Abstracts:

Poster Presentations

NITROGEN EFFECTS ON ROSE-SCENTED GERANIUM (*Pelargonium capitatum x P. radens*) PRODUCTION

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INTRODUCTION

Rose-scented geranium (*Pelargonium capitatum x P. radens*, family Geraniaceae) is one of the essential oil producing perennial herbs (Weiss 1997). Essential oil production of crops is reported to be influenced by several factors, including nitrogen rate, source and season of production. Therefore, this study was conducted to investigate the influence of nitrogen rate, source and season of production on herbage yield, essential oil yield and oil composition of rose-scented geranium.

MATERIALS AND METHODS

The experiment was conducted under field conditions at the University of Pretoria's Hatfield Experimental Farm, Pretoria, South Africa (25^{o} 45'S, 28^{o} 16'E) as a randomised complete block design, in four seasons (winter, spring, summer and autumn of 2006/2007). Two sources of N, conventional (limestone ammonium nitrate or LAN, 28% N) and organic fertilizers (blend of four organic fertilizers) at three levels (100, 200 and 300 N kg/ha/year) and a control (no N) were replicated four times. Phosphorous (P) and potassium (K) fertilizers were applied at 90 and 100 kg/ha/year respectively, in all the plots. Plants were harvested at three month intervals and at each harvest, fresh herbage yield, oil yield and oil compositions were determined.

RESULTS AND DISCUSSION

Rose-scented geranium herbage yield, essential oil yield and oil content were found to vary with nitrogen rate, source and season. Highest herbage and essential oil yield were attained in spring and summer growing seasons with organic N at 100 kg/ha/year. As compared to the control, applying nitrogen in winter or autumn seasons either at different rates or sources did not improve herbage or essential oil yield of the crop. Oil content followed a different trend, with the highest percentage oil in autumn, followed by summer, spring and winter.

CONCLUSION

Organic N at 100 kg/ha/year increased herbage and essential oil yield of the crop in spring and summer but further increases in organic or conventional N levels had no significant effect. N application either in winter or autumn did not improve production of the crop. Therefore, it can be concluded that N rate, source and season of production should be considered to ensure optimal rose-scented geranium production.

REFERENCES

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Keywords: oil content, oil yield, season

INFLUENCE OF WATER ON HARVESTING FREQUENCY OF AMARANTH (*Amaranth cruentus*)

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INTRODUCTION

Vegetable amaranth has a unique high nutrient content, high protein, vitamins and minerals. The ability of vegetable amaranth to adapt to adverse condition such as low nutrient soils, a range of temperatures, solar radiation and drought stress constitute the possibility to cultivate the crop as a nutritious green vegetable crop in semi-arid regions. Influence of water availability on harvesting frequency of biomass yield of amaranth was the focus of this study.

MATERIALS AND METHODS

One genotype of amaranth, *Amaranth cruentus* ex Arusha was grown during summer of 2008/2009 and 2009/2010 seasons. The field experimental site was Kenilworth Experimental farm of the Department of Soil, Crop and Climate Sciences of the University of the Free State, Bloemfontein. The soil at the experimental site belongs to loamy aridic ustorthents (*Amalia family*). The experiment was laid out as a split plot design with four replications and a line source sprinkler was used as source of irrigation. The treatments include five levels of water application from fully irrigated, plots closest to the line source (W5), to rainfed plots (W1). The rainfed plots were twice the size of the irrigated plots to avoid the effects of border and lateral movement of water. Irrigation water was supplied when the available water of the soil fell below 70% in the W5 treatment plots. The field soil water content was monitored weekly with the aid of a Waterman Neutron moisture meter. The seedlings were raised in the greenhouse preceding transplanting when the seedlings were about 5cm high. Whole plants were harvested at 14 days after transplanting to determine the fresh weight and dry mass. At approximately one month after transplanting, plants were harvested at 30cm above ground which was assumed to be the edible portion of the plant. Harvesting continued at the same height at two week intervals.

RESULTS AND DISCUSSION

During the two seasons, W2 produced the highest biomass for the first two cuttings consecutively while W5 produced the least yield at these periods. At the end of the seasons, W3 had the highest biomass yield while there was no significant difference between other treatments. Cumulatively, biomass produced from the cuttings was higher than the total above ground biomass of a whole plant at the end of a season.

CONCLUSIONS

The result shows that continuous harvesting is productive for a smallholder. The influence of the water treatments shows that small amount of water is needed to increase the production of the vegetable.

ACKNOWLEDGMENT

This project was funded by Water Research Commission project (WRC K5/1771/4).

Keywords: Amaranth, biomass, cuttings, harvesting, water treatments

D-MANNOHEPTULOSE: SPECIAL CARBOHYDRATE IN AVOCADO: PRESENCE POSTHARVEST AND COMMERCIAL IMPORTANCE

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INTRODUCTION

Avocados contain large amounts of the C7 sugar *D*-mannoheptulose and its reduced polyol form, perseitol (Liu *et al*., 1999). Mannoheptulose seems to be a multifunctional molecule, with roles as antioxidant (Tesfay *et al*., 2010) and probably as carbon storage compound (Tesfay, 2010). Additionally, Bertling and Bower (2006) have postulated that C7 sugars act as a 'source of energy', that could, by providing carbohydrates which are ultimately fed into the TCA cycle, play a significant role in maintaining a certain carbohydrate status allowing for intense respiration in avocado fruit postharvest. This energy supply could be critical in improving the shelf life of avocado fruit. Therefore, a study was carried out to investigate if the shelf life and quality of avocado fruit can be extended through increasing the supply of *D*-mannoheptulose.

MATERIALS AND METHODS

Fruit were collected from 'Hass' avocado orchards in the KZN-Midlands, South Africa (30°16´E, 29°28´S). Four postharvest infusion treatments (controls with and without pedicel, continuous water infusion, and continuous 9.52mM *D*-mannoheptulose infusion) were used. Fruit firmness, fresh weight loss, respiration and mesocarp mannoheptulose concentrations were monitored over a ten day period. During infusion the sugar profile of the mesocarp was analysed for alternate days until fruit became eat-ripe (softness 5.0 to 6.2 N).

RESULTS AND DISCUSSION

D-mannoheptulose-infused fruit had the lowest mass loss, followed by water-infused fruit. Fruit without pedicels showed the highest mass loss, followed by control fruit with pedicels. Mass loss started to increase in most treatments two days into the experiment. *D*-mannoheptulose-infused fruit were the firmest, followed by water-infused ones. *D*-mannoheptulose-infused fruit also had a lower respiration rate than both types of control fruit, but not significantly different from water-infused ones. The fruit respiration rate started to increase after four days of room temperature storage. Continuous *D*-mannoheptulose infusion resulted in the highest mesocarp *D*-mannoheptulose concentration in fruit continuously infused with this sugar, followed by water-infused fruit. The two controls had the lowest mesocarp mannoheptulose concentration.

CONCLUSION

Continuous infusion of *D*-mannoheptulose reduces the respiration rate of 'Hass' avocado fruit, indicating that its deterioration of post-harvest quality might, at least in part, be due to a lack of *D*-mannoheptulose in mesocarp tissue. This implies the need to search for a means to increase pre-harvest *D*-mannoheptulose concentrations in the mesocarp, as this sugar probably acts as an anti-oxidant, thereby permitting longer postharvest storage of avocado fruit.

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Keywords: avocado, carbohydrates, *D*-mannoheptulose

STRATEGIC NITROGEN FERTILIZATION FOR MIXED GRASS PASTURES IN THE WINELANDS REGION OF THE WESTERN CAPE

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INTRODUCTION

Nitrogen (N) fertilizer is one of the most expensive inputs for pasture production and over-fertilization is not only costly, but also contributes to ground water pollution as N is easily leached from the soil profile. Broad guidelines regarding N fertilization rates are between 400 and 600 kg N $ha^{-1}y^{-1}$, but there is little information available about how this N should be applied to best match the grasses' seasonal requirement. The aim of this project is to develop a strategic N fertilization regime for mixed grass pastures in the Western part of the Western Cape.

MATERIALS AND METHODS

A pasture consisting of perennial ryegrass (*Lolium perenne*), cocksfoot (*Dactylis glomerata*) and tall fescue (*Festuca arundinaceae*) was established under irrigation at Elsenburg in April 2010. The pasture was subdivided into 14.1 m^2 plots that each received a N treatment of 0, 20, 40, 60 or 80 kg ha^{-1} respectively after being mob grazed by sheep to a level of 50mm. Grazing cycles of 24, 28 and 35 days were applied for spring, summer and winter respectively. The layout of the trial is a randomized block design with 5 replicates and data collection will take place over a period of 2 years.

RESULTS AND DISCUSSION

Preliminary results from the first two cuttings taken in September and October indicate significant increases in DMY for 60 and 40 kg Nha^{-1} respectively. The September cut showed a typical N response curve with 60 and 80 kg N ha^{-1} producing the highest DMY, while for the October cut, 40 kg N ha^{-1} appeared to be the optimum level.

CONCLUSION

At this early stage it appears as if the application of 40 to 60 kg N ha^{-1} is optimal for optimum dry matter production of the grass mixture. The data represented here is only preliminary and final conclusions will be made at the completion of the experiment.

ACKNOWLEDGEMENTS

Department of Agriculture: Western Cape

Keywords: nitrogen, fertilizer, pasture

EVALUATING THE PRACTICALITY OF LARGE-SCALE RAINWATER HARVESTING AND CONSERVATION IMPLEMENTS

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INTRODUCTION

Various rainwater harvesting and conservation (RWH&C) implements have the potential to increase available water for successful crop production in semi-arid areas and therefore increase crop yields (Hensley *et al*., 2000). RWH&C techniques have become increasingly important especially for small-scale farmers for increased crop production in semi-arid areas. Various RWH&C implements are available for up-scaling but the question that needs to be answered is: How practical are they?

MATERIALS AND METHODS

Four different RWH&C tillage implements were tested in three provinces on eight different soils over two seasons (2008/09 and 2009/10). Field experiments were conducted on the Fort Cox/Valsrivier, Kwrakwra/Hutton, Glen/Swartland, Glen/Oakleaf, Merino/Swartland, Towoomba/Hutton, Towoomba/Arcadia and Lambani/Shortlands ecotopes with four treatments and four replications. The treatments were In-field rainwater harvesting with a 2-m runoff area (*IRWH*$_{2.0m}$), *IRWH* with a 2.4-m runoff area (*IRWH*$_{2.4m}$), Daling plough (*DP*) and Mechanized basins (*MB*). From implementation through to harvest the primary goal was to evaluate the practicality of the commercial up-scaling of these implements.

RESULTS AND DISCUSSION

Field preparation, implementation, planting, maintenance and harvesting went well on all the ecotopes with the tillage implements only posing minor practical problems. Problems were identified for different implements. Certain aspects of the implements made it difficult for maintenance activities like weed control. Planting operations were adapted to prevent damage to the ridges and basins.

CONCLUSIONS

All RWH&C tillage implements performed well and only minor practical problems were encountered. However, certain maintenance activities as well as precision planting need further investigation.

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Keywords: Rainwater harvesting, conservation tillage

FARMERS' PRODUCTION CONSTRAINTS, MAIZE SELECTION CRITERIA AND PARTICIPATION IN VARIETY SELECTION IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

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INTRODUCTION

Numerous biotic, abiotic and socioeconomic constraints affect maize production in the Eastern Cape, which is one of the poorest Provinces in South Africa. Adoption of maize varieties will be enhanced if they meet farmer-preferences, in addition to showing good adaption in different agro-ecologies. Participatory Rural Appraisal tools, such as Focus Group Discussions (FGDs), have been found to be useful in gathering information from farmers. Participatory Variety selection (PVS) increases adoption of varieties by farmers. This study sought to identify farmers' production constraints, their selection criteria for maize varieties, and to afford them a chance to participate in variety selection.

MATERIALS AND METHODS

Focus Group Discussions and PVS were conducted in the Eastern Cape Province during the 2009/2010 rainy season. A total of 72 farmers, from Amathole and O. R. Tambo districts, participated in FGDs and PVS. Semi-structured questionnaires were used to establish selection criteria and production constraints. Through pair-wise and matrix ranking, selection criteria and production constraints were prioritized. Varieties evaluated during PVS included nine stress tolerant open pollinated varieties (OPVs), ZM 305, ZM 423 (early maturing), ZM501, ZM525, Obatanpa (medium maturing), ZM 621, ZM627, BR 993, and COMP 4 (late maturing). The first seven were obtained from CIMMYT, while the latter two are from IITA. Four locally grown varieties, PAN 6479 and three OPVs (Okavango, AFRIC 1 and Nelsons Choice), were included as checks.

RESULTS AND DISCUSSION

The most important production constraints were lack of capital to hire tillage equipment, market availability, low grain prices and occurrence of drought. The main maize traits preferred were, drought tolerance, pest and disease resistance, early maturity, large cobs, prolificacy, yellow- seeded varieties and high yield. Variety preference differed among the districts. The most popular varieties selected in O. R. Tambo were ZM 305, ZM 501 and Okavango. Varieties that were selected in Amathole were ZM 621, Pan 6479 and Obatanpa. Farmers in Amathole district preferred varieties that could be grown for green mealies under irrigated conditions. Farmers from O. R. Tambo were more interested in earlier maturing varieties that they produce under rainfed conditions. Farmers in the later district were also more interested in maize grain that they mostly use as livestock feed, and for sale.

CONCLUSIONS

Farmers predominantly faced socioeconomic and abiotic constraints. During the PVS, farmers selected varieties based on most of the selection criteria they had identified. Furthermore, varieties selected were in line with length of growing season and production objectives.

ACKNOWLEDGEMENTS: Funding from Technology Innovation Agency (TIA) is acknowledged.

Keywords: Focus Group Discussions (FDGs), Participatory Variety selection (PVS), Production constraints, Selection Criteria

EVALUATION OF CROP PRODUCTION AS AFFECTED BY RAINWATER HARVESTING ON THE TOWOOMBA/HUTTON ECOTOPE

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INTRODUCTION

Maize and sunflower are important crops grown by farmers in Limpopo Province. Among the major constraints to increased agricultural production is low rainfall. The adoption of rainwater harvesting (RWH) techniques in low rainfall environments, typical of the area, to increase crop production, has been reported (Botha *et al.,* 2003). A preliminary study was conducted on the Towoomba/Hutton ecotope to identify appropriate RWH techniques that will result in higher crop yields for recommendation to small-scale farmers in the Limpopo Province.

MATERIAL AND METHODS

The study was carried out over two seasons (2008/09 and 2009/10). Five treatments, *viz.* two RWH techniques (in-field rainwater harvesting and Daling plough), two water conservation techniques (mechanized basins and no-till) and conventional tillage (mouldboard plough followed by discing) as the control, with four replications, were laid out in a complete randomized block design. Cultivars used were maize Zm 521 (20 000 plants ha^{-1}) and sunflower PAN 7351 (30 000 plants ha^{-1}). Growth indicators measured at 15, 40, 65, 90 and 125 days after planting were: crop biomass; plant height and stem thickness. Grain yield at harvest was used as the crop yield indicator. Analysis of variance was used to assess treatment effects on the various indicators.

RESULTS AND DISCUSSION

Growth and yield of maize and sunflower were significantly influenced by RWH&C techniques compared to conventional tillage. Conventional tillage resulted in the lowest yield.

CONCLUSIONS

Preliminary results indicate that RWH&C techniques can increase maize and sunflower yields. In-field rainwater harvesting and mechanized basins performed the best.

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ACKNOWLEDGMENTS

Water Research Commission; Department of Agriculture, Forestry and Fisheries; Provincial Departments of Agriculture of Free State, Eastern Cape and Limpopo for funding and collaboration.

Keywords: Rainwater harvesting, water conservation, Maize, Sunflower

DEVELOPMENT OF THE POLYGALACTURONASE INHIBITING PROTEIN (PGIP) FOR DELIVERY OF FOREIGN PROTEINS TO THE SURFACES OF PLANT CELLS

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INTRODUCTION

The bactericidal efficacy of the Hen Egg White Lysozyme (HEWL) has previously been demonstrated in transgenic plants, but most of the protein remains intracellular. For proteins to confer resistance to invading plant pathogens, it is preferred that they are associated with the plant cell wall, or secreted into the intercellular spaces where they can act almost immediately upon pathogen attack. Polygalacturonase-inhibiting proteins (PGIPs) are cell wall-associated plant proteins that inhibit endopolygalacturonases (endo-PGs) from phytopathogenic fungi. It was hypothesized that bean PGIP1, that has previously been expressed in transgenic tomato plants and was found to inhibit the endopolygalacturonase activity of *Stenocarpella maydis* in a reducing sugar assay, would deliver the HEWL protein to the intercellular spaces due to its inherent translocation to the plant cell wall by means of a translational fusion between bean *pgip1* and *hewl* genes. In this study, the efficacy of such a translational fusion was determined.

MATERIALS AND METHODS

The bean *pgip1-hewl* fusion was inserted into the binary vector pCAMBIA2300 and transformed into *Nicotiana tabacum* cv. LA Burley 21 plants by *Agrobacterium*-mediated transformation. Phenotypically normal transgenic plants were produced. Stable transgene insertion into the transgenic *N. tabacum* genomes was verified by PCR and Southern blot analyses. To demonstrate the efficacy of the bean PGIP1-HEWL fusion, independent homogenate and intercellular fluid protein extracts were prepared from transgenic *N. tabacum* leaf material. Protein extracts prepared so as to enrich for PGIP activity were tested *in vitro* for inhibition of *S. maydis* endo-PGs, whereas protein extracts for HEWL activity were tested for lysis of *Micrococcus luteus* cells.

RESULTS

Biochemical assays showed that bean PGIP1-HEWL inhibited *S. maydis* endo-PGs and cleaved *M. luteus* cell walls sufficiently to suggest that the PGIP1-HEWL fusion was structurally and functionally stable. Total protein extracts from the *pgip1-hewl* and *hewl* transgenic plants showed similar levels of HEWL specific activity, whereas intercellular fluid samples from *pgip1-hewl* transgenic plants showed high activity in contrast to *hewl* plants.

CONCLUSIONS

With the success of showing protein activity *in vitro* of HEWL in intercellular spaces, bean PGIP1 can be recommended as a vehicle for delivery of other proteins to cell surfaces.

Keywords: HEWL, PGIP, transformation, fusion protein

RELATIVE MACRO-CATION UPTAKE IN TOMATOES

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INTRODUCTION

It is important in soilless agriculture to synchronise plant demands for water and nutrients otherwise deficiency or salinisation may occur (Klaring, 2001). Calcium, potassium and magnesium are important macro-cations in tomato nutrition that influence marketable yield and fruit quality (Fanasca *et al*, 2005). Accumulation in substrate solution of potassium and magnesium can inhibit calcium uptake causing blossom end rot (BER) (van Noordwijk, 1990). This study examines the mutual uptake ratios of cations in tomato plants grown at different EC's, different irrigation frequencies and in different growing media.

MATERIALS AND METHODS

During September 2010 different irrigation frequencies (5x, 10x, and 20x) and fertiliser concentrations (EC1 and EC2 $mS.cm^{-1}$) were applied to tomato plants growing in three different growing media (coir, sawdust, sand) in a temperature controlled (23°C/18°C day/night temperature) glasshouse at Stellenbosch, Western Cape. A factorial split plot design with two randomised blocks (main effects: EC, frequency; subplot effect: media) was utilised. Plants were fertigated with a nutrient solution developed at the Department of Agronomy, Stellenbosch University. All treatments received the same total daily irrigation. Drainage was collected daily; Nutrient content, EC, pH and volume of drained nutrient solution was measured. Data was analysed using ANOVA and treatments were compared with Fischer's LSD ($P<0.05$).

RESULTS AND DISCUSSION

There was no significant difference between relative uptake ratios for cations across all treatments, except the 10x irrigation at low EC, giving a cation uptake ratio of 4.6: 3.1: 1, (K: Ca: Mg). A model used by Fanasca *et al* (2005) calculated the cation proportions that would optimise yield and gave similar ratios to the uptake ratios determined in this study. The ratios referenced in Sonneveld and Welles (2005) are very different with much lower proportion of K and higher proportions of Ca and Mg. Additional findings included that plants grown at the higher EC used on average 15% more water, and coir grown plants used 20% more water compared to plants grown in the other media.

CONCLUSION

The benefits of using the cation uptake ratios determined in this study still need to be quantified, but enable adjustment of fertigation practises to supply ions in the correct ratios and preventing accumulation. This study forms part of a larger project to develop a simple recirculating hydroponic system for local producers.

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Keywords: Tomato, macro-cations, hydroponic

POSTHARVEST CONTROL OF BOTRYTIS CINEREA IN SELECTED *Leucospermum* CULTIVARS

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INTRODUCTION

Botrytis cinerea is a widespread pathogen causing the development of grey mold in the leaves, young shoot tips and flower heads of several Proteaceace species, including *Leucospermum* (Bezuidenhout et al., 2010). Infection appears as necrotic spots that lead to tissue collapse and die-back, sometimes with abundant grey mycelium and spores visible, making stems unmarketable. The increased use of sea transport of periods up to 3 weeks under cool conditions of high humidity (to prevent desiccation) have significantly increased the incidence of postharvest losses to *Botrytis* in *Leucospermum*. Current control of *Botrytis* relies on protective sprays of Iprodione, Mancozeb, Chlorothalonil and Benomyl, but resistance has been reported and none of these fungicides are at present registered for use on Proteaceace in South Africa (Denman, 2000). Furthermore, the use of microbial antagonists or the use of natural plant regulators which could provide postharvest systemic protection have not been explored.

MATERIALS AND METHODS

Stems of *Leucospermum cordifolium*, 'Gold Dust', 'Goldi', 'High Gold', 'Jyoti', 'Soleil' , 'Succession', 'Tango', 'Tina', 'Tottum' & 'Veldfire' were harvested on commercial farms from the western and southern Cape, South Africa. All stems were treated on 18 Nov. 2008 by either being dipped in Switch (Cyprodinil & Fludioxinil; 4g/10L), Teldor™ (Fenhexamid, 7ml/L) or left dry (control). Stems were packed in standard transport boxes, either uncovered or wrapped inside the box in a 20 µm transparent liner (sheeting). The boxes were then either left uncovered or wrapped in plastic bags, after which they were stored at 4 °C for 3 weeks. Thereafter the stems were removed, placed in vases and evaluated on day 1, 5 & 10 of vase life for marketability, a score which included the incidence of *Botrytis* on the flower head and presence of wilting and desiccation on the foliage. On 18 Nov. 2009, stems of *Leucospermum* 'Jelena', 'High Gold', 'Soleil' and 'Veldfire' were inoculated with *Botrytis* spores and left to incubate for 24 h at room temperature after which treatments were sprayed to run off. Treatments included: Control (stems left dry or sprayed with distilled water), Bravo (Chlorothalonil, 2.75ml/L); Teldor™ (Fenhexamid, 7ml/L); ProGibb™ (GA_3, 1mM); Promalin™ (500mg/L); MaxCel ™ (Benzyl-adenine, 500mg/ L); Methyl-jasmonate (500 µM MeJ) and Eco-77 (*Trichoderma harzianum*; 1g/L). Stems were stored in standard boxes without liners, but covered in plastic bags for 3 weeks at 2°C. Thereafter the stems were evaluated for marketability.

RESULTS & DISCUSSION

Botrytis seriously affects the vase life and marketability of *Leucospermum* stems. Susceptibility to *Botrytis* varies significantly between cultivars, with *L. cordifolium*, 'Tottum' & 'Succession' being evaluated as the more resistant of the important cultivars. Desiccation of the flower head and foliage is a major factor reducing product quality. The use of a box liner can reduce desiccation, but wrapping of the box led to excessive moisture buildup which promoted the development of *Botrytis*. The use of a fungicide dip such as Switch in combination with a box liner produced stems with the highest marketability. For 'Jelena', 'High Gold' &'Veldfire' *Botrytis* control with conventional systemic and contact fungicides remains the optimum treatment. However, in 'Soleil' ,the use of Benzyladenine or Eco-77 as a postharvest spray for increased storage and vase life warrants further investigation.

CONCLUSIONS

The control of *Botrytis* under conditions that limit desiccation during long term cold storage of *Leucospermum,* remains a serious challenge.

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Keywords: cutflowers, fungicides, biological control agents, vase life, Proteaceae

COMPARISON BETWEEN THE ROOTING ABILITY OF MICRO- AND MACRO-CUTTINGS

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INTRODUCTION

Younger plant tissue does not show formed xylem and phloem structures due to the undifferentiated nature of the tissue. This tissue has the ability to form root initials at any area on the cut surface. Older, woodier plant tissue is more developed and has differentiated into xylem and phloem structures. Only at these points around the stem base can rooting occur (Hartmann *et al.,* 2001; Thompson, 2003).

AIM

The aim of this experiment was to determine the difference in the rooting ability of micro- and macro-cuttings of three Eucalyptus hybrids, and the morphology of rooting from the different cuttings.

MATERIALS AND METHODS

Micro- and macro-cuttings of three eucalypt clones of selected hybrids, namely *E. grandis x E. nitens, E. grandis x E. camaldulensis and E. grandis x E. urophylla,* were prepared using commercial greenhouse methods.The cuttings were planted into rhizotrons and monitored for 30 days. Root initials were examined under an electron microscope.

RESULTS AND DISCUSSION

Micro-cuttings showed no formation of xylem and phloem tissue when compared with macro-cuttings. The micro-cutting roots initiated from the entire cut surface, allowing for more roots to form evenly from the entire cut surface. In contrast, on the differentiated tissues of the macro-cuttings, the dominant root formation was from one or two vascular bundles of the cambial layer of the macro-cutting. This would result in an unsound root structure, and unstable trees, if these macro-cuttings were planted into the field.

CONCLUSION

Commercial nurseries should use undifferentiated *Eucalyptus* micro-cuttings because their root development is stronger, and critically, the development of roots is evenly distributed around the circumference of the micro-cutting tip, ensuring stable tree growth in plantations. In contrast, the use of *Eucalyptus* macro-cuttings of differentiated tissues results in uneven rooting, which will result in mature trees with unsound root architectures.

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ACKNOWLEDGEMENTS

Provision of plant material and financial support by Hans Merensky/ Westfalia and Sunshine Seedling Services are gratefully acknowledged.

Keywords: Differentiated, Macro-cuttings, Micro-cuttings, Rooting, Root Initials, Undifferentiated

THE ROLE OF SPERMIDINE IN FRUIT RETENTION AND CHILLING INJURY OF 'EUREKA' LEMONS

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INTRODUCTION

Polyamines (PAs) are known to play a vital role in various processes in plants. The roles of interest to the fruit industry include cell division and the ability to reduce ethylene-mediated abscission.Citrus is known to retain on average only 1% of their flowers or fruit. Reducing this problem could thus drastically improve yield. Chilling injury (CI) occurring due to regulatory cold storage diminishes lemon marketability. The reduction of this physiological disorder, visualised as sunken pits or flavedo discolouration, could be managed via the use of exogenous PAs.

MATERIALS AND METHODS

PAs were applied to randomly selected trees in an orchard on the Hatfield Experimental Farm. Putrescine (PUT), Spermidine (SPD) and Spermine (SPM), were applied at a concentration of 0.1mM and 1mM to 50 flowers (pre-anthesis) and 50 fruitlets (post-anthesis). The control treatment consisted of a wetting agent and water. Fruit growth and abscission rates were monitored post application. Endogenous PA-levels were determined at regular intervals by HPLC analyses. CI experiments were conducted by storing 40 fruit at ± 2°C for 48 days. Fruit were treated 7 days pre-harvest with the above mentioned PA solutions. Additional fruit were also dipped for 30s post-harvest. PA-titres were determined by taking samples weekly and analyzing by HPLC. CI was rated after the storage period via the use of a 0 to 10 scoring system, 0 indicating no CI, whilst 10 is equal to 90 - 100% of the fruit's surface affected by CI. Statistical analyses were using Chi-square test and a LSD test at a 0.05 level of significance.

RESULTS AND DISCUSSION

SPD application at 0.1mM pre- and post anthesis increased lemon fruit retention percentages. This action is probably attributable to a reduction of ethylene levels which contribute to abscission. In addition SPD could also act as an N and C source for growing fruit. None of the PA-treatments significantly influenced fruit growth, although PA-inhibitors reduced fruit size. This implies that PAs are required for fruit growth via their participation in cell growth and differentiation. SPD treatments 7 days before harvest also reduced the occurrence of post harvest CI, possibly as a result of increasing the rigidity of cell walls and minimising membrane permeability.

CONCLUSION

PAs are molecules that participate in a wide array of functions in plants and indications are that they play important roles in fruit set and initial fruit growth and in abiotic stress tolerance of ' Eureka ' lemons. Of all the PAs applied SPD appears to have the highest biological activity in these processes.

Keywords: Fruit retention, Chilling injury, polyamines, spermidine

EFFECTS OF A GROWING Bt- MAIZE CROP ON BIOMASS AND WEIGHT OF LOCALLY ADAPTED EARTHWORMS ON AN ALICE-JOZINI ECOTOPE INTHE EASTERN CAPE, SOUTH AFRICA

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INTRODUCTION

Cultivation of transgenic crops continues to increase in South Africa (James, 2007) and various stakeholders are concerned about the possible effects of these novel crops on the environment, and particularly on soil biodiversity. Cry proteins released into the soil from Bt crops bind to clay particles and resist microbial degradation. Effects of these proteins on soil biology are not clearly understood. Zwahlen et al. (2003b) observed that growth of earthworms was significantly reduced, with no lethal effects, after a prolonged exposure to the Cry1Ab protein from Bt maize. This study was carried out to determine effects of a growing Bt maize crop on numbers and biomass of locally adapted earthworms in cultivated lands on an Alice-Jozini Ecotope in the Eastern Cape.

MATERIALS AND METHODS

Two Bt maize hybrids, DKC61-25B and PAN6Q-321B (both with event MON810) and their corresponding non-transgenic varieties, DKC61-24 and PAN6777, were cultivated on an Alice-Jozini Ecotope at the University of Fort Hare Research Farm under irrigation. Earthworms were sampled at 6, 9 and 18 weeks after planting (WAP) by excavating the soil in 1 m^2, to a depth of 50 cm and hand-sorting. Their weight and biomass were determined immediately after sampling.

RESULTS AND DISCUSSION

Variety PAN6Q-321B and it near isogenic line PAN6777 had similar earthworm numbers and biomass throughout the study. On the other hand DKC61-25B had higher earthworm numbers at 6 WAP and lower numbers at 9 WAP when compared to its isoline. At 18 WAP (end of trial) earthworm numbers and biomass were not statistically different among all the hybrids. Saxena and Stotzky, (2001a) reported no differences in the mortality and biomass of earthworms subjected to biomass and root exudates of Bt and non-Bt maize.

CONCLUSIONS

Preliminary results suggest that a growing Bt maize (MON810) crop may not impact negatively on the population, biomass and activity of earthworms on an Alice-Jozini Ecotope in the Central Eastern Cape. Further work needs to be done to verify these findings.

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Keywords: Bt maize, Cry1Ab protein, earthworms, root exudates

CHAMBER DESIGN FOR IN-FIELD SOIL CO_2 FLUX MEASUREMENT

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INTRODUCTION

Soils are an important sink of carbon (C), and contain more C than the terrestrial vegetation and atmosphere combined. This sink can play a significant role in the sequestration of carbon, but conversely, a large quantity of C can be released through soil respiration which is responsible for a major CO_2 flux from ecosystems to the atmosphere (Han *et al.,* 2007). Agricultural activities significantly contribute to GHG emissions such as CO_2, CH_4 and N oxides that cause global warming and thus climate change. It is postulated that conservation agriculture (CA) practices can reduce GHG emissions, thereby mitigating global warming and climate change. This poster illustrates a chamber design to measure soil CO_2 flux, as well as some preliminary results comparing CA practices such as reduced tillage (RT) and multi-cropping with conventional tillage (CT) and maize mono-cropping, respectively.

MATERIALS AND METHODS

The chamber was constructed from a perspex tube 290 mm ID and 230 mm high. A Vaisala Carbocap® Infra Red Gas Analyser was inserted through the top perspex disc. A 40 mm diameter fan was installed to circulate the air in the chamber. The in-field measurement of soil CO_2 flux is done by placing the chamber on an 80 mm wide collar pressed in the soil to a depth of 60 mm and left, to reduce soil surface disturbance. Vaisala Carbocap® features include a 0-2000 mg CO_2 kg^{-1} measurement range with an accuracy of ± 5 mg CO_2 kg^{-1}, temperature compensation, and a quick response time (Vaisala, 2007). Diurnal observations were made during the growing season of CA and CT maize stands.

RESULTS AND DISCUSSION

The designed chamber was easy to handle and proved to give reproducible and accurate CO_2 flux readings. Diurnal and seasonal CO_2 flux peaks at 14h00 and in January, respectively. Higher (22%) CO_2 flux values were measured under CT than under RT. Maize mono-cropping exhibited slightly higher (6%) CO_2 flux values than a CA maize/legume inter-cropping system.

CONCLUSIONS

- The chamber is a portable instrument and can be used to measure in-field soil CO_2 flux.
- The assembly is a relatively inexpensive and gives reproducible results, due to its accuracy and compensation options.
- Higher CO_2 flux was measured under CT and under maize mono-cropping compared to RT and a CA inter-cropping system, respectively.
- Diurnal and seasonal CO_2 flux follows a parabolic trend.

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Keywords: CO_2 flux, conservation agriculture, global warming, in-field measurement

THE EFFECT OF PREVIOUS CROP AND DIFFERENTIAL NITROGEN FERTILISER APPLICATION ON WHEAT (*Triticum aestivum*) GROWN UNDER DRYLAND CONDITIONS IN THE SWARTLAND SUB-REGION OF THE WESTERN CAPE

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INTRODUCTION

Wheat forms an integral part of crop rotation systems in the Western Cape with large areas cultivated to wheat in the Swartland and Rûens sub-regions. For several years inexplicable differences in wheat yields on long-term crop rotation systems trials were observed (Hardy, 2005). Seasonal variation in climatic conditions, the previous crop and the resultant effect on N mineralisation rate may contribute to these observed differences.

MATERIALS AND METHODS

A trial was laid out at the Langgewens Research Farm near Moorreesburg to evaluate the effect of previous crop and differential nitrogen application on wheat production and grain quality. The trial was laid out as a factorial arranged in a split plot design with previous crop (wheat, canola or medic) allocated to main plots and N treatments to sub-plots. Nitrogen fertiliser treatments included were, either 0 or 30 kg N ha^{-1} at planting followed by various combinations of 0, 30 or 60 kg N ha^{-1} 30 and 60 days after emergence.

RESULTS AND DISCUSSION

Mean grain yields during the 2008 season for the wheat after medic, wheat monoculture and wheat after canola treatments were 5320.7, 4193.8 and 4025.9 kg ha^{-1} respectively. Fertiliser nitrogen treatment did not influence ($P>0.05$) grain yields in the wheat after medic system. The highest grain yields (although not significantly higher than various other treatment combinations) for the wheat monoculture (5354.8 kg ha^{-1}) and wheat after canola (4660.7 kg ha^{-1}) systems were recorded in the 0 - 30 - 60 treatment.

Mean grain yields during the 2009 season for the wheat after canola, wheat after medic and wheat monoculture treatments were 3781.8, 3658.5 and 2887.7 kg ha^{-1} respectively. The highest grain yields, although not significantly higher ($P\leq0.05$) than various other treatment combinations, were recorded where 90 kg N ha^{-1} was applied in different combinations at planting and as one or two topdressings.

CONCLUSIONS

The systems where wheat follows medic or canola produced higher grain yields compared to wheat in a monoculture system. The effect of differential topdressings on grain yield and quality needs further investigation and will be finalised after data from the 2010 season becomes available.

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Keywords: grain quality, nitrogen, wheat

VINE MULTIPLICATION POTENTIAL OF NEW SWEETPOTATO VARIETIES RELEASED IN SOUTH AFRICA

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INTRODUCTION

Sweet potato (*Ipomoea batatas* L. Lam) is a major staple crop of the world cultivated in more than 100 countries. It is commonly grown in the tropical, subtropical, and temperate climatic regions. In South Africa, sweet potato plays an important role in reducing food insecurity and increasing economic growth in resource-poor farming areas. New lines have been developed at the ARC-VOPI for improved yield, β-carotene and dry matter content. The multiplication potential is of importance in production of planting material as well as for profitability of vine multiplication. The aim of this study was to determine the multiplication potential of new sweetpotato varieties and lines.

MATERIALS AND METHODS

Seven orange-fleshed and five cream-fleshed varieties/lines were tested, including Blesbok (major SA commercial variety), W-119 and Resisto (orange-fleshed USA imports) as control varieties. Trial 1 (foundation block) was established at the ARC-VOPI in October 2009 from virus-indexed source materials. Cuttings from the foundation block were established in trial 2 (base block 1) on 17 December 2009, and trial 3 (base block 2) on 21 January 2010. Lastly, trial 4 (multiplication block) was established on 15 February 2010 with cuttings from the base block. Data was collected on number of cuttings produced at the three intervals, as well as sprouting date after winter, stem thickness and number of cuttings produced.

RESULTS

The results indicated remarkable differences among the varieties. Line 2001-5-2 had particularly thin and twining vines with lower establishment percentage. Orange-fleshed clones 2002-21-1, Impilo and 2000-10-7 were characterized with thicker vines. Sprouting of cream-fleshed varieties was earlier in spring (October 2010), compared with orange-fleshed varieties. Ndou produced the highest number (±10/plant) of full-length (>25 cm) cuttings by October 2010, followed by 199062.1 and Monate; all out-yielding the commercial control Blesbok. The orange-fleshed variety W-119 was the slowest of all varieties and no useful cuttings were available in October 2010. Average vine production potential was identified for orange-fleshed clones Resisto, 2000-10-7, 2001-5-2 and 2001-21-1 (producing 2.5 – 4 cuttings/plant).

CONCLUSION

Significant differences were detected in the vine multiplication potential of 12 sweet potato varieties, which can be used in recommendations for larger scale vine production.

Keywords: number of marketable cuttings, orange-fleshed sweet potato, vine production, vine thickness

LABORATORY ASSESSMENT OF COWPEA (*Vigna unguiculata* L.) LINES FOR BRUCHIDS RESISTANCE

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INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is an important grain legume in West Africa and in many parts of the tropics (Singh *et al*., 2002). The cowpea weevil, *Callosobruchus maculatus* (F) is a serious pest of various *Vigna* species. Infestation of this bruchid species starts in the field and continues in storage where sometimes it causes total destruction of seeds.

MATERIALS AND METHODS

An experiment was conducted at the Plant Production Laboratory, University of Limpopo; to assess 12 cowpea lines for resistance against *Callosobruchus maculatus* (F). The cowpea lines used were: seven locally available cultivars (Shangane, Small drum, Black eye, Red Caloona, Sepedi, Bechuana white and Pan 311) and five cultivars from the International Institute for Tropical Agriculture (IITA) Nigeria (IT84D-449, IT84S-2246, IT81D-1137, IT81D-994 and IT82D-716). The *C. maculatus* used were reared on bruchid-susceptible cultivar 'Glenda'. Ten cowpea seeds were placed in 12 different Petri-dishes and infested with two new male and female *C. maculatus.* Treatment was replicated four times. The Petri-dishes containing the seeds and the insects were allowed to stay undisturbed for five days to allow bruchids to lay eggs. At five days after infestation, eggs laid on the seeds in each Petri-dish were observed and counted. Germination of infested seeds was performed.

RESULTS AND DISCUSSIONS

The adult *C. maculatus* did not feed on the cowpea seeds but instead laid eggs and died. However, after seventeen days, new *C. maculatus* adults were observed on the cowpea seeds. The numbers of insects that emerged from cultivar IT81D-1137 were significantly lower than the numbers that emerged from the other cultivars, thus indicating that IT81D-1137 was the most resistant against *C. maculatus* when compared to other selected lines. The highest germination percentage (87.5%) was also observed on cultivar IT81D-1137.

CONCLUSION

The cowpea cultivar IT81D-1137 had the highest ability of all cultivars tested, to resist *C. maculatus* in storage.

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Keywords: Cowpea, *Callosobruchus maculatus*

SIMULATING THE EFFECT OF PLANTING DENSITIES ON GROWTH AND YIELD OF SOYBEAN (*Glycine max*)

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INTRODUCTION

Soybean is a very popular crop of the world and is widely cultivated in many provinces of South Africa including Limpopo Province (Mabapa *et al*., 2010). Planting populations may vary due to seed size and spacing. Various models are used in crop simulations and the importance thereof have been reported in a number of studies. APSIM, developed in Australia, contains an array of modules for simulating growth, development and yield of crops, pastures and forests and their interactions with the soil (Keating *et al*., 2003). This study was aimed to assess the effect of planting density and to evaluate the performance of APSIM model in simulating biomass accumulation and grain yield of soybean in Limpopo Province.

MATERIALS AND METHODS

A field experiment was conducted at UNIVEN experimental farm to assess the effect of planting density and the performance of APSIM model in simulating biomass accumulation and grain yield of soybean in Limpopo Province. Three population densities of 55 000 (D1), 44 000 (D2) and 37 000 (D3), plants ha^{-1} were used as the experimental treatments. Cultivar Highveld Top was used to test the treatments. The APSIM model does not have the cultivar used in the experiment; however, the cultivar Magoye available in APSIM best represented the growth of Highveld Top. The experiment was laid out in a randomized complete block design and replicated three times. Biomass samples were taken at 50% flowering and harvest maturity and grain yield was determined at harvest maturity.

RESULTS AND DISCUSSION

Simulated biomass was overestimated at flowering but underestimated for all the densities at harvest maturity. Densities showed no significant difference in grain yield between the treatments. The highest grain yield of 1859 $kgha^{-1}$ was produced by density 1, while density 3 produced the lowest grain yield. The simulation predicted the yield better for density 3 as compared with densities 1 and 2.

CONCLUSION

Farmers may need to use a high population density in order to enhance yield of soybean. APSIM model was able to simulate soybean biomass and grain yield with a high degree of precision.

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Keywords: APSIM model, Biomass, Grain yield, Plant density, Soybean

EVIDENCE OF PROLINE ACCUMULATION IN SEEDLINGS OF MAIZE (*Zea mays*, L) LANDRACES SUBJECTED TO WATER STRESS

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INTRODUCTION

Proline accumulation has been shown to be a widespread plant response to stress. The aim of this study was to determine whether accumulation of proline in response to stress is a sign of tolerance or a symptom of drought stress.

MATERIALS AND METHODS

Two colour variations of a local maize germplasm, white (Land A) and dark red (Land B), were compared to two hybrids, SC701 and SR52. Maize seedlings were grown in seedling trays (25°C/17°C, 65% RH) using pine bark wetted to 25% and 75% of field capacity (FC), respectively, for 21 days. Proline content was determined from leaf samples using the method of Bates *et al*. (1973). A sample of 0.5 g leaf material was homogenized in 10 ml of 3% sulfosalycic acid (w/v) and centrifuged at 11000 rpm for 10 min at 4^{o}C. The supernatant (@ 2 ml) was reacted with 2 ml acid-ninhydrin and 2 ml glacial acetic acid in a test tube for 1 hour at 100^{o}C, and the reaction terminated in ice. The reaction mixture was extracted with 4 ml toluene, and vortexed for 15-20 sec. The chromophere containing toluene was aspirated from the aqueous phase, warmed to room temperature and absorbance read at 520 nm using toluene as a blank. Proline concentration was determined from a standard curve.

RESULTS

For all varieties, proline concentration significantly increased under water stress (25% FC). There were highly significant differences ($P<0.001$) between varieties as well as in the interaction between FC and variety. Landrace B, SC701 and SR52 had the highest concentrations of proline, respectively, under non-stress conditions (75% FC). Under water stress, SC701 and SR52 had the highest concentrations of proline, respectively, compared to Landrace A and Landrace B.

CONCLUSIONS

We concluded that proline accumulation in maize seedlings may be a symptom of drought rather than tolerance. Landraces may be more tolerant to water stress at the seedling stage than SC701 and SR52 since they accumulated less proline, indicating less damage.

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ACKNOWLEDGEMENTS

Financial support from the Water Research Commission (K5/1771/4) is gratefully acknowledged.

Keywords: Hybrids, Landraces, Proline, Water Stress

GENOTYPE BY ENVIRONMENT INTERACTION IN SOYBEAN FOR YIELD AND YIELD COMPONENTS

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INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) has diverse agricultural values such as a source of quality plant protein and vegetable oil and nitrogen fixing ability. It plays a vital role for substantial food production in South Africa. The demand for food soybean products is growing both in the national and international market (Boerma and Mian, 1998). The objective of this study was to determine the genotype by environment interaction of yield and important agronomic traits among ten selected soybean genotypes in two localities in Limpopo province.

MATERIALS AND METHODS

Field experiments were conducted in Limpopo Province under dry land conditions during the 2007/2008 and 2008/2009 growing seasons. Experiments were established at two localities viz. Syferkuil in Capricorn District and Gabaza in Mopani District near Tzaneen. Ten selected soybean cultivars were evaluated without inoculation under a randomised complete block design with three replications. Stability of yield and yield components were assessed through joint regression and superiority analyses.

RESULTS AND DISCUSSION

Significant interactions were detected ($P \leq 0.05$) due to genotype by location, genotype by year and genotype by year by location for different various characters. Clark and L81-4858 were the highest yielding genotypes with average seed yield of 5235 kg ha^{-1} and 4839 kg ha^{-1}, respectively. Magoye was excellent genotype with regards to number of pods per plant (143 to 222 pods per plant) and reduced plant height (62.67 - 98.67 cm) across environments. Eberhart and Russell's (1966) model and cultivar superiority parameters indicated that CLARK, BARC-4 and BARC-2 were the most stable genotypes with regards to seed yield, number of nodules and number of active nodules.

CONCLUSIONS

BARC-2 was selected as the most stable genotype for seed yield, nodule formation and other agronomical characters that can be grown in Limpopo Province or other similar environments.

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Keywords: Glycine max, nodule formation, soybean, stability analysis

START OF A SMALL-SCALE OYSTER MUSHROOM INDUSTRY IN GAUTENG

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INTRODUCTION

Gauteng is South Africa's fastest growing province, both in population and economy. Due to rapid urbanization, agricultural land has become a scarce resource. Only the cultivation of high value crops is therefore feasible. Oyster mushroom production is an example of a protein rich high value crop that can be grown on a small-scale in this area.
The objective of this venture is to start small-scale oyster mushroom production units in the Gauteng area.

MATERIALS AND METHODS

Initially four interested communities were identified from different parts of Gauteng. The selection was according to set selection criteria which include the availability of water and an existing structure that can easily be converted into a growth room. A further requirement is to have easy access to substrate sources and to be a reasonable distance to markets. Representatives of the four groups including those from the Gauteng Department of Agriculture and Rural Development (GDARD) were trained in the production of mushrooms and small business management. This was followed-up by on-site demonstration of production techniques. Sites are regularly monitored and any production problems that might arise are addressed.

RESULTS AND DISCUSSION

Of the four interest groups, only two were selected, as the others did not have a structure available that could be renovated and turned into a suitable mushroom growth room. Cultivation started in July 2010 and the farmers already had various levels of success and failures. Failures were mainly due to improper pasteurization of substrate and not maintaining a high humidity in the growth rooms. Various avenues of marketing and markets have been explored with success.

CONCLUSIONS

According to the progress thus far it seems like small-scale oyster mushroom production to improve poverty and nutrition is a viable option in Gauteng Province.

ACKNOWLEDGEMENTS

Gauteng Department of Agriculture and Rural Development

Keywords: Oyster mushrooms, small scale industry, Gauteng

FERTILITY RESTORATION CAPACITIES OF NEW SORGHUM LINES AS MEASURED BY HYBRID SEED SET

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INTRODUCTION

Effective exploitation of the male-sterility system for sorghum hybrid production depends on the development of locally adapted male-sterile lines and the subsequent full restoration of fertility in the F_1 hybrids. Therefore, the objective of the study was to evaluate potential male lines for fertility restoration capacity across environments and to identify potential local lines for conversion into male-sterile lines.

MATERIALS AND METHODS

Ten male-fertile sorghum parents consisting of five local lines and five introductions were crossed with eight introduced cytoplasmic male-sterile lines in accordance with a North Carolina II mating scheme. The resultant 80 hybrids were evaluated for fertility restoration at two sites. The trials were laid out as row-column α-lattice design at Makhathini (27º24'S; 32º11'E, 72m.a.s.l.) and Ukulinga (30º24'E; 29º24'E, 781m.a.s.l.) during 2008/09. The heads of F1 hybrids were covered with pollination bags before the onset of anthesis. The level of fertility restoration by males lines was determined *inter se* by visual scoring of hybrids for seed set at the hard dough stage, using a scale of 0 (no seed set) to 100% (complete seed set). Data was analysed using GenStat® 12.

RESULTS AND DISCUSSION

There were significant ($P \leq 0.01$) differences among hybrids for fertility restoration capacity. Six hybrids displayed high sterility levels above 60% and three above 95%. Male lines exhibited significant differences in fertility restoration capacities probably because of the significant interactions with the female genetic backgrounds. Male parents ICSV700, ICSV93046 and MRL15 displayed complete failure to restore fertility in one hybrid each, although they showed complete restoration in the other seven crosses. Restoration by environment interaction effects were significant and confirmed restorer lines ICSR165 and ICSR57 were involved in hybrids with less than 50% restoration. The two showed contrasting restoration on female lines ICSA307 and ICSA724, respectively, at Makhathini and Ukulinga, demonstrating sensitivity of restoration to the environmental.

CONCLUSIONS

The regional lines ZLR1, Macia, IMDP97 and MRL15 and introduced line ICSR165 are potential restorers for use in hybrid development. The line ICSA724 is a potential male-sterility-inducing cytoplasm donor for the local line MRL15.

Keywords: Fertility restoration, male-sterility, sorghum hybrids

SIMULATING THE EFFECTS OF NITROGEN AND PHOSPHOSRUS FERTILIZERS ON MAIZE BIOMASS AND GRAIN YIELD IN VHEMBE DISTRICT, LIMPOPO PROVINCE

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INTRODUCTION

In South Africa, maize is the staple diet for more than half of the country's population. In Vhembe district of Limpopo province, a large proportion of the population depends on maize as their primary staple food. Simulation models such as Agricultural Production System Simulator (APSIM) are valuable tools in the analysis of farming systems for assessing impacts of climatic variability and long term results of management strategies.

OBJECTIVES

To evaluate the ability of APSIM model to simulate the response of maize biomass and grain yield to applied nitrogen and phosphorus fertilizers.

MATERIALS AND METHODS

The study was conducted over two seasons, 2005/6 and 2006/7. Treatments consisted of N fertilizer applied as LAN at the rate of 0(N0) and 75(N1) kg N ha^{-1} in 2005/6 season and 0(N0), 37.5(N1), and 75(N2) kg N ha^{-1} in 2006/7 season. Phosphorus was applied at 0(P0) and 30(P1) kg P ha^{-1} as SSP at planting in both seasons. Maize was planted at a spacing of 90 x 25 cm in plots measuring 5m x 4.5 m laid out in a RCBD, replicated three times. Biomass was collected at 6-8 WAP, tasseling and at harvest. Grain yield was determined at harvest maturity. Data was analysed using the GLM procedure of SPSS. Simulations using the APSIM model were done by inputting data for weather, soils and management into the model.

RESULTS AND DISCUSSION

Biomass yield: In 2005/6 season, simulated biomass was higher than observed biomass at all sampling periods. In 2006/7, simulated biomass was higher than observed biomass at 6-8 WAP and at taselling. At harvest, treatments N1P0 and N1P1 had lower observed than simulated biomass.

Grain yield: In 2005/6 season, the observed grain yield was higher than the simulated yield for all treatments with the exception of treatment N1P0. In 2006/7 season, the observed grain yield was high compared with the simulated yield for all treatments.

CONCLUSIONS

APSIM model was able to simulate biomass production with a reasonable degree of precision. In terms of grain yield, however, the simulated yield was lower than the observed grain yield. This was mainly due to uncontrollable factors (damage by wild animals especially as maize cobs developed and matured) which led to very small sample size collected at harvest, thus possibly overestimating the grain yield.

ACKNOWLEDGEMENT

The authors wish to thank ACIAR for funding this study

Keywords: APSIM, Biomass, Grain yield, Maize, Nitrogen, Phosphorus

EFFECTS OF PLANTING DEPTH, APPLICATION TIMING AND TEMPERATURE ON INJURY TO KENAF BY PRE-EMERGENCE HERBICIDES

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INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is a fibre crop, recently re-introduced in South Africa by Sustainable Fibre Solutions Pty Ltd. Their aim is to promote the production of natural fibres for use in a variety of products. One of the main problems is the lack of registered herbicides and how planting depth, application timing and temperature can affect kenaf survival. The focus of this study was to document kenaf injury caused by pre-emergence herbicides in combination with different planting depths, application timing and temperature.

MATERIALS AND METHODS

Pre-emergence herbicides (S-dimethenamid, imazethapyr, pendimethalin and S-metolachlor) were evaluated in a glasshouse study at the University of Pretoria. The herbicides were used in a planting depth, a temperature and an application timing trial. Planting depth trial: two planting depths (2.5 and 5cm) and three application rates (1x, 2x and 3x the recommended rate). Temperature trial: three temperature regimes (20°/10°C and 30°/20°C day/night constant and 30°/20°C for two days then 15°/5°C for 10 days followed by 30°/20°C for rest of trial) combined with two application rates (1x and 2x the recommended rate). Timing trial: three application times (day of plant, two or four days after plant) at the recommended rate. All treatments were compared to an untreated control. Six seeds were planted in pots filled with a soil with 22% clay and fertigated twice a week with Supafeed. The trials lasted 40 days to allow for maximum damage development on the kenaf seedlings. A fully randomized design with four replications was used. Data were analysed with SAS to determine LSD's of the treatments at the 5% level of probability.

RESULTS AND DISCUSSION

Planting depth and application time of herbicide did not cause significantly different injury ratings in kenaf. At low temperatures (20°/10°C) some of the herbicides did lead to significantly higher injury ratings at the recommended rate. So did high temperatures interrupted by low temperatures also cause higher injury ratings.

CONCLUSIONS

Best planting depth is 2.5cm – faster emergence without causing significant injury to the seedlings. Application timing – preferable before plant, but from the pot trial even applying the herbicides four days after planting did not cause injury. Too early planting (cold soil) should be avoided since it causes slower germination and in the presence of pre-emergence herbicides it could lead to severe seedling damage.

ACKNOWLEDGEMENTS

Sustainable Fibre Solutions

Keywords: Hibiscus cannabinus, imazethapyr, pendimethalin, S-metolachlor, pyrithiobac sodium

EFFECT OF HOT WATER AND MOLYBDENUM DIPS ON BIOACTIVE COMPOUNDS IN LEMON FLAVEDO AND THEIR ANTIOXIDANT CAPACITY DURING COLD STORAGE

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INTRODUCTION

South African citrus fruit requires cold sterilization against fruit flies during or before shipping to certain lucrative markets, as a phytosanitary measure. However, cold storage may result in chilling injury, which manifests as pitting and sunken lesions on the surface of the fruit, reducing its marketability. Vitamin E (α-tocopherol), vitamin C (ascorbic acid), β-carotene and phenolics (e.g. flavonoids and flavonones, viz, Hesperidin and Naringin) are bioactive compounds which play a significant role in mitigating chilling injury during cold storage, by scavenging reactive oxygen species (ROS) (Cano *et a*l., 2008, Abeysinghe *et al*., 2007). Previous research found a combination of hot water dips (HWD) and molybdenum (Mo) to be a possible means of alleviating chilling injury. The purpose of this investigation was to alter bioactive compounds in the flavedo and to quantify their effect on membrane lipid peroxidation as a measure of cold storage damage to lemon fruit.

MATERIALS AND METHODS

Fruits were obtained from two sources and treated with a 2 min HWD at 47°C or 53°C, in combination with a subsequent 1 or 10µM $Na_2MoO_4.2H_20$ soak for 30 min. Fruits were subsequently stored at -0.5°C for 7, 14, 21 or 28 days and thereafter evaluated weekly for chilling injury. Total antioxidants (FRAP), phenolics, flavonoids, ascorbic acid, lipid peroxidation, specific flavonones, α-tocopherol and β-carotene were quantified in the flavedo.

RESULTS AND DISCUSSION

Lemon fruit sourced from Sun Valley Estates during the 2007 harvest season were the only consignment susceptible to chilling injury. Greater chilling susceptibility was related to low levels of bioactive compounds and higher lipid peroxidation, as compared with non-chilled and chilling sensitive fruit. Hot water dips at 53°C, and 1µM Mo in combination with HWD at 53°C, seem to enhance bioactive compounds, and it is suggested that this played a vital role in modifying the chilling response.

CONCLUSION

Vitamin C and phenolics were found to be the most dominant bioactive compound in lemon flavedo. Fruit origin contributed to lemon fruit's susceptibility to chilling injury through reduced bioactive compounds. However, molybdenum plus HWD at 53°C significantly stimulated bioactive compounds at different cold storage times and reduced chilling injury of otherwise susceptible fruit.

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Keywords: Citrus, Chilling injury, Hot water, Molybdenum, Bioactive compounds

PERFORMANCE OF SELECTED DROUGHT TOLERANT BREAD AND DURUM WHEAT LINES IN LIMPOPO PROVINCE

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INTRODUCTION

Limited water availability is one of the major limiting factors for potential wheat production. Cultivar development for drought tolerance, increased yield and quality under the prevailing environments remain important. The objective of this study was to determine agronomic performance and the nature and magnitude of the genotype x environment interactions in selected drought tolerant wheat genotypes across three localities in Limpopo Province.

MATERIAL AND METHODS

Field experiments were conducted in the Limpopo Province during 2008 at three selected localities viz. Maraba, Moletjie, and Syferkuill. Ten bread and 10 durum wheats with known drought tolerance were evaluated under the randomized complete block design with three replications. Yield and important agronomic traits were collected and stability of genotypes determined using joint regression and cultivar superiority analyses.

RESULTS AND DISCUSSION

Significant differences were detected ($P \leq 0.01$) among genotypes, environments and genotype by environment interactions. Across environments, bread wheat cultivar Milan was the most stable and relatively high yielding genotype with an average yield of 1295 kg/ha, followed by Frame that yielded 1258 kg/ha. Durum wheat cultivar Rascon was relatively the most stable and best yielding with an average grain yield of 1249 kg/ha followed by Mexicali with 1212.78 kg/ha. Overall, Moletjie was the best locality for suitable bread and durum wheat production with genotypes performing relatively better for all agronomic traits.

CONCLUSIONS

The study identified bread and durum wheat cultivars Milan and Frame, Rascon and Mexicali, respectively, with increased grain yield and considerable stability. The candidate cultivars could be useful for direct large scale production under these or similar environments.

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ACKNOWLEDGMENT

The Department of Agriculture is acknowledged for financial assistance of the study.

Keywords: Cultivar trial, wheat genotypes, stability, locality

Fusarium graminearum MYCOTOXINS CONTAMINATING MAIZE

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INTRODUCTION

Fusarium graminearum can cause pre- and post-harvest economic losses due to root, stalk and ear rots of maize. The fungus produces mycotoxins, nivalenol (NIV), deoxynivalenol (DON), zearalenone (ZEA) and derivatives thereof. Zearalenone is an estrogenic metabolite that can induce feminization in animals. In humans, it is associated with alimentary toxic aleukia and Akakabi toxicosis, which are characterized by nausea, vomiting, anorexia and convulsions (Goswami & Kistler, 2004).

MATERIALS AND METHODS

Field samples and mycological assays

Maize samples were collected from 2006 to 2009 at various localities in South Africa. *F. graminearum* incidence was determined from 200 seeds per sample by plating on Nash Snyder medium.

Mycotoxin assays

DON and ZEA were extracted and analysed using the Veratox ELISA kits.

Quantitative Real-time PCR

Real-time PCR was used for detection and quantification of *F. graminearum* (Waalwijk *et al*., 2004).

RESULTS AND DISCUSSION

DON levels ranged from 0.25 to 5.52 ppm whilst ZEA ranged from 0.025 to 17.8 ppm. Few *F. graminearum* isolates were recovered and this could indicate that other *Fusarium* spp. may be responsible for the high ZEA levels. *F. graminearum* biomass based on qPCR was variable, ranging from 0 to 12 000 pg, indicating that this pathogen is able to readily colonise maize grain.

CONCLUSION

Monitoring of mycotoxins and *Fusarium* spp. in South Africa needs to be done consistently. High mycotoxin levels found in samples need to be confirmed using HPLC or LC-MS.

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Keywords: mycotoxins, maize, *F. graminearum*

GLOMALIN CONTENTS OF APPLE ORCHARD SOILS OF THE WESTERN CAPE

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INTRODUCTION

Glomalin is a soil glycoproteinaceous substance produced by ubiquitous root symbionts, and arbuscular mycorrhizal fungi (AMF). Glomalin is linked with soil carbon (C) storage via its effect on soil aggregate stabilization and also presents a potentially valuable C pool in soil. Hence, it is widely acknowledged as being a good indicator of soil health. While knowledge concerning the response of glomalin to agricultural management practices is accumulating, still very little is known about the glomalin status of a majority of agricultural production systems, including those of apple production. This investigation I studied the glomalin concentrations of various apple orchard soils of the Western Cape.

MATERIALS AND METHODS

A total of 26 conventional and 4 organic apple orchards, established on either sandy or heavy soil and covering various areas in the Western Cape, were monitored. The experiment consisted of four scion/rootstock combinations i.e Pink Lady/M7, Pink Lady/M793, Golden Delicious/M7 and Golden Delicious/M793, of eight to 12 years old. Production areas include Ceres Koue Bokkeveld, Villiersdorp, Grabouw, Vyeboom, Joubertina, Piketberg, Somerset West and the Langkloof area. Soil samples were collected in the tree row at a 30 cm depth from September to November 2009. Standard soil chemical analyses were carried out. Glomalin was measured using the Bradford assay method.

RESULTS AND DISCUSSION

Effects of soil chemical properties on glomalin contents were inconsistent. Glomalin content was found to be statistically similar for conventional and organic farming types, as well as for sandy and heavy soil types and was fairly inconsistent among various apple production areas. Pink Lady/M7 orchards hosted significantly more glomalin than PinkLady/M793, GoldenDelicious/M793 and GoldenDelicious/M7. When scion and rootstock were considered independently, higher glomalin concentrations were associated with the Pink Lady and M7, as opposed to Golden Delicious and M793, respectively, the strongest effect being that of rootstock M7. Since mycorrhizal development is mainly triggered by root exudates, differences in the chemical composition of the root exudates between M7 and M793, due to genetic variation, could be the underlying reason for differences in glomalin concentrations.

CONCLUSIONS

Farm type, soil type and production area clearly had little effect on soil glomalin content, but when scion/rootstock combinations were considered, rootstock M7 hosted more glomalin than M793, most likely due to a genetic variation in rootstock.

ACKNOWLEDGEMENTS

The Deciduous Fruit Producers Trust and the ARC's financial support is gratefully acknowledged.

Keywords: AMF, apple, glomalin, orchard soil, survey

EFFECT OF ORGANIC AND INTEGRATED SOIL MANAGEMENT PRACTICES ON MYCORRHIZAL AND MICROBIAL ENZYME ACTIVITY AND DIVERSITY IN AN APPLE ORCHARD SOIL

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INTRODUCTION

Since microorganisms are the driving forces of fundamental metabolic processes in soil involving specific enzyme activities, different soil management practices may have different impacts on such activities. Rooting patterns, available nutrient supply, and quantity and quality of root exudates, could also be altered by different practices. As a consequence, root colonisation levels by the beneficial root-fungus, arbuscular mycorrhiza fungi (AMF), could also be affected by such changes, especially since root colonisation is mainly triggered by the supply of root exudates. In apple production this information is particularly scarce. The objective of this study was to assess the effect of different organic and integrated soil management practices on the microbial enzyme and AMF activities in an apple orchard soil.

MATERIALS AND METHODS

The investigation was conducted in the form of a factorial field trial in an existing 0.7 ha orchard at Elgin Experiment Farm in Grabouw, involving 8 year old Cripps Pink/M7 apple trees. Treatments consisted of two management practices applied to the tree row, namely chemical weed control or mulching. These were applied in combination with different treatments applied in the work row. The latter treatments included (a) full surface mulching or (b) cover crops during winter, killed chemically or slashed during summer or (c) weed growth during winter, killed chemically or slashed during summer. Each treatment consisted of four replicates applied to randomly isolated plots. Soil samples were taken at the tree row, 30 cm deep, in spring 2009. Colorimetric assays were performed to measure *ß*-glucosidase, urease and phosphatase activities. Root colonisation was measured using a compound microscope and metabolic profiles of microbial communities were measured using microtiter plates.

RESULTS AND DISCUSSION

Chemical weed control clearly had negative impacts on AMF root colonisation levels in spring (26% - 42%), as oppose to visible positive mulching effects (41% - 71%). Effects in summer were similar i.e. chemical control (62% - 65%) and mulching (83% - 86%). The lower root colonisation levels could possibly be ascribed to the herbicide glyphosate, which may have hampered AMF development. The marked different effect on root colonisation was consistent with effects on pH, microbial enzyme activities and microbial diversity.

CONCLUSIONS

Mulching clearly had positive impacts on AMF, microbial enzyme activity and microbial diversity, whereas chemical weed control had visible negative impacts.

ACKNOWLEDGEMENTS

The Deciduous Fruit Producers Trust and the ARC's financial support is gratefully acknowledged.

Keywords: AMF, apple, chemical control, enzyme, microbial community, mulch

EFFECT OF OAT (*Avena sativa* VAR MAX) AND VETCH (*Vicia dasycarpa* VAR PALLINUP) COVER CROP BICULTURES ON BIOMASS PRODUCTION, WEED SUPPRESSSION AND N AND P FERTILITY IN A SUBSEQUENT IRRIGATED MAIZE CROP

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INTRODUCTION

Maintaining permanent soil cover is basic to success with conservation agricultural systems currently being promoted because of the perception of improved sustainability. The growing of cover crops ensure permanent soil cover which in turn results in benefits such as reduction in runoff, water erosion, weed abundance, nutrient leaching and improved soil fertility. However, no single cover crop species has been observed to achieve all these benefits on its own. Biculturing grass and legume cover crop is an option that can deliver diverse benefits and make a better contribution to improved soil quality compared to their monocultures. A field experiment was conducted to investigate the effects of various oat and vetch biculture ratios on biomass production, weed suppression and residual effects on N and P fertility when followed with a maize crop under Alice-Jozini Ecotope in the Eastern Cape.

MATERIALS AND METHODS

The treatments were 90% oat + 10 % vetch, 70% oat + 30 % vetch, 50% vetch +50% oat, 100% vetch, 100% oat and weedy fallow (control), in winter. The experiment was laid in a RCBD with three replicates. Fertilizer application to the cover crop was at 13.34 kg N ha^{-1}, 20 kg P ha^{-1} and 26.66 kg K ha^{-1}. The cover crops were killed with a tractor pulled-roller followed by herbicide application at maturity. Subsequently, in summer, maize (SC 701) was planted in all the plots, targeting a population of 37 000 plants/ha. Fertilizer was applied to the maize at 58 N kg ha-^{1}, 25 kg P ha^{-1} and 33 kg K ha^{-1}. Both plant and soil nutrient reported are from the first season of cover crop- maize rotation while cover crop biomass is from two seasons.

RESULTS AND DISCUSSION

In 2009, bicultured treatments had significantly lower biomass than that of sole oat and higher than that of sole vetch in the following order: 100%oat > 90%:10% >70%:30% > 50%:50% > 100% vetch. In 2010, bicultures had significantly higher biomass than the monocultures of both oat and vetch in the following order 70%:30% > 90%:10% > 50%:50% > 100% vetch > 100% oat. Low biomass as observed from sole oat was due to grazing during the first 20 days of its establishment. All the treatments showed no significant differences ($P > 0.05$) with regards to weed species number and dry weight during cover crop and maize growing period. However, control plot maintained higher weed dry weights and species numbers. The cover crop residue nutrient analysis at termination (128DAP), had sole vetch with the highest N uptake of 233kg ha^{-1}, followed by 50:50 with 231kg ha^{-1}, whereas sole oat had the lowest uptake of 175kg ha^{-1}. No significant differences ($P > 0.05$) were observed with P uptake. Total soil N, measured at maize planting, was in the order: sole vetch (0.56% N) > 50:50 (0.55% N) > 70:30 (0.45% N) > 90:10 (0.34 %) > sole oat (0.32% N) > control (0.18% N). Significant differences ($P < 0.05$) were observed among the treatments with regards to maize yield. Compared to the control, treatment with 50:50 had the highest maize relative yield increase (19%) followed by sole vetch (18%), then 70:30 (16%), 90:10 (13%) and lastly sole oat (7%).

CONCLUSIONS

Oat-vetch bicultures were able to provide optimum biomass yields, increased total soil N and consequently produced higher maize yields without compromising weed suppression as given by their monocultures.

ACKNOWLEDGEMENTS

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Keywords: oat-vetch biculture, biomass, weed suppression, nitrogen, phosphorus

TRACE METALS – ANTAGONISTS TO GLYPHOSATE EFFICACY?

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INTRODUCTION

Glyphosate was initially patented as a metal chelator before being introduced as a herbicide. Thus when mixed with trace metals it results in a complex that is poorly absorbed. This results in a deficiency of a trace metal in a complex (McBride & Kung, 1989). Trace metals, in turn, have the potential to antagonize glyphosate efficacy (Bernards *et al*., 2005). Trace metals that were implicated in glyphosate antagonism include iron, manganese and zinc, and monovalent and divalent cations found in hard water. The aim of this study was to investigate the effect of manganese (Mn) in mixture with glyphosate in a Petri dish assay and establishing whether varying concentrations of Mn or molybdenum (Mo) in nutrient solutions antagonize foliar applied glyphosate within a leaf. The study was carried out using glyphosate resistant and susceptible populations of *Lolium* spp.

MATERIALS AND METHODS

1) A growth chamber Petri dish assay was conducted in a 2 x 3 x 6 factorial arrangement replicated three times. Factors were: glyphosate resistant and susceptible populations of *Lolium* spp.; three levels of Mn (0, 10 and 50 mM) in a nutrient solution; and six concentrations of glyphosate (0, 10, 20, 40 80, 160 mg a.e. L^{-1}). The effects on germination and root growth were investigated. 2) A 2 x 3 x 6 factorial experiment was carried out in a greenhouse to investigate the role of Mn and Mo in glyphosate efficacy. Treatment factors were: glyphosate resistant and susceptible Lolium populations; Mn or Mo at 0, 1x and 2x concentration (where 1x = 0.55 mg ml^{-1} Mn or 0.05 mg ml^{-1} Mo) and five glyphosate concentrations (0, 90, 180, 360, 720 g a.i. ha^{-1}). The parameters measured were percentage survival and shoot length.

RESULTS AND DISCUSSION

Manganese treatment combinations had significant effects ($P < 0.05$) on germination and root length in the Petri dish assay. Similar to previous findings, results in the Petri dish assay indicates that Mn affects glyphosate efficacy whereas in the greenhouse did not show any significant effect ($P > 0.05$). In the greenhouse studies only the treatment combination with Mo showed significant ($P < 0.05$) interaction with regard to percentage survival and dry mass yield. These results show that there may be complex formation involving molybdenum within the leaf which results in reduced efficacy of glyphosate.

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Keywords: Glyphosate, Efficacy, Antagonism, Mn, Mo

CATTLE MANURE IMPROVES AGGREGATE STABILITY OF SOME HARDSETTING SOILS UNDER RAPID AND SLOW WATER INTAKE CONDITIONS

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INTRODUCTION

Most soils in the Eastern Cape Province, South Africa, have low soil organic matter content, which exacerbates their vulnerability to degradation including hardsetting and crusting. Soil strength and hardsetting tendency are known to increase with depth as soil organic matter decreases. However, soil organic manure is known to improve soil aggregate stability. Animal manure is a good source of soil organic matter and can be a good ameliorant in soil productivity restoration.

MATERIALS AND METHODS

A field study was conducted at the University of Fort Hare research farm under irrigation to determine the effectiveness of cattle manure in improving the aggregate stability and penetration resistance of freshly exposed hardsetting soils. The study was arranged in a split-plot treatment structure in a randomized complete block design with three replications. Soil scalping to 0, 10 and 20 cm depths made up the main plots whilst cattle manure at 0 and 20 t/ha, made up the sub plots. Soil sampling for the determination of aggregate stability was done in the top 0 to 15 cm. Aggregate stability was determined using slow wetting, fast wetting and mechanical shaking.

RESULTS AND DISCUSSION

Cattle manure increased mean weight diameter (MWD) by 18% when the soil was fast wetted and 33% after slow wetting thus indicating a reduction in slaking and dispersion respectively. Fast wetting resembles high rainfall intensity whilst slow wetting resembles gentle rain. However, a 16% reduction in MWD after mechanical shaking was observed due to soil organic matter acting as a deflocculant. Although soil penetration resistance was not affected by cattle manure it decreased linearly with increasing soil wetness.

CONCLUSIONS

Cattle manure improved the stability of aggregates of the hardsetting soil to rapid or slow water intake conditions experienced during rainfall or irrigation. However stability of aggregates to mechanical stress associated with conventional tillage did not improve.

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Keywords: mean weight diameter, soil organic matter, soil penetration resistance, aggregate stability, cattle manure, hardsetting

THE INFLUENCE OF VARIOUS ADJUVANTS ON GLYPHOSATE EFFICACY

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INTRODUCTION

Glyphosate is a broad spectrum, non-selective systemic herbicide. It is effective in killing all plant types including grasses, perennials and woody plants. When glyphosate is mixed with carrier waters that contain high salt levels, the activity of glyphosate is reduced as a result chemical modification of the herbicide. This effect is known as antagonism in the spray mixture. Adjuvants, such as ammonium sulphate, are added to such spray mixtures to overcome antagonism. Although adjuvants do not have any herbicidal effects of their own, they play an important role to increase herbicide efficacy. Several adjuvants are registered for use with pesticides, however there is a misconception that adjuvants are alike and that one adjuvant may be substituted for another. This study was conducted to determine which specific adjuvants, including ammonium sulphate, optimise glyphosate efficacy.

MATERIAL AND METHODS

Multiple greenhouse trials were conducted at the Agricultural Research Council Small Grain Institute, Bethlehem. Roundup® (glyphosate) was used as representative of a glyphosate herbicide for all trials. Four registered and five unregistered adjuvants, representative of seven different adjuvant classes, were applied to cultivated oats, cv. Potberg at the recommended rate. A treatment without adjuvant served as control. All experiments were set up as randomized complete block designs. Distilled water was used to eliminate the effect of poor water quality since glyphosate is very sensitive to poor water quality (eg. hard and brackish water). The five unregistered adjuvants that were applied were included in the trials to determine their effect on glyphosate efficacy. The experiments were evaluated after fourteen days by means of weighing fresh shoot mass and data was analyzed using Genstats 11th ed (11.1.0.1575).

RESULTS AND DISCUSSION

Antagonism still occurred when a spreader/sticker adjuvant was mixed with Roundup® in the spray mixture. Low percentages control was also recorded with both buffer/wetter adjuvants (lower than 45%), both stickers (lower than 77%) and the plant oil (lower than 80%). Percentages control of higher than 85% were recorded with when ammonium sulphate, mineral oil or a wetter on its own was mixed with the spray mixture. Additionally, the addition of ammonium sulphate to spray mixtures most often leads to greater herbicide efficacy and weed control.

CONCLUSION

Results from this study indicate that various adjuvants have an impact on the efficacy of glyphosate herbicides. This interaction however does not necessarily increase the efficacy of the herbicide and therefore it remains important that correct choices are made and most appropriate spray mixtures be used for optimal weed control.

Keywords: adjuvants, ammonium sulphate, glyphosate, herbicide efficacy, Roundup

EVALUATION OF DRYLAND MAIZE/PIGEONPEA INTERCROPING UNDER VARIABLE PHOSPHORUS APPLICATION RATES

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INTRODUCTION

Intercropping of legumes with cereals is an age long practice particularly among rural smallholding farmers for the purpose of economizing inorganic nitrogen fertilizer use and increasing productivity and profitability per unit area. Numerous cereal/legume intercrop trials have been reported by different authors. The success of such intercrop studies is largely dependent on the compatibility of the component crops to clearly lessen the negative effects of shading and resource-use constraint arising from competition. Pigeonpea (*Cajanus cajan L.*), a drought tolerant, deep rooted and slow-growing plant (Willey & Reddy., 1981) is a potential legume crop that may be successfully intercropped with maize by resource-poor farmers in low rainfall areas. Despite the nutritional value of pigeon pea, limited studies have been reported on its compatibility with maize in an intercrop particularly under dryland condition. Thus, this study was initiated to assess the productivity of maize/pigeon pea intercrop under rainfed conditions.

MATERIALS AND METHODS

A field trial was initiated during 2009/ 2010-summer growing season at University of Limpopo Experimental farm, Syferkuil. Treatments consisted of different phosphorus rates (0, 15, 30, 45, and 60kg ha^{-1}) were used on both sole and intercropped pigeonpea/maize. Each treatment was laid out on an $18m^2$ plots arranged in a randomized complete block (RCBD) design. Open pollinated maize seeds variety (ZM526) and pigeon pea (ICEAP360) were sown at a population of 37037 and 111111 plants ha^{-1}. Yield data obtained at harvest were subjected to analysis of variance using Statistix 8.1 while treatment means were tested at 5% probability level.

RESULTS AND DISCUSSION

Pigeonpea and maize grain yield increased with increase in level of phosphorus. Pigeonpea highest grain yield (447.24kg ha^{-1}) was recorded at P rate of 60kg ha^{-1}. Cropping system showed no significant influence on the grain yield of pigeonpea. There was significant cropping system x P interaction effect on the grain yield of pigeon pea. Maize grain yield were high when it was intercropped with pigeonpea at P rates of 30kg ha^{-1}, this accounted for 1235.9kg ha^{-1}, but beyond 30 P kg ha^{-1} grain yield decrease. The calculated total land equivalent ratio (LER) for two crops gave high and positive value which suggests favourable grain yield advantage for maize/pigeonpea intercrop.

CONCLUSION

The results of this study revealed a significant cropping x P rate interaction effects on the grain yield of pigeonpea while both phosphorus rates and cropping system significantly influenced maize grain yield. The greater than one value of the LER value suggested that intercropping of maize and pigeonpea could be of a great advantage for growers.

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Keywords: Maize, pigeon pea, intercropping, dryland, phosphorus

INFLUENCE OF AMBIENT TEMPERATURE ON THE RESPONSE OF TWO APPLE CULTIVARS TO REST-BREAKING AGENTS

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INTRODUCTION

Chemical rest-breaking agents (RBA) are applied to most commercial apple cultivars in the Western Cape during spring in order to reduce the abnormal growth associated with insufficient winter chilling. It was assumed that higher ambient temperatures during RBA application would enhance their effectiveness. The effect of ambient temperature on the response of two apple cultivars to the selected rest-breaking agents was evaluated over two seasons.

MATERIALS & METHODS

Two commercial RBAs, [Dormex^R/oil (0.5%/3% v/v) and Lift^R (3% v/v)], were each applied on six occasions during August and September 2008 and 2009, to Royal Gala (RG) and Granny Smith (GS) apple cultivars in Elgin. Hourly day and night temperatures were converted to daily heat units (HU>10^{o}C) before and after treatments. The relationship and association between HU and bud-break (BB) and yield (fruit/tree) responses to the RBA over two seasons were analysed by Pearson's correlation, stepwise multiple linear regression and principal component analysis (r>0.5 was considered significant). Tree dormancy status was monitored by forcing excised shoots.

RESULTS & DISCUSSION

Progression from dormancy was more advanced in GS in both seasons, and more advanced in 2009 in both cultivars. RG and GS emerged from dormancy, after mid-September and mid-August respectively. During 2009, BB of RG was significantly (R^2=0.66) predicted by accumulated daily HU three days before and after Dormex application with both the correlation and PCA association being negative. During 2009, yield of GS was significantly (R^2=0.50) predicted by daily HU three days before Dormex application with the correlation and PCA association being positive. No general association was found between HU, and BB or yield in either of the cultivars, seasons or RBAs. There appears to be an ideal stage of bud development for optimum response to a RBA, which may be influenced by HU's, after which BB may be retarded or reduced irrespective of the HUs. Improved BB may be at the expense of yield.

CONCLUSIONS

The effect of temperature appeared to depend on the dormancy status of the cultivar during RBA application, as influenced by the season and RBA used. In more advanced seasons, or later in the season, warmer conditions during RBA application could result in adverse effects on BB and yield. Application timing and RBA concentration should be modified according to tree dormancy status.

ACKNOWLEDGEMENTS

The Deciduous Fruit Producers Trust and ARC's financial support is gratefully acknowledged.

Keywords: apple, delayed foliation, heat units, rest breaking, temperature

FUNGAL INHIBITORY ACTIVITIES OF APPLE POLYGALACTURONASE INHIBITING PROTEINS 1 AND 2 PURIFIED FROM TRANSGENIC TOBACCO

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INTRODUCTION

Plant polygalacturonase inhibiting proteins (PGIPs) are cell wall-associated glycoproteins that effectively inhibit fungal *endo* PGs. These PGIPs have different specificities against different fungal PGs. The *Malus domestica* apple *pgip1* and apple *pgip2* genes, isolated from *Malus domestica* cv Granny Smith, were expressed in transgenic tobacco plants. *Md*PGIP1 and MdPGIP2 inhibitory activities against PGs from the lupin pathogen *Colletotrichum lupini*, two maize pathogens *Fusarium verticillioides* and *Stenocarpella maydis*, the onion pathogen *Botrytis cinerea*, and *Aspergillus niger* was investigated.

MATERIALS AND METHODS

MdPGIP1 and MdPGIP2 were purified from tobacco leaves by high salt extraction, clarification by DEAE-Sepharose and cation exchange HPLC. SDS-PAGE of HPLC collected fractions was performed and stained with silver nitrate. Crude PG preparations of *C. lupini*, *B. obtusa* and *D. ambigua*, partially purified *S. maydis*, *B. cinerea* and *A. niger* PGs, and purified *C. lupini* and *F. verticillioides* PGs were used in PG:PGIP inhibition studies using the agarose diffusion assay (ADA). *C. lupini* PGs were used to screen the fractions collected during the purification of MdPGIP1 by HPLC for MdPGIP1 activity to identify which peak contained the MdPGIP1.

RESULTS

MdPGIP1 appeared to be a more effective inhibitor of PGs from the apple pathogens, since twice as much MdPGIP2 (20 ng) was required for 50% inhibition of a crude PG preparation of *C. lupini* in an agarose diffusion assay. Both MdPGIP1 and MdPGIP2 were strong inhibitors of partially purified PGs from *S. maydis* and *B. cinerea*, requiring only 6ng for 50% PG inhibition. In contrast, 30ng of either PGIP was required for 50% inhibition of a purified PG from *C. lupini*. Neither of the MdPGIPs was able to inhibit purified PGs from *F. verticillioides* or *A. niger*.

CONCLUSION

We conclude that there are no differences in the spectrum of PGs inhibited by the two MdPGIPs. Thus, either *Mdpgip1* or *Mdpgip2* could be used to engineer for resistance to *C. lupini*, *S. maydis* and *B. cinerea*. However, neither of the *Mdpgips* would be suitable for engineering of resistance to *F. verticillioides* or *A. niger*.

Keywords: polygalacturonase inhibiting protein, *Colletotrichum lupini, Fusarium verticillioides, Stenocarpella maydis, Botrytis cinerea, Aspergillus niger*

PLANTING TIME AND PLANTING DENSITY INTERACTIONS FOR YIELD OF WINTER WHEAT CULTIVARS IN THE SUMMER RAINFALL REGION

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INTRODUCTION

In the summer rainfall region of South Africa, wheat is recommended and planted at generally low planting densities which vary from 20 to 30kg seed ha^{-1}. Winter wheat cultivars are generally not very sensitive to planting density in this region. This study was conducted to investigate the interaction between planting date and planting density on yield in this region.

MATERIAL AND METHODS

Three factorial field trials (2007-2009) with split-split-plot arrangements were planted at the ARC premises in Bethlehem under dryland conditions. A plot planter was used to establish 20 winter wheat cultivars at six different planting densities at three different planting times in four replications. The row width was set at 45 cm and the crop was fertilized with standard fertiliser at planting providing totals of 50 kg N ha^{-1} and 16.5 kg P ha^{-1} and 8 kg K ha^{-1}. Routine maintenance, pest and weed control were performed through the season. Yield of each plot was determined after harvesting the middle 3 rows of 5 m in length within each plot with a plot harvester.

RESULTS AND DISCUSSION

Significant interactions between the factors cultivar, planting date and planting density occurred in all three seasons indicating that cultivars responded differently to these factors. The planting densities brought no differences about in the first two planting dates of 2007. At the third planting date the yield increased significantly as the planting density increased. During the low yielding 2008 season, no significant differences in yield were measured due to increases in planting density at any of the planting dates. In 2009 the germination of the fist planting date was influenced by surface crusting. Yield increased up to a planting density of 22 kg seed ha^{-1} after which it decreased. A similar trend was found with the third planting date but no significant differences in the second.

CONCLUSION

The proposed planting times and planting densities as published are generally correct for the Eastern Free State. Although lower densities will be efficient in most seasons, higher densities will be beneficial when problems with germination occur. Therefore lower than recommended rates may increase risk.

ACKNOWLEDGEMENTS

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Keywords: Wheat, planting time, seeding density, yield

ROOTSTOCKS FOR PEACH TREES EVALUATED IN SELECTED SOUTH AFRICAN SOIL CONDITIONS

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INTRODUCTION

Peach production is increasing on more marginal soils. However, soils differ in type, salinity, alkalinity and in the occurrence of nematodes, and this affects yield. 'Fantasy' and 'Supreme' on selected rootstocks were evaluated in Ashton with high pH and salinity soil; while 'Western Sun' was evaluated in Tulbagh on nematode infested land.

MATERIALS AND METHODS

Data from five harvests of 'Fantasy' and 'Supreme' grafted on GF 677, Viking, Flordaguard, SAPO 778, Kakamas seedling and Sandvliet rootstocks was collected with regard to yield, fruit mass and stem circumference. With 'Western Sun' budded on Kakamas seedling, SAPO 778, GF 677, Flordaguard, Nemaguard, Atlas, Viking, Ferciana and Tsukuba 5, the fruit yield was monitored for five consecutive years. All trials were in randomised complete block designs.

RESULTS AND DISCUSSION

In the fifth harvest season, 'Fantasy' and 'Supreme' trees yielded significantly (P=0.05) better on GF677 than on other rootstocks, with Viking as the best alternative. Both Kakamas seedling and Sandvliet suffered from severe leaf burn. 'Western Sun' fruit mass was highest on SAPO 778,. Low yield and low average fruit mass was obtained with Kakamas seedling. Kakamas seedling was found to host root-knot (*Meloidogyne* spp) nematodes in appreciable numbers. Ring nematode (*Criconemoides xenoplax*) numbers were high in root zones of all rootstocks used.

CONCLUSIONS

The rootstocks Sandvliet, Kakamas seedling and SAPO 778 are not recommended on soils with a pH range of 7.4-7.7 and EC range of 2-5 dS/m. Peach trees on Atlas and SAPO 778 rootstocks will be more suitable than Kakamas seedling on soils where both root-knot and ring nematodes occur.

Keywords: rootstocks, peach

ARBUSCULAR MYCORRHIZAL FUNGI AS A SOIL HEALTH INDICATOR

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INTRODUCTION

Mycorrhiza is a term that defines an obligate symbiotic association between fungi and the roots of majority of plants. It has been identified as a key species indicator of soil health. Soil health on the other hand is a broadly defined concept. It is defined as the capacity of a soil to function as a vital living system, by recognizing that it contains biological elements that are key to ecosystem function within land use boundaries. The aim of this ongoing study is to evaluate mycorrhiza status of maize production under conservation agriculture (CA) practices.

MATERIALS AND METHODS

A CA trail that consists of 24 different tillage, fertilizer and crop practices, was monitored over a two year period. Arbuscular mycorrhizal spores were extracted from soil by wetsieving and decanting (Sylvia, 1994). The roots were assessed for colonization by staining; mounting and analyzing using an intercept method (Daniels and Skipper, 1982). Glomalin was extracted and quantified using a Bradford assay (Janos et al., 2008).

RESULTS AND DISCUSSION

In both 2008/9 and 2009/10 cropping seasons very few spores were recovered from the soils. Root colonization was not detected. The easily extracted glomalin concentrations were also low throughout the whole trail. Over the two year period only a slight increase in the various indicators was detected. Low levels of spores, glomalin and absence of root colonization indicate that the trial site soil was not properly managed for a long period before the trail was started in 2007, resulting in the absence of these critical soil microorganisms.

CONCLUSION

Long periods of fallow and clean management of soils has resulted in depleted mycorrhizal populations. Three years after the start of the CA trail, the mycorrhiza levels are insignificantly low to have any effect on crop production. In such cases it is important to inoculate fields before planting.

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Keywords: Arbuscular mycorrhizal fungi, soil health, conservation agriculture

EFFECT OF SOIL ACIDITY ON NUTRITIONAL QUALITY (PROTEIN AND OIL CONTENT) OF GROUNDNUT (*Arachis hypogea*, L) SEEDS

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INTRODUCTION

Groundnuts (*Arachis hypogaea.* L) are grown for their nutritious seeds, with 25% to 32% protein and 42% to 52% oil content. Their rich nutritional content assists rural communities in the fight against malnutrition. As part of a broader study on tolerance to soil acidity, the response of groundnut seed quality to acid soils was examined. The aim of the study was to determine whether genotypes deemed as tolerant to acidity would maintain the desired quality in terms of protein and oil content when grown at high acid saturation.

MATERIALS AND METHODS

Three groundnut genotypes, Harts, Kwarts and Rambo, were grown in pots in a glasshouse at the University of KwaZulu-Natal using the Inanda soil form with a high acid saturation of about 80%, exchangeable acidity of 2.88 cmol/L and pH of 3.95. Treatments were arranged in a completely randomised design with two factors: cultivars (Harts, Kwarts and Rambo) and lime (calcium silicate, dolomite and no lime) with 3 replicates. Seeds were harvested at maturity and analysed for protein and oil contents. Total protein from groundnut seeds was extracted according to the modified method of Zhang *et al*. (2005). Protein concentration was determined using bovine albumin (BSA) as standard (Bradford, 1976). Lipid concentration was determined according to Meyer and Terry (2008). The recovered oil was weighed and percentage oil calculated (% w/w).

RESULTS AND DISCUSSION

For all cultivars, protein content increased significantly ($P<0.001$) in response to high soil acid saturation. When no lime was applied, Rambo had the highest protein concentration (39.2 mg g^{-1}), followed by Kwarts (38.2 mg g^{-1}) and Harts (28.9 mg g^{-1}), respectively. When acidity was ameliorated to 20% acid saturation, protein contents of there cultivars were 24.1; 18.9 and 26.9 mg g^{-1} respectively. Although groundnuts have high protein content, the observed increase in protein under low soil pH may be attributed to soil acidity stress. Oil content was significantly ($P<0.05$) reduced by high soil acidity; the extent of reduction varied ($P<0.05$) among the cultivars.

CONCLUSION

Soil acidity significantly affects nutritional quality of groundnuts as measured by oil and protein content.

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Keywords: Groundnuts, Oil Content, Protein Content, Soil Acidity

EVALUATING ADAPTATION OF CASSAVA (*Manihot esculenta*) IN LIMPOPO PROVINCE

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INTRODUCTION

Cassava (*Manihot esculenta*) is extensively cultivated as an annual crop in tropical and subtropical regions and is the third largest source of carbohydrates for human food in the world (Claude & Denis, 1990). The edible parts are the tuberous root and leaves. Since cassava thrives in poor soils better than most other crops and is drought resistant, it is often considered an insurance and hence major food security crop for resource-poor smallholder farmers cropping the more marginal lands. However, production of cassava as a food crop in South Africa is currently insignificant. Therefore the objective was to assess the adaptation of cassava to the dry environments of Limpopo province.

MATERIALS AND METHODS

Three cassava genotypes (LOCAL MZINTI, LAL and I-89/00715) were planted at the University of Venda's experimental farm, with no irrigation and fertilizer application, in November 2010 in a completely randomized block design replicated three times. Cassava mosaic virus disease (CMVD) incidences were scored (on a scale of 0 to 9; 9 being severe infestation) regularly, and root yield and yield components were determined at 6 months after planting (MAP).

RESULTS AND DISCUSSION

There was no genotypic effect on the number of tubers per plant (average of 12) and fresh tuber yield (38.4 t ha^{-1}) at 6 MAP. These yields were much greater than the African average (determined at 12 MAP) of 9.9 t ha^{-1} in 2007 (FAO, 2008). However, they may be comparable to the potential yield of 75-90 t ha^{-1} (Cock *et al*., 1979) which have been obtained under experimental conditions in Colombia and India at 12 MAP (El-Sharkawy, 2004). The incidence of CMVD at 6 MAP was greater in LAL (8.3) compared with I-89/00715 (2.3) and LOCAL MZINTI (2.7) but the difference between I-89/00715 and LOCAL MZINTI was not significant.

CONCLUSION

These preliminary findings show the huge potential of cassava in this dry environment of Limpopo province.

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Keywords: Drought tolerance, genotypes, mosaic virus, tuber yield

SEED QUALITY COMPONENTS OF A BAMBARA GROUNDNUT (*Vigna subterranea* L.) LANDRACE FROM KWAZULU-NATAL

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INTRODUCTION

Bambara groundnut is a protein-rich legume, with food security potential in drought-prone regions. However, there is a dearth of information describing seed quality of local landraces.Previous research (Zulu and Modi, 2010) indicated that seed colour is associated with seed quality. Proline is known to accumulate in response to water stress. The aim of the study was to evaluate the effect of seed colour on quality and proline accumulation in seeds of a local bambara landrace.

MATERIALS AND METHODS

Seeds were collected from subsistence farmers in Jozini, KwaZulu-Natal, and sorted into three distinct colours: red, white and brown. Seed of the different colours were compared in standard germination (SG) and cold test (CT) trials. Seeds were germinated under two conditions, 25°C for 8 days (SG) and 4°C for 7 days followed by 8 days at 25°C (CT). Germination, seedling size and mass were recorded. Desiccation tolerance was evaluated by suspending 30 seeds of each colour over saturated salt solutions of NaCl, LiCl, KNO_3 and H_2O (control) for 0, 2, 4, 8, 24 and 48 hours. Five seeds were sampled at each interval and stored at -21°C for 7 days. Samples were ground and analysed for proline content (Claussen, 2005).

RESULTS & DISCUSSION

The standard germination test resulted in a higher germination percentage than the cold test. Brown seeds showed the highest germination across treatments, followed by red and white, respectively. Seedling mass was not significantly affected by CT or SG. Seed proline content increased from 0 hour to 8 hour and later declined. There were highly significant differences between seed lots ($P<0.05$) and salt solutions ($P<0.05$) with respect to proline content. Sodium chloride was associated with the highest proline accumulation. There were also significant differences ($P<0.05$) in shoot length and root/shoot ratio's between treatments.

CONCLUSION

Indications that brown seed germinated better than white or red seed deserve more research. Brief exposure of the seed to saturated salt solutions resulted in measurable increases in the proline concentration, but with longer exposure the proline concentration declined. Information from this study will be useful for future germplasm studies of bambara groundnuts.

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Keywords: Bambara, Dessication, Seed Quality, Proline

EVALUATION OF CONSERVATION MEASURES ON HIGHLY ERODIBLE SOILS IN THE FREE STATE PROVINCE

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INTRODUCTION

The ARC-ISCW was approached by the FSDA to collaborate in a study on the evaluation of different bio-textiles to rehabilitate and manage highly erodible soils in the Ladybrand district, south-eastern Free State. The site is situated in the commonage of Ladybrand, which is threatened by severe erosion at specific sites. Typically, highly erodible soils occur in the area associated with Karoo sandstone and mudstone parent material.

MATERIALS AND METHODS

Wischmeier runoff plots measuring water runoff and soil loss (sediment) were used to evaluate the following seven treatments: a) Mac Mat, b) Bio Jute (fine), c) Bio Jute (coarse), d) Palm leaf mats, e) Half-moon basins, f) Stone bunds and g) Bare soil (control). Runoff and soil loss data were collected approximately twice a month or after major rainfall events in summer, while in winter only after rainfall events. Once collected, the runoff samples were used to determine the sediment load. The runoff data was collected using “Hobo” dataloggers. The Ground and Basal Cover were measured to give an indication of the effect of the conservation measure (material) on the vegetation recovery or regeneration.

RESULTS AND DISCUSSION

The treatment where the most runoff occurred was the bare soil control plot. This was followed in descending order by the half-moon basins, the palm mats, the stone bunds and finally by the Mac Mat plot, which was therefore the most successful treatment in reducing runoff. The overall (two seasons combined) runoff results show that, as for sediment load, the bare plot was clearly the worst, followed by the stone bunds. The half-moon basins performed best, while there was not too much variation between the four geotextile treatments. Two (of the three) commercially available bio-textiles, namely Mac Mat and Bio Jute (coarse), generated the highest vegetation cover, namely 70% ground (7% basal) and 82% (8%) respectively. Bio Jute (fine) generated only 55% (5%), while the low-cost measures, i.e. half-moon basins, stone bunds and palm mats, generated lower vegetation cover {around 50% (5%)} and the bare soil control plot generated only 30% (3%) cover.

CONCLUSIONS

Data collection and analysis have produced satisfactory results and this process will be continued for at least one more season, especially in order to verify the previous season’s results. Ultimately these results would lead towards the obtaining of useful insights into the stabilisation and rehabilitation of highly erodible soils in the eastern Free State and South Africa in general.

Keywords: bio-textiles, runoff

AN INVESTIGATION TO REDUCE UNCERTAINTIES ABOUT THE INFLUENCE OF SOIL PATTERN ON GROUND WATER RECHARGE

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INTRODUCTION

Hydrodynamic monitoring is time consuming, expensive and weather dependent. Using soil point observations as an alternative to model landscape hydrology is the basis for hydropedology. Point observations are made in the soil in one place and time, which reflect the dominant pedological processes that occur; water being the most common soil forming agent in hillslopes. Connecting watershed dynamics to point observations can effectively be done with the use of a soil map. Point observations such as texture (sand, clay and gravel content) and organic material (OM) content, can be acquired from most soil survey datasets. The aim of this study is to use these point observations to investigate whether soil survey information can be used to predict the role of soil pattern in catchment hydrology, and ultimately in aquifer recharge in a fractured bedrock aquifer system.

MATERIALS AND METHODS

A semi-detail soil survey was conducted in the Kogelberg Nature Reserve near Kleinmond, Western Cape. This mountainous environment consists of fynbos vegetation on soils derived from sandstone parent material. Six dominant soil forms were identified and soil samples were collected at these sites for texture and OM content analysis. The acquired data was used to calculate saturated hydraulic conductivity and plant available water according to Saxton & Rawls's (2006) model. A single factor ANOVA was performed to investigate whether a significant difference exists between the hydrological properties of the soil forms.

RESULTS AND DISCUSSION

A soil map showing the dominant soil form distribution in the catchment was compiled. It shows that shallow, sandy Cartref soil forms dominate the hillslopes whereas deeper sandy Pinegrove, Concordia, Witfontein and Fernwood soil forms are found on the footslopes. A statistical analysis indicated that soil form can be used to estimate saturated hydraulic conductivity [P = 0.01] and plant available water [P = 0.003], suggesting that soil survey information can be used to predict general hydraulic behaviour in a fractured bedrock aquifer system. The results

CONCLUSIONS

Using soil survey information, such as soil form, can prove useful in determining general hydraulic behaviour in an ungauged fractured sandstone bedrock aquifer system, provided parameters such as texture and OM content are known.

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Keywords: Aquifer recharge, Soil texture, Soil survey

AVOCADO ORCHARD MANAGEMENT: EFFECTS OF BORON AND BRANCH-GIRDLING ON SPECIAL CARBOHYDRATES

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INTRODUCTION

Few reports on the combined effects of B application and tree branch girdling exist (Noel, 1970). Therefore this experiment was designed to investigate if B fertilization and girdling can improve fruit size and carbohydrate accumulation in avocado fruit.

MATERIALS AND METHODS

The experiment comprised two factors, B applications (four levels of solubor: 0, 37.5, 75 or 150 g/tree) and branch girdling (girdled and ungirdled). Each treatment combination of branch-girdling and B application was randomised on three different 'Hass' trees. In total, there were 12 trees for the experiment. Fruit length and weight was recorded throughout the experimental period, from 75 DAF to 180 DAF. Sugars were analysed by HPLC. GenStat Version 12.0 was also used for statistical analysis.

RESULTS

Fruit on girdled branches had higher concentrations of hexoses than fruit borne on non-girdled branches; similarly, B application increased the hexose concentration of the fruit mesocarp. The girdled-branches also had a higher concentration of heptose than non-girdled branches and B application increased the heptose concentration of the fruit mesocarp. The combined treatments significantly improved the mannoheptulose concentration.

DISCUSSION

The combined treatments of high B applications (75 and 150 g/tree) and branch-girdling significantly increased mannoheptulose concentration of the mesocarp tissue, confirming that mannoheptulose is a key sugar alcohol produced in avocado. This sugar has been reported as an important carbohydrate that plays multi-functional roles, such as an antioxidant and as a source of energy during plant growth and development (Tesfay et al., 2010).

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Keywords: avocado, boron, D-mannoheptulose

GROWTH, DEVELOPMENT AND QUALITY OF WHEAT IN RESPONSE TO CROP ROTATION AND SOIL TILLAGE

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INTRODUCTION

The Western Cape produces about 41 % of the total RSA wheat crop of two million ton (Abstract Agriculture Statistic, 2008). South Africa consume about 2.4 million ton of wheat per annum and is therefore a net importer of wheat. Increasing production costs and low produce prices resulted in narrowing of profit margins and a decrease in production. Results in long-term crop rotation and soil tillage trials showed differences in yield of wheat crops (Maali, 2003). The aim of this study is to quantify how the difference in yield is affected by crop rotation and method of soil tillage.

MATERIALS AND METHODS

This study comprise of component studies within the current research program system at Langgewens Research Station. The trial is laid out as a factorial arranged in a split plot design (Snedecor & Cochran, 1967) with three crop rotations and four methods of soil tillage. For this study, only the wheat crop, grown in three rotational systems, namely wheat monoculture, wheat-medics and a wheat-canola-wheat-lupins system, using the four different methods of tillage, namely zero-till, no-till, minimum till and conventional tillage, is being monitored.

RESULTS AND DISCUSSION

The results show that there is a 4.6% higher yield (dry mass) in the wheat-canola-wheat-lupins system, than in the wheat monoculture. Within both these systems, minimum tillage has the highest biomass yield, with the biomass yields from the zero-till plots being the lowest. In leaf area yield, the no-till system gave the highest yield within the wheat monoculture, whilst minimum till gave the highest yield in the wheat-canola-wheat-lupins system. In both rotation systems zero-till produced the lowest yield.

CONCLUSIONS

The use of rotational crop systems in dry-land production, in the Western Cape, in conjunction with the correct method of tillage, will increase yields and affect soil moisture which has an effect on the plant-available nitrogen and can possibly decrease production costs.

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Keywords: wheat, crop rotation, soil tillage