institute, Mount Edgecombe
M	Jones	South African Sugarcane Research Institute, Mount Edgecombe
T	Lumsden	Council for Scientific and Industrial Research, Durban

Introduction

Reliable predictions of sugarcane crop response to climate change are necessary to plan adaptation strategies for the sugarcane industry of South Africa (SA). The objective of the study was to estimate sugarcane productivity, water use and irrigation requirements for current and future climate for existing and potential new sugarcane production areas in South Africa.

Materials and Methods

The DSSAT-Canegro model was used to simulate dryland and irrigated crops for 2000 catchments in SA that are considered potentially suitable for production, using daily weather data for the periods 1971-1990 (past) and 2046-2065 (future). Future weather data were derived from statistical downscaling of climate projections from three general circulation models (GCMs), assuming the A2 emission scenario. Crop model output was statistically summarized and key statistics mapped using ArcGIS.

Results and Discussion

Future temperatures are expected to be about 2 °C warmer than the past for the eastern parts of SA. Rainfall projections are less certain with a possibility of slight increases in annual total rainfall, especially in the northern parts of the industry. Sugarcane productivity is expected to increase in future for most dryland production areas. Increases in long term mean simulated biomass, stalk, sugar and ethanol yields varied from about 10% in warm coastal areas to 35% in cool high-lying inland areas. This is ascribed to accelerated canopy development leading to greater seasonal radiation capture, as well as higher water use efficiency. Seasonal crop water use is expected to increase by between 2% and 14% due to higher evaporative demand. Irrigated yields are expected to increase marginally (1-4%) in current high potential areas, while larger increases are expected for current cool areas with low potential (assuming that increased irrigation demand is met). Seasonal crop water use and irrigation requirements are expected to increase by 9% to 14%, putting additional pressure on limited water resources. New areas are likely to become suitable for sugarcane production as temperatures increase. These include catchments in northern Limpopo, in the north-eastern parts of the Eastern Cape and high lying areas of KwaZulu-Natal and Mpumalanga.

Conclusions

A database was generated of estimated sugarcane yields, water use and irrigation requirements, at sub-catchment level, for the past and the future climate, for areas in SA where sugarcane can potentially be grown. Spatial distribution of key statistics for past and future estimates may be compared graphically using a Microsoft Excel® application. The information will guide the planning and future management of sugarcane production in SA.

References

WATER USE DYNAMICS OF MACADAMIA ORCHARDS

Presenter: TG Smit (theunis@mayomacs.co.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
TG	Smit	Department of Plant and Soil Sciences , University of Pretoria / Private Bag X20, Pretoria 0028
NJ	Taylor	Department of Plant and Soil Sciences , University of Pretoria / Private Bag X20, Pretoria 0028
JG	Annandale	Department of Plant and Soil Sciences , University of Pretoria / Private Bag X20, Pretoria 0028
SJE	Midgley	Independent Consultant

Introduction

As one of the fastest growing subtropical crops in a semi-arid country, Macadamia producers in South Africa will have to overcome various environmental constraints in future, to ensure the sustainability of the industry. None of these constraints are as important as water, and managing this limited resource requires an in depth knowledge of all components within the soil-plant-atmosphere continuum. Macadamias have, however, been largely understudied due to the young nature of subtropical fruits in general. As a result very little is known regarding water requirements and the environmental as well as physiological factors driving macadamia water use, which is why the Water Research Commission solicited, funded and managed a project on macadamia water use (Project K5/2552//4). This study therefore attempts to determine macadamia water use whilst attempting to capture the driving variables of water use in relation to other Proteaceae species.

Materials and Methods

Trials were conducted on a commercial macadamia farm outside Nelspruit, Mpumalanga. Transpiration volumes were measured using the heat ratio method and combined with measurement of total water use from the eddy covariance measurements to determine orchard water use. Ecophysiological measurements including stem- and leaf water potential, stomatal conductance and leaf gas exchange were made during various measurement campaigns throughout the phenological cycle of the tree. Measurements of canopy size, fruit growth and both yield and quality were also conducted to determine both water use efficiency and water use productivity for macadamias.

Results and Discussion

In the 2016/2017 season (August to August) the full bearing macadamia orchard transpired on average 2.1 mm day⁻¹ (69 L tree⁻¹ day⁻¹) and a total of 790 mm for the season. There was also a good, but non-linear relationship between reference evapotranspiration and transpiration which may indicate that macadamia transpiration is supply rather than demand limited. A distinct inverse relationship between stomatal conductance and vapour pressure deficit further supports this hypothesis. However, measurements of leaf gas exchange indicate that sink strength can significantly influence various aspects of photosynthesis, with net assimilation rate increasing as sink strength increases. Thus during the oil filling stage the trees may not be as conservative with transpiration regulation.

Conclusions

Current results indicate that there is both environmental and physiological control of macadamia water use. These results may indicate that macadamias follow an isohydric behaviour, similar to other Proteaceae species, through low hydraulic conductance and high stomatal control. This approach might, however, be dynamic due to the high sink strength of developing oil-rich fruit.

References

Acknowledgements

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The effect of nitrogen and phosphorus application rates on chemical composition, growth and yield of *Moringa oleifera*

Presenter: A Sokombela (201001011@ufh.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Sokombela	1Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare, Private Bag X1314, Alice, 5700. Email
B.K	Eiasu	1Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare, Private Bag X1314, Alice, 5700. Email
L.B	Joko	1Department of Agronomy, Faculty of Science and Agriculture, University of Fort Hare, Private Bag X1314, Alice, 5700. Email

Introduction

Moringa oleifera has recently gained research attention because of its medical and nutritious benefits. The major limiting factor for crop production in the subtropics is soil nutrient deficiency attributed to land degradation which has a negative impact on plant growth, plant nutrient uptake and plant nutrient assimilation (Dania et al., 2014). Phosphorus (P) and Nitrogen (N) have been identified as major limiting nutrients for initial establishment and growth in *Moringa*. Thus, determining the effect of N and P application rates on *Moringa oleifera*'s growth, chemical composition and yield is of great importance in order to establish a proper fertilization program

Materials and Methods

A 4x3 factorial experiment in RCBD was conducted at the University of Fort Hare research farm. Nitrogen was applied at four levels (100, 200, 300, 400kg/ha) while P was applied at three levels (40, 80, 120kg/ha). Potassium was applied in the form of KCL at 731kg/ha equally. Growth data was collected on a weekly basis and the following parameters were measured: height, stem width and number of leaves. Chemical parameters measured included: protein, fibre, fat, ash and mineral nutrients. Data was analysed using SAS ver. 9.1 and mean separation was done using Fisher's protected least significant difference ($p < 0.05$) test.

Results and Discussion

Plant height and stem width, moisture, protein, fibre, fat, ash and mineral nutrients were significantly affected by fertilizer application. The highest treatment combination, 400 kg N/ha x 120 kg P/ha, gave the highest values of all measured parameters. This study agrees with previous results by Pahla et al. (2014), who reported that an increase in P and N application rates increases *Moringa* quality and growth.

Conclusions

An increase in P and N application can improve *Moringa* growth and nutrient assimilation. More research is still needed to establish the effect of P and N on *Moringa* economical yield and water productivity

References

Dania, O., Akpansubi, P. and Eghagara, O.O. (2014): Comparative Effects of Different Fertilizer Sources on the Growth and Nutrient Content of *Moringa (Moringa oleifera)* Seedling in a Greenhouse Trial Hindawi Publishing Corporation Advances in Agriculture Volume 2014, Article ID 72631 Pahla, I., Tagwira, F., Muziri. T., and Chitamba J., 2014: Effects of pH, Nitrogen and Phosphorus on the Establishment and Growth of *Moringa oleifera* Lam International Journal of Agriculture and Forestry, 4(3): 211-216 DOI: 10.5923/j.ijaf.20140403.11

BRIDGING THE EXTENSION GAP: FAST TRACKING ACCESS TO IMPROVED SWEETPOTATO VARIETIES THROUGH SCHOOLS IN UGANDA

Presenter: G Ssemakula (nankingag@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
G	Ssemakul	National Crops Resources research Institute, P.O. Box 7084, Kampala Uganda
G	Babirye	Volunteer Efforts for Development Concerns, P.O Box 1244 Kampala, Uganda
J	Mirembe	International Institute of Tropical Agriculture, P.O Box 7878, Kampala,
C	Serebe	National Crops Resources research Institute, P.O. Box 7084, Kampala Uganda
M	Kiddo	Sugarcane Research Institute, P. O. Box 30031, Kibaha, Tanzania

Introduction

Longstanding efforts in sweetpotato breeding in Uganda have led to the official release of 27 varieties by the National Agricultural Research organization (NARO). However, most of these varieties have not been widely adopted largely due wanting dissemination channels and inadequate amounts of quality planting materials. We sought to fast track the dissemination and adoption of preferred and improved varieties by small holder farmers and to increase knowledge on the recommended production practices and seed system for enhanced sweetpotato productivity.

Materials and Methods

We used rural primary school-going children as modes to fast-track the access to improved and preferred sweetpotato varieties by communities. Vines were purchased from “decentralized vine multipliers” and distributed to farmers through their children. Prior to the distribution, selected teacher and elected community facilitators were trained in basic agronomy and seed production. The facilitators in turn trained farmers and school children and assisted with the monitoring of the project. The vines were packaged into bundles of 30 of each of four varieties; they were transported to pre-selected schools whose administration and parents were prior sensitized about the project. A minimum of 200 children/school representing 200 households were given 3-4 bundles different varieties (120 vines/child). After one growing season, each beneficiary returned twice the amount of vines received; these were re-distributed to new recipients. School teaching gardens in the conduit schools and a community demo attached to each school were established. Children transferred basic knowledge and skills acquired from the school gardens to the parents; community facilitators imparted knowledge and skills to farmers in their jurisdiction and ensured that recipients brought back the required vines for re-distribution.

Results and Discussion

To date we have outreached 55 schools with improved varieties, 19 in Wakiso, 20 in Mukono and 17 in Kamuli districts, translating into more than 11,000 direct households with an estimated coverage of 100 acres. The indirect households reached are estimated at 16,000 with coverage of about 144acres. Farmers are able to get and apply improved skills and knowledge to produce sweetpotato.

Conclusions

Using the school going children model, we were able to move improved/popular sweetpotato varieties and some essential basic knowledge and skills to farmers. The model builds on the existent informal seed system for sweetpotato to bridge the technology dissemination gap and can be adopted for other vegetatively propagated crops.

References

Insights into alternate bearing in Citrus spp.

Presenter: O.P.J. Stander (jakkie@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
O.P.J.	Stander	Citrus Research International, (Pty) Ltd, Department of Horticultural Science, University of Stellenbosch, South Africa
C.J.	Lovatt	Department of Botany and Plant Sciences, University California Riverside (UCR), USA
M	Orozco-Cárdenas	Transformation Research Center, Department of Botany and Plant Sciences, UCR, USA
G.H.	Barry	4XLnT Citrus, Cape Town, South Africa
P.J.R.	Cronjé	Citrus Research International (Pty) Ltd, Department of Horticultural Science, University of Stellenbosch, South Africa

Introduction

Studies on alternate bearing in Citrus spp. have produced two generalized theories, viz. the hormonal and nutritional theories of alternate bearing (Goldschmidt, 1999). The hormonal theory proposes that phyto-hormones inhibit vegetative shoots and flowering positions, and the expression of flowering genes (Muñoz-Fambuena et al., 2011; Verreyne and Lovatt, 2009). The nutritional theory proposes that flowering is determined by nutrients and carbohydrates (Goldschmidt and Golomb, 1982; Martínez-Alcántara et al., 2015). We investigated the relevance of these over a period of four years, using 'Nadorcott' mandarin (*C. reticulata* Blanco) trees in South Africa and 'Washington Navel' sweet orange [*C. sinensis* (L.) Osbeck] trees in Riverside, California, in the USA.

Materials and Methods

Experiments were conducted in De Doorns, Citrusdal and Riviersonderend in South Africa and in Riverside, CA, in the USA. The experiments were set up in a completely randomised design in which an individual tree equalled a replicate. Measurements in heavy- and low-fruited trees included analysis of monthly root and leaf carbohydrates and leaf and fruit mineral nutrients; seasonal root, leaf and fruit phyto-hormones, and the expression of citrus flowering genes. Important phenological events such as root growth, vegetative flush, flowering, and fruit load were recorded and quantified at the shoot-, branch- and tree-level. Analysis of variance was performed using STATISTICA (version 13; Dell Inc.). Mean separations were carried out using the LSD test, where applicable ($P \leq 0.05$).

Results and Discussion

Fruit load and the number of newly developed vegetative shoots were the most important determinants of return bloom. Sprouting of a higher number of new vegetative shoots from "off" shoots, "off" branches and "off" trees was unrelated to leaf carbohydrates and mineral nutrients. Fruit load and root sugar content provided the best correlations with the intensity of vegetative flushes. Root sugar content peaked during full bloom and higher root growth activity occurred prior to more vegetative shoots developing in "off" trees in summer. Flowering was inhibited in the presence of fruit and appeared to be determined by phyto-hormones that inhibited the expression of genes necessary for flowering, and not by carbohydrates and mineral nutrients.

Conclusions

The results confirmed that lack of vegetative shoot development in "on" shoots, "on" branches, and "on" trees plays a central role in the poor return bloom response and the perpetuation of alternate bearing in citrus. Increased vegetative shoot development and flowering in "off" trees were unrelated to carbohydrates and mineral nutrients, but appeared to be determined by a different endogenous regulator.

References

GOLDSCHMIDT, E.E. 1999. Carbohydrate supply as a critical factor for citrus fruit development and productivity. Hortscience 34(6):1020-1024. GOLDSCHMIDT, E.E. and A.GOLOMB.1982. The carbohydrate balance of alternate bearing citrus trees and the significance of reserves for flowering and fruiting. J. Amer. Soc. Hort. Sci. 107:206-208. MARTÍNEZ-ALCÁNTARA, B., D.J. IGLESIAS, C. REIG, C. MESEJO, M. AGUSTÍ, and E. PRIMO-MILLO. 2015. Carbon utilization by fruit limits shoot growth in alternate-bearing citrus trees. J. Plant Physiol. 176:108-117. MUÑOZ-FAMBUENA, N., C. MESEJO, M.C. GONZÁLEZ-MAS, E. PRIMO-MILLO, M. AGUSTÍ, and D.J. IGLESIAS. 2011. Fruit regulates seasonal expression of flowering genes in alternate-bearing 'Moncada'

mandarin. *Ann. Bot.* 108:511-519. VERREYNNE, J.S. and C.J. LOVATT. 2009. The effect of crop load on bud break influences return bloom in alternate bearing 'Pixie' mandarin. *J. Amer. Soc. Hort. Sci.* 34:299-307.

The effect of irrigation on the performance of young apple trees in newly established orchards.

Presenter: A Stofberg (16552105@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
A	Stofberg	Department of Soil Science, Stellenbosch University, P/Bag X1, Matieland 7602
J.L.	Van Zyl	Department of Soil Science, Stellenbosch University, P/Bag X1, Matieland 7602
J.E.	Hoffman	Department of Soil Science, Stellenbosch University, P/Bag X1, Matieland 7602

Introduction

This study entails determining of the most effective irrigation schedule for the optimum performance, including root growth and root distribution, of young apple trees in a newly established orchard on a gravelly soil near Grabouw. This is the first time that irrigation research is being done on apple trees in their first leaf in South Africa.

Materials and Methods

The irrigation trial consisted of three treatments where treatment one (T1) was a short irrigation cycle, treatment two (T2) was a medium irrigation cycle and treatment three (T3) was a long irrigation cycle. Physical and chemical properties of the soil were determined, followed by the installation of irrigation equipment, soil water measuring instruments and newly-developed rhizotrons for studying roots in situ. Irrigation systems were operated remotely by cell phones and soil water measurements were logged continuously. At the end of the season (June 2017) tree response to irrigation treatments was determined by measuring stem circumference and shoot growth. Root studies was carried out to evaluate final root distribution after the first season.

Results and Discussion

Irrigation treatments were applied successfully according to the planned depletion levels between December 2016 and June 2017. The three treatments, T1, T2 and T3, received 11 mm every 3.8 days, 19 mm every 7.3 days and 28 mm every 12.1 days, respectively. Rainfall to an amount of 153 mm also added to the water supply of the trees. Evapotranspiration (ET) at the end of the season was 642.31 mm, 580.09 mm and 568.47 mm for T1, T2 and T3, respectively. Tree response in terms of shoot extension growth and trunk circumference was not significantly different between treatments. At the end of the season (July 2017) results of root studies in the rhizotron showed that the total root length density of the T2 and T3 were higher than T1. There was no significant difference between the mean root densities of T2 (145 ± 62 roots/m²) and T3 (148 ± 76 root/m²) throughout the soil profile as determined with the soil profile wall method, but both these treatments had significantly higher root densities than T1 (69 ± 41 roots/m²). The preferred medium for root growth was the loamy textured top soil. T1 had the fewest roots (7) with T3 having the highest number of roots (44), significantly more than T1, in the clayey textured subsoil.

Conclusions

Less frequent irrigation had a positive effect on the root growth of the young apple trees and also lowered evapotranspiration without reducing tree development.

References

HIGH DENSITY SLUDGE FROM ACID MINE WATER NEUTRALIZATION IN THE MPUMALANGA COALFIELDS: A HAZARDOUS WASTE OR AGRICULTURAL RESOURCE?

Presenter: BH Sukati (bonokwakesukati@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
BH	Sukati	University of Pretoria, Department of Plant and Soil Sciences, X20, Hatfield 0028, South Africa
PC	de Jager	University of Pretoria, Department of Plant and Soil Sciences, X20, Hatfield 0028, South Africa
JG	Annandale	University of Pretoria, Department of Plant and Soil Sciences, X20, Hatfield 0028, South Africa
PD	Tanner	University of Pretoria, Department of Plant and Soil Sciences, X20, Hatfield 0028, South Africa

Introduction

Classification is essential for the management of wastes to limit potential environmental pollution. However, global classification systems vary substantially. The aim of this study was to obtain a better understanding of the waste characterization of High Density Sludge (HDS) arising from the neutralization of acid mine drainage with either lime or limestone from both a local and international perspective.

Materials and Methods

HDS products emanating from the coalfields of Mpumalanga, South Africa (SA) were considered. Classification systems of SA, Australia, Canada, China and the USEPA were considered. Two sludges from limestone treatment plants, and three from a lime treatment plant were evaluated.

Results and Discussion

Neutralizing acidic waters with lime did lower the risk classification of the resultant sludge using the SA waste classification system, from a Type 0 (high environmental risk) to a Type 3 (low environmental risk). Limestone treatment resulted in TCLP extractable Mn (259 mg/l) exceeding the maximum Leachable Concentration Threshold (LCT3) of 200 mg/l specified by the SA guidelines, while the Australian guidelines allocated a Restricted Solid Waste status (can pollute the environment) based on Ni (108 mg/kg) exceeding their threshold of 40 mg/kg. The risk determined by the Australian Guidelines was reduced to that of General Solid Wastes (putrescible and non-putrescible) for acid waters treated with lime. The USEPA considered all sludges considered in this study to be non-hazardous, while the Canadian and Chinese systems only allocated a hazardous status to one of the limestone treated sludges based on its Ni content. The SA system makes use of a stricter minimum Leachable Concentration Threshold test (LCT0) for Cd, Hg, Pb, As and Se, than do the other countries. LCT0 for these elements seem to be below method detection limits (MDL) in TCLP extracts. This increases the risk of inconclusive results, incomplete waste characterization and/or misclassification.

Conclusions

The SA waste classification system may be unnecessarily conservative and consideration should be given to bench-marking against other systems. This statement is further strengthened when one considers that according to the Fertilizer Act, 36, some of the sludges considered qualify in SA for use as agricultural gypsum. It is clear that there is a mismatch between our waste and agricultural amendment guidelines, and these should be aligned.

References

DEPARTMENT OF AGRICULTURE FORESTRY AND FISHERIES (2012). Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 Of 1947). Regulations Regarding Fertilizers. Government Gazette, Republic of South Africa.
<http://www.daff.gov.za/daffweb3/Branches/Agricultural-Production-Health-Food-Safety/Agriculture-Inputs-Control/Guidelines>. (Accessed 20 June 2017) Feng XH, Zhai LM, Tan WF, Liu F & He JZ. 2007. Adsorption and redox reactions of heavy metals on synthesized Mn oxide minerals. *Environmental pollution* 147: 366-373. Fischel MHH, Fischel JS, Lafferty BJ & Sparks DL. 2015. The influence of environmental conditions on kinetics of arsenite oxidation by manganese-oxides. *Geochemical transactions*: 1-10. KAVOURAS P, KAIMAKAMIS G, IOANNIDIS TH A., KEHAGIAS TH, KOMNINOU PH, KOKKOU S, PAVLIDOU E, ANTONOPOULOS I, SOFONIOU M, ZOUBOULIS A, HADJANTONIOU CP, NOUET G, PRAKOURAS A and KARAKOSTAS TH (2003) Vitrification of lead-rich solid ashes

from incineration of hazardous industrial wastes. Waste Management 23: 361–371. NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT NO. 59 (2008) Waste classification and management regulations. Government Gazette no. 10008. Pretoria, South Africa; 578.
https://www.environment.gov.za/sites/default/files/legislations/nemwa59of2008_wasteclassification.pdf (Accessed 9 March 2017) NEW SOUTH WALES ENVIRONMENT PROTECTION AUTHORITY (EPA) (2014) Waste Classification Guidelines, Part 1: Classifying waste. 59–61 Goulburn Street, Sydney. www.epa.nsw.gov.au (Accessed 9 March 2017) UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA) (1990). Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions. Federal Register, Rules and Regulations.
<https://www.epa.gov/sites/production/files/2016-04/documents/55fr11798.pdf> (Accessed 9 March 2017) WEN X, LUO Q, HU H, WANG N, CHEN Y, JIN J, HAO Y, XU G, LI F and FANG W (2014) Comparison research on waste classification between China and the EU, Japan, and the USA. Material Cycles and Waste Management 16: 321–334. DOI: 10.1007/s10163-013-0190-1

NEMATODE COMMUNITY STRUCTURE OF KIKUYU-BASED DAIRY PASTURES

Presenter: PA Swanepoel (pieterswanepoel@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
PA	Swanepoel	Stellenbosch University, Private Bag X1, Matieland 7602, Stellenbosch, South Africa
C	Kapp	Stellenbosch University, Private Bag X1, Matieland 7602, Stellenbosch, South Africa
SG	Storey	Nemlab, PO Box 2825, Durbanville 7551, South Africa
AP	Malan	Stellenbosch University, Private Bag X1, Matieland 7602, Stellenbosch, South Africa
S	Ammann	Western Cape Department of Agriculture, PO Box 249, George 6530

Introduction

Nematodes play an important role in all agricultural soil in terms of their pest status, and in terms of the contribution that they make to soil quality and sustainable crop production. Nematodes might be a valuable indicator to assess the effect of soil tillage on the soil biological component, and specifically, to support plant production. The aim of the current study was to assess the changes occurring in nematode community structure, as affected by the soil management practices applied to high N-input and irrigated pastures in South Africa.

Materials and Methods

Different kikuyu-based pasture systems, where ryegrass are over-sown following a gradient of soil disturbance, were investigated on Outeniqua Research Farm near George. These practices were investigated by means of analysing diversity and ecosystem function indices, as well as the faunal profile, to enable analysis of their effect on chemical and biological soil properties.

Results and Discussion

The pre-treatment analysis showed a low overall mean nematode density. The populations of such families as Rhabditidae and Cephalobidae were found to increase with the various tillage treatments, without the occurrence of either a dramatic increase, or decrease, in the nematode population numbers. Such a phenomenon was likely linked to a variety of factors that could be attributed to the high N inputs involved, which are known to affect nematode populations as well as to the overall functioning of the pasture system. The botanical composition played a role in the above, especially since the pasture in question consisted of only two species, namely kikuyu and annual ryegrass. The lack of indicative information leading from the nematode community structure to the tillage disturbance types might also be linked to the fact that such systems were able to recover from soil disturbance within the relatively short period of less than a year.

Conclusions

Either a single-species system (kikuyu only), or a binary species system (kikuyu-ryegrass), that functions under high N, and other inputs, can recover within a year, and that the use of nematode community structure as an indicator of soil functionality in such systems is not possible.

References

INFLUENCE OF NITROGEN SOURCES AND PLANT GROWTH-PROMOTING RHIZOBACTERIA INOCULATION ON GROWTH, CRUDE FIBER AND NUTRIENT UPTAKE IN SQUASH (CUCURBITA MOSCHATA DUCHESNE EX POIR.) PLANTS

Presenter: Al Tchiaze (dtaffouo@yahoo.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
Al	Tchiaze	University of Douala, 24157 Douala, Cameroon
VD	Taffouo	University of Douala, 24157 Douala, Cameroon
H	Fankem	University of Douala, 24157 Douala, Cameroon
M	Kenne	University of Douala, 24157 Douala, Cameroon
R	Baziramakenga	University of Laval, Horticulture Research Center, 2480, blvd Hochelaga Québec (QC), Canada G1V 0A6
GE	Ekodeck	University of Laval, Horticulture Research Center, 2480, blvd Hochelaga Québec (QC), Canada G1V 0A6
H	Antoun	University of Laval, Horticulture Research Center, 2480, blvd Hochelaga Québec (QC), Canada G1V 0A6

Introduction

Squash contributes to an important part of the diet to many people in the tropics, more especially in Cameroon. But its production is seriously affected by poor soil fertility. In this study, it was checked specific combinations of PGPR with NO₃⁻, NH₄⁺ or NO₃NH₄ fertilizers can be considered as efficient alternative biofertilizers to significantly improve squash growth and nutrient uptake.

Materials and Methods

The trial was conducted at the Research Center of Horticultural of Laval University, Canada. Seeds of squash plants (*Cucurbita moschata* Duchesne ex poir.) were provided by the breeding program of the Agronomic Institute for Research and Development of Cameroon. The bacterial inoculum used was the PGPR containing four beneficial mixture strains of *Bacillus subtilis*; *B. amyloliquefaciens*; *B. pumilus*; *B. licheniformis* and *Saccharomyces cerevisiae*. The experiment was carried out in a randomized complete block design with seven treatments and eight replicates. The root (RDW), shoot (SDW), and total plant (PDW) dry weight, number of leaves (NL), shoot length (SL), stem diameter (SD), number of ramifications (NR), cellulose content and nutrient uptake (N, P, K, Ca, Mg, Na, Fe, Cu, Mn and Zn) were determined. Statistical differences between treatments means were established using the Fisher LSD test at p values < 0.05. Multi-factorial ANOVA was used to estimate whether N fertilization sources, PGPR inoculation, alone or in interaction had a significant influence on the measured parameters.

Results and Discussion

In the present study, application of NO₃⁻, NH₄⁺ or NO₃NH₄ singly or in combination with PGPR inoculation led to a significant increase in RDW, SDW, PDW, SL, SD, NL and NR compared to untreated control plants. Application of NO₃⁻, NH₄⁺ or NO₃NH₄ singly or in combination with PGPR inoculation had a positive effect on leaf N, P, K and Mn concentrations while those supplied with NH₄⁺ showed significant increase of leaf K concentration. The CE content of leaves (12.58-13.67%) recorded in this study was lower than those (26.22-32.62%) obtained by other researcher.

Conclusions

The plants supplied with NO₃+B, NH₄+B and NO₃NH₄+B showed significantly higher plant biomass and accumulation of N, P, K and Mn concentrations in leaves compared to all other treatments. These results suggest that specific combinations of PGPR with NO₃⁻, NH₄⁺ or NO₃NH₄ fertilizers can be considered as efficient alternative biofertilizers to improve significantly the squash growth and nutrient uptake.

References

DIVERSITY IN PUCCINIA TRITICINA ON WHEAT AND TRITICALE IN SOUTH AFRICA

Presenter: TG Terefe (terefet@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
TG	Terefe	Agricultural Research Council - Small Grain, Private Bag X29, Bethlehem 9700, South Africa
R	Labuschagne	Department of Plant Sciences, University of the Free State, P.O. Box 339, Bloemfontein 9300, South Africa
WHP	Boshoff	Department of Plant Sciences, University of the Free State, P.O. Box 339, Bloemfontein 9300, South Africa
B	Visser	Department of Plant Sciences, University of the Free State, P.O. Box 339, Bloemfontein 9300, South Africa
ZA	Pretorius	Department of Plant Sciences, University of the Free State, P.O. Box 339, Bloemfontein 9300, South Africa

Introduction

INTRODUCTION Leaf rust caused by *Puccinia triticina* (Pt) is an important disease of wheat in South Africa (SA). New Pt races frequently emerge and infect previously resistant cultivars, in particular if conditions are favourable and virulence adaptation occurred for single gene resistance. Regular rust surveys help to timeously detect new races which can be used in clarifying cultivar reaction and to identify effective sources of resistance. The objective of this study was to determine the diversity of Pt races detected in SA from 2010 to 2016.

Materials and Methods

MATERIALS AND METHODS Wheat and triticale leaves infected with Pt were collected from the different production regions in SA. Mineral oil suspensions of urediniospores, representing single spore isolates, were sprayed onto seedlings of a standard set of differential lines. Seedlings were incubated in a dew chamber and then placed in a glasshouse under conducive conditions for leaf rust development. Infection types were recorded using a 0-4 scale 10 days after inoculation to identify Pt races based on their virulence profiles. The genetic relationships between new and existing Pt races were determined with microsatellite markers.

Results and Discussion

RESULTS AND DISCUSSION Thirteen Pt races were identified from 960 isolates pathotyped. Predominant races were 3SA145 (CCPS, North American notation) with average frequency of 42%, 3SA115 (CBPS) (23%) and 3SA146 (MCDS) (19%). These three races were all identified for the first time during 2009-2012. In 2016, three new Pt races namely 3SA38 (CDPS), 3SA10 (CFPS) and 3SA248 (CFPS+Lr20) were detected in the Western Cape. Except for increased virulence on the resistance gene Lr24 by all three races and on Lr20 by 3SA38 and 3SA248, the new races appeared similar in virulence to 3SA145. Seedling tests on commercial wheat cultivars and advanced breeding lines indicated that the new races are more virulent than 3SA145 and that 3SA248 is the most threatening. While 3SA38 was genetically most similar to 3SA147, 3SA10 and 3SA248 shared extensive similarity to 3SA145, thereby confirming the phenotypic data.

Conclusions

CONCLUSIONS Six new Pt races were identified over the past seven years, indicating continued adaptation in virulence variability by the leaf rust pathogen in SA and stressing the need for regular rust monitoring. Rust monitoring should be conducted annually to timeously detect new races, to inform producers of their impact on cultivar reaction, and to identify resistance sources, ensuring sustainable development and availability of resistant cultivars in SA.

References

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Sludge drying depth on drying beds affects the nitrogen and organic matter content of wastewater sludge

Presenter: EH Tesfamariam (eyob.tesfamariam@up.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
E.H.	Tesfamariam	University of Pretoria, private box x20, Hatfield, 0028, Pretoria, South Africa
M.T.	Demana	University of Pretoria, private box x20, Hatfield, 0028, Pretoria, South Africa

Introduction

Generally, the quality and composition of a sludge is mainly influenced by the origin of wastewater (Feigin et al., 2012). Wastewater treatment processes and post treatment drying techniques also contribute to changes in the organic matter content and nitrogen fertilizer value of sludge (Penn and Sims, 2002; Kunhikristinan et al., 2012). Such changes in the sludge organic matter content and composition influences the decomposition rate of the substrate (Cogger et al., 2004). Despite this there is little information on the effect of drying depth on the N fertilizer value of sludge. The aim of this study was to determine the effect of sludge drying depth and time on drying beds in a) the organic matter content and composition; as well as b) the nitrogen content and composition of sludge.

Materials and Methods

To achieve the stated aim, a field experiment was conducted at Vlakplaats (around Johannesburg area) using anaerobically digested sludge. Five drying depths (5, 10, 15, 20 and 25 cm) replicated three times were laid on the ground in a completely randomized design. Once the sludge reached to a 5% moisture, sludge samples were collected and ground to pass through a 150 µm screen and analysed for total C and N using a Carlo Erba NA1500 C/N analyzer (Carlo ErbaStrumentazione, Milan, Italy). Similarly the samples were extracted in 1:5 1 M KCl and tested for ammonium and nitrate with the LachatAuto analyzer (Lachat Quick Chem Systems, Milwaukee, WI, USA). Sludge organic matter composition was determined using Van Soest method.

Results and Discussion

Sludge dried in shallow drying depth of 10 cm for shorter period time of 3 week (autumn) and 5 weeks (winter), had the highest total N (3.53-3.72%) and sludge dried in 25 cm depth the least (2.62%-2.65%). The inorganic N content of the dried sludge accounted for less than 10% of the total N in all drying depths both in winter and autumn seasons. Sludge organic matter composition, however, did not differ significantly between drying depths. The soluble compounds were the dominant fraction of the total sludge organic matter accounting for 75% by mass. While the hemicellulose was the least.

Conclusions

Results from this study also showed that a 15 cm drying depth, which had slightly lower total N content than the 10 cm but significantly higher than the 20 and 25 cm drying depths, could be a better compromise for higher N fertilizer value and practical application on the ground.

References

Cogger CG, Bary AI, Sullivan DM and Myhre EA (2004) Biosolids Processing Effects on First- and Second-Year Available Nitrogen: Divisions 4 soil fertility & plant nutrition. *Soil Sci. Soc. Am J.* 68 162-167. Feigin A, Ravina I and Shalhevet J (2012) Irrigation with treated sewage effluent: management for environmental protection, vol. 17. Springer Science & Business Media. Kunhikrishnan A, Bolan NS, Müller K, Laurenson S, Naidu R and Kim W-I (2012) The influence of wastewater irrigation on the transformation and bioavailability of heavy metal (loid) s in soil. *Adv.Agron.*115 215. Penn CJ and Sims JT (2002) Phosphorus forms in biosolids amended soils and losses in runoff: effects of wastewater treatment process. *J. Environ. Qual.* 31 926-936.

Yield, resource use efficiency and trace metal uptake of weeping lovegrass grown on municipal sludge-amended soil

Presenter: EH Tesfamariam (eyob.tesfamariam@up.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
E.H.	Tesfamariam	University of Pretoria, private box x20, Hatfield, 0028, Pretoria, South Africa
J.G.	Annandale	University of Pretoria, private box x20, Hatfield, 0028, Pretoria, South Africa
J.M.	Steyn	University of Pretoria, private box x20, Hatfield, 0028, Pretoria, South Africa
W.F.	Truter	University of Pretoria, private box x20, Hatfield, 0028, Pretoria, South Africa
L.K.	Debusho	University of South Africa
D.G.	Talore	University of Pretoria, private box x20, Hatfield, 0028, Pretoria, South Africa

Introduction

Pastures are ideal for sludge application because they are often situated in the close vicinity of urban areas; they display efficient nitrogen utilization under intensive management practices and can be harvested repeatedly during the year (Cogger et al. 2001). There are, however, concerns that fertilization using sludge will compound the effect of drought, resulting in the decline of yield (Herbel 1983) as a result of potential salt accumulation (Muyen et al. 2011). This is because both water deficit and osmotic effects are probably the major physiological mechanisms for growth reduction, as both stresses lower the soil water potential (Hu and Schmidhalter 2005). The aim of this study was to test the hypothesis that in semi-arid areas, where rainfall is erratic, continuous application of municipal sludge based on plant N requirements will not negatively affect weeping lovegrass hay yield, crude protein content, rainfall use efficiency and nitrogen use efficiency. Similarly, weeping lovegrass planted to soils amended with low trace metal concentration municipal sludge will not result in the accumulation of trace metals in the short to medium term.

Materials and Methods

Field experiments were conducted (2004/05 – 2011/12) in a formerly natural grassland area at the East Rand Wastewater Care Works (ERWAT), Johannesburg, Gauteng, South Africa. Plots of 25m² were arranged in a randomized complete block design comprising four replications of four treatments. The treatments consisted of 0 (control), 4, 8 and 16Mg dry sludge per ha per year. Above-ground samples for hay dry matter yield determination were collected 0.05m above the soil surface from a 1m² area. Additional samples were collected at harvest from each plot for total N, total P, and trace metal uptake determination.

Results and Discussion

Both hay yield and RUE increased by 5–53% as the sludge rate increased. Hay yield was highest (13.3Mg/ha) during the wet season and RUE (27.1 kg/mm) during the dry season. RUE was highest at sludge rates of 16Mg ha⁻¹ and NUE at 4Mg/ha. Similarly, municipal sludge application increased CP content as well as crop Cr and Zn uptake from the 16Mg/ha treatment.

Conclusions

Results from this study indicated that eight consecutive years of treated municipal sludge application increased weeping lovegrass hay yield, CP content and RUE. Similarly, trace metal uptake by crop did not differ between the zero control and the 16Mg/ha treatment, except for Zn and Cr, which showed a slight increment. Nonetheless, all trace metals remained well below the maximum tolerable dietary concentrations for domestic animals.

References

Cogger CG, Bary AI, Fransen SC and SullivanDM (2001) Seven years of biosolid versus inorganic nitrogen applications to tall fescue. *J Environ Qual.* 30:2188–2194. Herbel CH (1983) Principles of intensive range improvements. *J Range Manag* 36:140–144. Hu Y and Schmidhalter U (2005) Drought and salinity: a comparison of their effects on mineral nutrition of plants. *J Plant Nutr Soil Sci* 168:541–549. Muyen, Z, Moore GA and Wrigley RJ, (2011) Soil salinity and sodicity effects of wastewater irrigation in South East Australia. *Agric Water Manag* 99:33–41.

Influence of priming potato planting tubers using phytonematicides solutions on nematode suppression in potato production

Presenter: T.E Thopola (mpulokenge@gmail.com)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T.E	Thopola	University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa.
K.M	Pofu	Agricultural Research Council-VOP, Private Bag X293, Pretoria, 0001, South Africa.
P.W	Mashela	University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa.
T.P	Mafeo	University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa.
Z.P	Dube	University of Limpopo, Private Bag X1106, Sovenga, 0727, South Africa.

Introduction

Potato (*Solanum tuberosum* L.) genotypes do not have resistance to root-knot nematodes (*Meloidogyne* species) with yield losses being as high as 50% to total crop failure (Mashela et al. 2017). Highly effective synthetic chemical nematicides have been withdrawn from the agrochemical markets due to their environment-unfriendliness. The available alternative cucurbitacin-containing phytonematicides are labour-intensive in terms of application. The objective of this study was to determine the effects of priming potato tubers in phytonematicide solutions prior to sowing on nematode suppression.

Materials and Methods

A 2 × 2 × 2 factorial experiment, with factors arranged in a randomised complete block design, with 14 replications, was conducted in a nematode-infested field. Tuber seeds were primed in 3% Nemarioc-AL, 3% Nemafric-BL and 3% Mormo-Nem for seven hours prior to sowing. At 56 days after inoculation, plant and nematode variables were collected and analyzed using Statistix 10.0 software.

Results and Discussion

The first order interactions, Nemarioc-AL × Nemafric-BL and Nemarioc-AL × Mormo-Nem, were significant on seed emergence, each contributing 30% total treatment variation (TTV) of the variable. The first order interaction Nemafric-BL × Mormo-Nem, was highly significant on dry root mass, contributing 60% in TTV of the variable. First order interaction, Nemarioc-AL × Mormo-Nem was significant on fresh tubers and chlorophyll content, contributing 33 and 15% in TTV of the respective variables respectively. The first order interaction was highly significant on eggs in roots, contributing 45% in TTV of the variable. Nemarioc-AL, Nemafric-BL and Mormo-Nem second order interaction increased dry shoot mass by 40%. Combination of Nemarioc-AL and Mormo-Nem increased potato yield by 18%.

Conclusions

Priming potato seed tubers with Nemarioc-AL, Nemafric-BL and Mormo-Nem phytonematicide solutions improved seedling emergence, stimulated plant growth and suppressed nematode population densities in potato production.

References

Mashela PW, De Waele D, Dube Z, Fourie H. 2017. Alternative nematode management strategies. Nematology in South Africa: A view from the the 21st century.151-181

Evaluation of replacement of maize by cassava and the particles hand aggregation for poultry feed formulation

Presenter: L D Tivana (lucastivana@yahoo.co.uk)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
M	Maholela	Department of Chemical Engineering, Faculty of Engineering, Eduardo Mondlane University, Maputo, Mozambique
Lucas	Tivana	Department of Rural Engineering, Faculty of Agronomy and Forest Engineering, Eduardo Mondlane University, Maputo, Mozambique

Introduction

Aiming to find alternative resources and simple production techniques of poultry feed, this work proposes the use of cassava, which is easy to produce in Mozambique, as a substitute for maize, and, in addition, to test simple manual operation of particles aggregation for the production of the alternative feed, technology that may be suitable for rural household sector conditions. For the alternative feed formulation it was used the protein concentrate for poultry, maize and cassava.

Materials and Methods

In the formulations, maize was replaced by dry cassava flour at 30, 60 and 100%. To aggregate this three components particles, was used the technique that is used to produce roasted shredded cassava roots, gari, in rural areas, consisting of toasting grated cassava roots. The physic-chemical characteristics of alternative feed evaluated were the particle size and the water absorption capacity. In addition it was evaluated the growth performance (weight gain, feed intake and feed conversion) in broilers with administration of experimental feed compared to commercial feed. For chicks from 1 to 21 days was provided feed with aggregate size of 1.4 to 2.8 mm, and for those with more than 21 days, feed pellets of 2 to 4 mm were supplied.

Results and Discussion

For all three formulations of 30, 60 and 100% of maize substitution by cassava, were obtained for the starter feed and broiler growth: The water absorption was 3.9, 4.9 and 5.2 times per gram to 30, 60 and 100% substitution, respectively. The birds performance at 35 days (slaughter day) for the three formulations (30, 60, 100%) was 1.351g, 1.368g, 1.445g of weight gain, 1.445g, 1.366g, 1.585g for food consumption and 1.07, 1.00, 1.10 for feed conversion respectively, and for commercial feed was 1.545g of weight gain with a food consumption of 1.550g and feed conversion of 1.00.

Conclusions

The results show that the replacement of maize by cassava and the manual aggregation of food particles allowed to get a feed production technology that can adapt to small farmers in rural areas and may enable the poultry production as way to increase the protein consumption in rural areas.

References

Tivana, L. D.; Dejmek, P.; Bergenstahl, B., (2010), Characterization of the agglomeration of roasted shredded cassava (*Manihot esculenta crantz* roots), Wiley-VCH Verlag GmbH & Co. KGaA Weinleim, pp. 637-646. Tivana, L. D.; Dejmek, P.; Bergenstahl, B., (2013), Effect of pH and soybean flour heat treatment on the texture and colour of fortified roasted shredded cassava roots (garri), Wiley-VCH Verlag GmbH & Co. KGaA Weinleim, pp. 628-636.

Pre breed screening for Naringin and Naringenin content in Grapefruit

Presenter: AMJ Van der Loo (vanderlooa@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
AMJ	Van der Loo	ARC-ITSC, Private Bag X11028, Nelspruit 1200
M	Labuschagne	University of the Free State, PO Box 339, Bloemfontein 9300
Z	Bijzet	ARC-ITSC, Private Bag X11028, Nelspruit 1200
G	Osthoff	University of the Free State, PO Box 339, Bloemfontein 9300
M	Booyse	ARC-Biometry Private Bag X5026, Stellenbosch, 7599

Introduction

When selecting suitable parents in a controlled breeding program, information on the breeding value of available parents and the heritability of specific characters will aid the breeder in parent selection and the planning of controlled crosses (Abouzar and Nafiseh, 2016). However, in a citrus breeding program screening for fruit quality traits such as flavonoid content are influenced by several environmental factors (Sinclair, 1961; Chen, 1990; Hunlun, 2016). Determining which environmental factors impact the physical - and chemical characteristics could provide important information for the effective screening of breeding parents and selections in the Agricultural Research Council's citrus breeding programmes.

Materials and Methods

The physical - and chemical characteristics as well as the naringin and naringenin content of three grapefruit varieties ('Star Ruby', 'SweetHeart' and 'Marsh') grown and harvested over two seasons (2015-2016 and 2016-2017) were evaluated. The data were subjected to analysis of variance (ANOVA) using General Linear Models Procedure (PROC GLM) of SAS software (Version 9.2; SAS Institute Inc, Cary, USA). Shapiro-Wilk test was performed on the standardized residuals from the model to verify normality (Shapiro and Wilk, 1965). Fisher's least significant difference (LSD) was calculated at the 5% level to compare treatment means (Ott and Longnecker, 1998). Pearson product moment correlations were performed using Correlation Procedure (PROC CORR) of SAS software (Version 9.2; SAS Institute Inc, Cary, USA). Principal component analysis was conducted for each year separately and years combined to investigate the relationship between the factors (years, varieties and quadrants) and variables, using XLSTAT (Version 2015.1.03.15485, Addinsoft, Paris).

Results and Discussion

Significant varietal differences were seen for fruit size, brix, pH and naringin content. Canopy positions varied in physical characteristics such as fruit mass, circumference, peel mass and segment mass. As for the chemical composition of the fruit, the northern quadrant fruit were highest in brix content, and also had a high brix:acid ratio. The effect of quadrant sampling on flavonoid content did not indicate any significant differences. From the results a strong association was recognised between naringin and naringenin. The interactions between the physical and chemical characteristics were constant over both seasons.

Conclusions

This study indicates that screening fruit in a citrus breeding program for naringin and naringenin content, the sampling quadrant does not seem to have an effect, but genetic differences and climatic differences between seasons would affect the naringin content of fruit. Thus, the sampling of fruit for naringin and naringenin content screening can be simplified.

References

Abouzar, A. and Nafiseh, M. N. 2016. The Investigation of Citrus Fruit Quality. Popular Characteristic and Breeding. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis* 64: 725-740. Chen, C. S., 1990. Model for seasonal changes in °Brix and ratio of citrus fruit juice. *Florida State Horticultural Society* 103: 251-254. Hunlun, C., 2016. Characterising the flavonoid profile of various citrus varieties and investigating the effect of processing on the flavonoid content (Doctoral dissertation, Stellenbosch: Stellenbosch University). Ott, R.L. and Longnecker M. 2001. *An Introduction to Statistical methods and data analysis*. 5th Edition Belmont, California: Duxbury Press: 440: 1-1152. Shapiro, S.S. and Wilk, M.B. 1965. An analysis of Variance Test for Normality (complete samples). *Biometrika* 52: 591-611. Sinclair, W. B. ed. 1961. *The orange, its biochemistry and physiology*. Berkley, USA: University of California, Division of Agricultural Sciences.

Mineralisation and Uptake of Organic and Mineral Fertilizer by Rooibos Tea under Northern Cape Field Conditions

Presenter: SG van Heerden (17204712@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
SG	van Heerden	Department of Soil Science, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa
AG	Hardie	Department of Soil Science, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa
JE	Hoffman	Department of Soil Science, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa

Introduction

Rooibos tea production increase is required due to increased international demand and restrictions on establishment of new rooibos fields in fynbos regions. Currently no information is available on mineralization, nutrient availability and nutrient uptake of rooibos tea plants under field conditions. The aim of the study was to determine the nutrient mineralization and rooibos uptake of selected organic and chemical fertilizers during the winter rainfall months under Nieuwoudtville field conditions.

Materials and Methods

Three commercial organic and three mineral fertilizer treatments, with NPK ratios of 3:1:5; 2:3:2; and 3:2:4, were applied at a P application rate of 15 mg/kg, based on the work of Joubert, et al., (1987). Soil and whole plant samples were taken monthly during the winter month (June - September) to correlate mineral N, P and K availability in the soil to the nutrients taken up and stored by the plant. Topsoil was sampled to a depth of 15 cm where majority of rooibos fine roots are concentrated.

Results and Discussion

The mineral 3:2:4 treatment had a significantly ($p < 0.05$) higher initial Bray II P, which decreased significantly over time. Bray II P initially increased significantly in the organic 3:2:4 treatment, then decreased again in August. A weak positive correlation ($R^2 = 0.463$) was found between soil pH (KCl) and Bray II P, with highest pH occurring in the mineral treatments. The mineral 3:1:5 treatment had a significantly higher mineral N. Root N ($R^2 = 0.0574$) and P (%) ($R^2 = 0.0293$) showed a weak positive correlation to soil nutrient availability. In September total plant N and P (%) was highest in the mineral treatments, whereas K (%) was highest in the organic 3:2:4 treatment. The increase in Bray II P in the organic treatments is linked to mineralization occurring. The decrease in Bray II P and N in the mineral fertilizer treatments occurred possibly due to leaching in the sandy soil.

Conclusions

Mineral fertilizers initially provide a high source of nutrients in topsoil, but decreases over a short period of time. Organic fertilizer mineralize effectively with rainfall present, however under drought conditions it can lead to a deficient nutrient supply for plant growth. The results suggest that nutrient uptake is increased when the nutrient availability is also increased. Further research is currently underway to determine the optimal organic and chemical nutrient application for maximal growth under Nieuwoudtville growing conditions.

References

Joubert M, Kotze WAG, du Preez M. 1987. Voedingsbehoefte van Rooibostee. Tuinbouwetenskap 5: 11-14

SOIL WATER BALANCE AND ROOT DEVELOPMENT IN ROOIBOS PLANTATIONS UNDER CLANWILLIAM FIELD CONDITIONS

Presenter: R van Schalkwyk (17043255@sun.ac.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
R	van Schalkwyk	University Stellenbosch
J. E.	Hoffman	University Stellenbosch
A. G.	Hardie	University Stellenbosch

Introduction

Rooibos tea (*Aspalathus linearis*) grows in Clanwilliam area and Northern Cape (Morton, 1983). Currently, no field information is available on the soil water balance of rooibos tea under Clanwilliam conditions. The aim of this study is to determine the soil water balance of rooibos since the soil water availability is closely linked to productivity.

Materials and Methods

An experimental trial consisting of unfertilised rooibos, fertilised (20 mg/kg N, 30 mg/kg P and 20mg/kg K) rooibos rooibos and bare soil treatments was carried out on deep (90-100 cm) and shallow sites (< 40 cm) at Vaalkrans farm, Clanwilliam. The water content was measured at 10 cm depth intervals with a Diviner 2000 for determination of the soil water balance from July 2016 until 1 April 2017. Diurnal soil water and temperature fluctuations of the three treatments at the deep site were determined using continuously ECH2O water sensors. Air temperature and light intensity were determined by an automatic weather station.

Results and Discussion

The cumulative evapotranspiration (ET) of the unfertilised treatment was 121.2 and 110.8 mm, the fertilised treatment of 115. 8 and 108.4 mm and bare treatment had 120.4 and 108.6 mm on the deep and shallow soils, respectively. The cumulative ET and evaporation (E) was lower at the shallow soil sites due to less available soil water compared to the deep soils. The evaporation of the bare soil did not differ from the planted soils, as was expected, due to drought. During the winter season, the soil water content in the 10-20 cm layer of all treatments was higher (3.21 - 38.51%) than the other layers likely due to higher organic carbon of 0.24 - 0.40% in the 0 - 20 cm layer compared to in the 20 - 40 cm layer of 0.15 - 0.30 % and fine root content (29.26%). The soil temperature fluctuations were significant in the 5 cm layer of all treatments but less at the deeper depths. This was due to poor energy transfer in the dry sandy soil.

Conclusions

The shallow soil stored less water and thus had a lower cumulative evapotranspiration than the deeper soils. The soils contained slightly more water at 10-20 cm which corresponds to root distribution pattern. Soil temperature fluctuations were less at depth due to poor energy transfer.

References

Morton, J.F. 1983. Rooibos tea, *aspalathus linearis*, a caffeineless, low-tannin beverage. *Econ. Bot.* 37(2): 164-173. ACKNOWLEDGEMENTS Rooibos Limited for funding.

EVALUATION OF SIXTEEN GROUNDNUT VARIETIES FOR TOLERANCE TO SOIL ACIDITY IN MPUMALANGA AND KWAZULU - NATAL PROVINCES

Presenter: NM Vilane (vilanem@mpg.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
NM	Vilane	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs, Private Bag X 11318, Nelspruit 1200, South Africa.
GE	Zharare	University of Zululand, Department of Agriculture, Private Bag X 1001, Kwa - Dlangezwa 3886, South Africa.
AZ	Zobolo	University of Zululand, Department of Agriculture, Private Bag X 1001, Kwa - Dlangezwa 3886, South Africa.

Introduction

Groundnut (*Arachis hypogaea* L) is the most important crop after maize in Mpumalanga and in the north coastal region of KwaZulu - Natal. In these areas, most soils are acidic and poor in mineral plant nutrients. Both the problem of low soil pH and low mineral nutrient concentrations are exacerbated by the inability of the smallholder farmer to provide remedial measures. One way to deal with this is to use varieties that are tolerant to soil acidity. The objective of the study was to explore the genetic diversity of groundnut germplasm currently available in South Africa, tolerant to acid-soil infertility.

Materials and Methods

Sixteen groundnut varieties were evaluated in field experiments for their tolerance to low pH in Nelspruit (pH 4.54) and Manguzi in North KwaZulu - Natal (pH 4.21) during the 2008-2009 season. The groundnut varieties were planted in a randomized complete block design (RCBD) with 4 replications. The plot size was 4 rows of 5 m long with inter and intra - row spacing of 70 cm and 10 cm respectively. The seed placement was 5-7cm deep. Analyses of variance of the data collected performed using the Genstat 12th edition software package and means of the treatments were separated by the least significant difference (LSD) at 5% level.

Results and Discussion

The groundnut varieties tested differed widely in their performance in terms of yield, which ranged from 774 to 1709 kg/ha at Nelspruit and from 383 to 2358 kg/ha at Manguzi, which reflected the considerable diversity in the adaptation of groundnut to soil acidity. The outstanding varieties at Mpumalanga were Inkanyezi, ICGV 95714 and Anel which produced seed yields ≥ 1456 , 1457 and 1709 kg/ha. At Manguzi, the outstanding varieties were ICGV 99529, Mwenje and Inkanyezi, which produced seed yields ≥ 1599 , 1664 and 2358 kg/ha. Thus, the groundnut varieties that performed best at Mpumalanga were different to those that performed best at Manguzi, which indicated that there is a strong genetic and environment interaction on the performance of yield groundnut. Consequently, it is prudent to test groundnut varieties for their suitability to a particular area before introduction to the area.

Conclusions

There is considerable diversity in the tolerance of groundnut to acid soil conditions. Groundnut varieties were identified for production on acid soil at both Manguzi and Nelspruit. However, the study revealed strong genetic x environment interaction on the seed yield performance of groundnut, which necessitates varietal testing prior to groundnut introduction.

References

BIOLOGICAL PATHWAYS OF INFESTATION BY THE FALL ARMYWORM AND TOMATO LEAFMINER

Presenter: D Visser (dvisser@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
D	Visser	ARC Vegetable and Ornamental Plants, Private Bag x293, Pretoria, 0001

Introduction

Two new pests were reported in South Africa during the past eighteen months. They were the tomato leafminer, *Tuta absoluta*, and the fall armyworm, *Spodoptera frugiperda*. The tomato leafminer is a serious pest of tomato (EPPO 2005), and the fall armyworm a serious pest of maize (EPPO 2015). Both these pests entered South Africa from its northern neighbours. The path of entry for the tomato leafminer is unknown, but it is widely accepted that the fall armyworm migrated in the adult stage with the aid of strong prevailing winds. Both these pests are now firmly established in the country. Here we consider what biological pathways may lead to local spread and infestations.

Materials and Methods

Both the tomato leafminer and the fall armyworm were surveyed in experimental research fields at ARC-VOP, Roodeplaat, northeast of Pretoria. Occurrence as well as dispersal were observed to ascertain possible pathways of infestation to newly planted crops.

Results and Discussion

The tomato leafminer was encountered in tomato plots early in the season. However, these infestation levels were very low, and limited damage was observed. A second planting was established soon after, and in close proximity, of the first one. A severe infestation with high yield loss was experienced with the second crop. The fall armyworm invaded an experimental maize field in early 2017. All plants in the field were attacked; each whorl was infested with two to five larvae. In both these two cases, ballooning of first instar larvae (spreading by wind on a line of silk), was noted regularly. Tomato leafminer moths were noted in tomato fields in extremely high numbers in the latter parts of the season, while fall armyworm moths were mostly absent.

Conclusions

It is concluded that the tomato leafminer invades tomato fields in low numbers, but that the build-up in numbers occur quickly within one season, placing follow-up, or adjacent tomato fields, at high risk. Invasions by the fall armyworm occur suddenly and in high numbers, with moths flying from remote areas. Build-up of numbers within a season by fall armyworm is mostly irrelevant, because moths lay too many eggs on one plant; ballooning is always used to distribute the excess larvae to nearby maize plants. A 100% infestation of plants early in the season is therefore not unusual for the fall armyworm while the tomato leafminer only attains these levels at the end of the season.

References

EPPO. 2005. Data sheets on quarantine pests - *Tuta absoluta*. EPPO Bulletin 35, 434-435. EPPO. 2015. *Spodoptera littoralis*, *Spodoptera litura*, *Spodoptera frugiperda*, *Spodoptera eridania*, EPPO Bulletin 45, 410-444.

IRRIGATION MANAGEMENT OF APPLE ORCHARDS IN SANDY SOIL IN TWO WESTERN CAPE WATER MANAGEMENT AREAS

Presenter: T Volschenk (volschenkt@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
T	Volschenk	ARC Infruitec-Nietvoorbij, Private Bag X5026, Stellenbosch, 7599, South Africa
S	Dzikiti	CSIR, Natural Resources and Environment, Stellenbosch, South Africa
M	Gush	CSIR, Natural Resources and Environment, Stellenbosch, South Africa
S	Midgley	University of Stellenbosch, Department of Horticultural Science, Stellenbosch, South Africa
N	Taylor	Department of Plant Production and Soil Science, University of Pretoria, Pretoria, South Africa

Introduction

Information on orchard water use is crucial for irrigation scheduling and on-farm water management to ensure growth and sustainability of the deciduous fruit industry in South Africa. The Water Research Commission therefore initiated and funded a four year project (WRC K5 2398) in collaboration with HORTGRO Science to study the water use of apples in the Olifants-Doorn and the Breede Water Management areas. The objective of this component of the study was to monitor soil water content throughout the season and to calculate evapotranspiration according to a soil water balance for unstressed apple orchards.

Materials and Methods

Orchard soil water dynamics in non-bearing, intermediate-bearing and full-bearing apple orchards were measured collectively over three seasons. Soil water content was monitored hourly throughout the season in two commercial apple orchards per season from 2014/15 to 2016/17 using thirty CS616 soil water content sensors per site. Irrigation applied was monitored using continuous logging flow meters, and precipitation as well as reference evapotranspiration data obtained from a representative weather station at/near each site.

Results and Discussion

Irrigation scheduling of the orchards in the two water management areas are compared, taking into account differences in atmospheric evaporative demand and precipitation, crop load and soil water holding capacity. The orchard soil water dynamics depended largely on management practices (i.e. mulched and/or wetted area, irrigation scheduling).

Conclusions

Periodic excessively wet or water deficit conditions may have decreased orchard evapotranspiration below the optimum.

References

PROVIDING FARMERS WITH USEFUL CLIMATE INFORMATION

Presenter: S Walker (walkers@arc.agric.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S	Walker	ARC-ISCW, PB X79 Pretoria 0001
P	Maluleke	ARC-ISCW, PB X79 Pretoria 0001
O	Phahlane	ARC-ISCW, PB X79 Pretoria 0001

Introduction

Agricultural productivity is dependent on the environmental conditions as well as management decisions. Therefore, farmers need detailed and local information about the environmental potential for the area surrounding their farms. General regional information about the natural resources is not detailed or specific enough for farmers to use for their agricultural production decisions (Dinku et al., 2014). Innovative methods were investigated to provide farmers with the necessary information.

Materials and Methods

Agromet information meetings were held across six provinces during winter of 2017. Information about current availability of weather forecasts, use of cellular phones and farming practices was collected using a questionnaire. Weather information pertinent to planting of maize was formulated into advisories. Status quo of agricultural production by small-scale farmers were obtained from statistical analysis. Information about the farmers was classified according to age, wealth, education, land tenure and size of farming enterprise as well as location.

Results and Discussion

Questionnaires show that small-scale farmers (SSF) in rural and peri-urban areas have different characteristics. Those in peri-urban areas are slightly older (by 6y), have a higher level of formal education and more of them have access to a smart phone (>11%). Others only had a simple cellular telephone without any connection to internet so this limits availability of weather forecasts. In many areas, participants reported difficulties with internet connection and that the data transfer was expensive, also limiting opportunities for use of apps. Most SSF indicated that they prefer to obtain the weather information in their mother tongue, however about a quarter to half of them suggested English was a second choice. Approximately half the SSF interviewed grow maize, while others grow an assortment of vegetables, so information relative to maize should be a priority. More than 70% of SSF did receive some weather forecasts. Many requested more specific information related to their own farming operations. Maize planting information to be delivered via USSD and Apps, was generated using rain received in the past 5days together with the rain forecast for the next 5days.

Conclusions

These preliminary results show that farmers are in need of specific local weather information to assist in their farming decision making activities. Farmers will be able to benefit from weather forecast with additional planting date information relevant to their farming activities.

References

Dinku T, Block P, Sharoff J, Hailemariam K, Osgood D, del Corral J, Cousin R, Thomson MC. 2014. Bridging critical gaps in climate services and applications in Africa. *Earth Perspectives* 1:15. ACKNOWLEDGEMENTS Rain for Africa (R4A) project is funded by The Netherlands Space Office.

EXPERIENCE ON INTEGRATED SEED SYSTEM APPROACH IN CENTRAL AND EASTERN KENYA

Presenter: S Wanderi (susan.wanderi@kalro.org)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
S	Wanderi	Kenya Agricultural and Livestock Research Organization (KALRO), P.O. Box 27 Embu 60100 Kenya
B	Rono	Kenya Agricultural and Livestock Research Organization (KALRO), P.O. Box 27 Embu 60100 Kenya
B	Kikuvi	Kenya Agricultural and Livestock Research Organization (KALRO), P.O. Box 27 Embu 60100 Kenya
L	Gachemi	Kenya Agricultural and Livestock Research Organization (KALRO), P.O. Box 27 Embu 60100 Kenya

Introduction

Quality seed ensures high crop yield and subsequently food and nutrition security as well as income. However, limited access to quality seeds hinders adoption of improved crop varieties resulting into low crop production. An integrated seed system approach ensures adoption of improved varieties and quality seeds among smallholder farmers.

Materials and Methods

To improve seed access, Upper Tana Natural Resource Management Project (UTaNRMP) employed integrated seed system approach in six counties namely; Embu, Tharaka Nithi, Meru, Kirinyaga, Nyeri and Murang'a. The project partnered with Kenya Agricultural & Livestock Research Organization (KALRO) to produce and maintain early generation seed of improved varieties using formal systems. KALRO also trained extension staff and farmers to enhance their capacity in quality seed production. Community based seed production was initiated through supply of starter seeds to the trained farmers using retrieval model. Participatory monitoring involving researchers, extension staff and farmers followed to ensure production of quality declared seeds and certified seeds.

Results and Discussion

Through integration of formal seed system by KALRO and informal seed production by the community, farmers were able to secure 350 metric tons of quality seed. Using the retrieval model, farmers gave back to the project double the amount of seed that was loaned to them. Farmers were also required to save an equivalent amount to plant in the following season or sell the surplus to other farmers. The model ensured that the seed of the selected crop varieties diffused in the farming community within the project area and beyond, thereby establishing a farmer-to-farmer system of seed delivery. The community seed bulking was implemented through farmer groups with the provision of technical and material support as well as facilitating monitoring of crops at critical stages by researchers and extension staff. This supervision resulted into good crop management, minimal crop rejection, high seed retrievals and several groups qualified as contract growers. Four hundred trained farmers and eighty extension staff officers reached more than 12,000 farmers in their respective counties. KALRO also engaged 200 contract growers to bulk certified seeds on contract basis. Through this initiative smallholder farmers were provided with basic seeds and linked to the market

Conclusions

Integrated seed systems approach is a sustainable way of ensuring increased access and availability to quality seed to the farmers, hence a faster way of disseminating new varieties. The success of community seed production hinges on collaboration of research, extension services and farmers resulting into increased crop production and household incomes.

References

THE EFFECT OF DRYING METHODS AND STORAGE ON NITROGEN COMPOSITION OF TOP SOIL SAMPLES AT DÖHNE AGRO-BLOCKS, EASTERN CAPE, SOUTH AFRICA.

Presenter: O.S Wutu (sinazo.wutu@dradr.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
O.S	Wutu	Department of Rural Development and Agrarian Reform
Z	Mkile	Department of Rural Development and Agrarian Reform
A.M	Ras	Department of Rural Development and Agrarian Reform

Introduction

Nitrogen (N) is one of the most deficient plant nutrients in South Africa and replenishment of it plays a pivotal role in retaining humus thus maintaining soil quality (Mills and Fey, 2003). Losses of N during sampling, handling and transportation is often ignored by farmers hence the analysis of soil for N-content is important. The objective of this study was to monitor N dynamics on top soil samples during the period of storage at different temperatures as this may assist in N fertiliser recommendations.

Materials and Methods

Soil samples were collected from Döhne ADI Agro-blocks on a Westleigh soil form. Two experimental blocks, fertilised and unfertilised were used. The experimental design was factorial (3x3x2x2) arranged in a randomised complete block design. The treatments were oven-dried (70°C for 24 hours), air-dried (room temp for 24 hours), zero-dried (closed container stored in polyethylene bags) all replicated three times. NH₄—N, Total-N and NO₃--N were analysed using a Continuous flow analyser. Extraction was done in a sequence of 1, 2, 4, 8, 16 and 32 days after sample drying. Some samples awaiting extraction were stored at a freezer at -18°C and some were stored at 25°C.

Results and Discussion

All treatments did not show significant differences ($p < 0.001$) in NH₄—N after days 1 and 2. The highest NH₄—N content were obtained in day 4 and 8 on the zero-dried soils. All this occurred in fertilized block whilst the opposite was observed in the unfertilised block. The highest NO₃—N content was obtained on the 1st day when samples were air-dried. The oven dried samples followed the same trend whilst zero-dried samples followed their own trend. Oven-dried and air-dried followed similar trend when it came to total-N content. Zero-dried soil samples had the highest total-N content (3.860 mg/kg). Even though the samples were exposed to room temperature (25°C) as they are stored for a longer period, NO₃—N decreased. The NH₄—N results of the present study agreed with those obtained by Gray and McLaren (2013) which did not increase with storage period.

Conclusions

It can be concluded that storage, method of drying and fertilization have an influence on the top soil N-content of Döhne Agro-blocks. The results from Döhne Agro-blocks show that air-drying is the best and relatively reliable method even though zero-drying showed the highest N content in all N forms.

References

Gray CW, McLaren RG (2003). Effects of air drying or sample storage on soil solution properties of biosolids amended soil. *Commun. Soil Sci. Plant Anal.* 34 (15-16):2327-2338. Mills, A., Fey, M.V., 2003. Declining soil quality in South Africa: Effects of land use on soil organic matter and surface crusting.

Evaluating soil acidification in active cropping projects of the Eastern Cape using analytical results

Presenter: Z Zizo (zizo.mzayiya@drdar.gov.za)

Author Details

Initials	Surname	Authors Company/Organisation and Postal Address
Z. B	Mzayiya	PVT Bag X15 Stutterheim 4930
T.T	Silwana	Private Bag X15 Stutterheim 4930
B	Ras	Private Bag X15 Stutterheim 4930

Introduction

Over the years different cropping programmes and projects have been initiated and implemented throughout the Eastern Cape Province. Since 2013 cropping projects in Bizana, Mqanduli and Ncora under RED HUBs have been producing maize as a source of food security; however, there is little information about the effect of the cropping and fertilization on soil properties. Maize plant struggle to thrive in soils with high acid saturation (ARC, 1995) and acidified soils are at risk of developing nutritional deficiencies and metal toxicity, which may result in low productivity (Fey, 2001). For sustainable management soil acidity should be monitored and corrected as it may reduce efficiency of these cropping projects.

Materials and Methods

To determine which cropping project(s) is affected by soil acidity in the province, a soil analytical data mining exercise was conducted at Dohne analytical laboratory and Eastern Cape Rural Development Agency.

Results and Discussion

From 1899 samples analysed in 2013, 1090 have pH (KCL) <5. Three hundred and twenty three of the samples had acid saturation > 20%, with the highest saturation recorded to be 94.4%. From 775 soil samples analysed in 2017, 588 of soils have pH (KCL) value < 5. One hundred and seventeen soil samples had acid saturation > 20% with the highest acid saturation of 86.6%. All the nineteen fields in Ncora had a pH (KCL) value <5, seven of the fields had acid saturation >20%. In Mqanduli out of 86 fields sampled, 51 had pH (KCL) value < 5. No farms had acid saturation >10%. Soils from 26 farms in Bizana had pH (KCL) value < 5, and had >20% acid saturation in 9 of the farms with the highest recorded to be 70 % acid saturation.

Conclusions

Percentage of acidified soil samples has increased from 57-75% between 2013-2017. About 73% of fields under RED HUBs in the Eastern Cape is acidified. This continued increase in the number of acidified soils may pose a serious threat to food security and render food production unsustainable.

References

ARC-Institute for Soil, Climate and Water. 1995. Natural soil acidity map. Pretoria, South Africa. Fey M.2001. Acid Soil Degradation in South Africa: A Threat to Agricultural Productivity. FSSA Journal. Pp 37-41

Thank you for attending the congress.