

EVALUATION OF THE PUTURUN MODEL TO PREDICT MAIZE YIELDS WITH CONVENTIONAL TILLAGE AND IN-FIELD RAINWATER HARVESTING ON THE GLEN/BONHEIM ECOTOPE

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INTRODUCTION

Short-term experiments over seven consecutive growing seasons with maize on the Glen/Bonheim ecotope have shown that it is possible to increase maize yields considerably when using the in-field rainwater harvesting (IRWH) crop production technique due to the total stoppage of ex-field runoff (R). However, to be able to make reliable recommendations on the best crop production technique in a particular area it is desirable to have long-term yields to quantify risk, especially in semi-arid areas with marginal rainfall. Long-term field experiments are expensive and labour intensive. However, research can be conducted more cost-effectively if it is possible to accurately model the system with the necessary computer software and then use the model to obtain long-term yields. Extensive modelling has already been done for maize production under conventional tillage (CON), but work on the simulation of IRWH is limited. With the IRWH system the available water in the basins after each rainfall event recorded in the long-term weather dataset needs to be simulated correctly. The PutuRun model consists of three sections programmed to work in unison, viz. firstly, a rainfall generator which can convert daily rainfall data into rainfall intensity (P_i) data using the Huff curve procedure; secondly, the Morin & Cluff runoff model which receives the P_i data from the first section; and thirdly, an adapted version of the Putu-Maize model that can make use of the R data from the R model, as well as the normal climate data.

The aim of this study was to test, calibrate and validate the performance of the PutuRun yield prediction model to cater for maize production using the IRWH technique on the Glen/Bonheim ecotope in the Free State Province.

MATERIALS AND METHODS

The measured data of on-station experiments conducted at Glen were used to create the input files needed by the PutuRun model. Simulations with the model can be done with nine different R options. R is estimated from either an empirical regression equation, the area under the rainfall intensity curve, or using the Morin & Cluff (M & C) model. Of all the available options the M & C model (options 5 and 6) had the most scientifically sound principles and therefore only these options were used for the yield predictions. Model weaknesses were also identified and, where possible, minor alterations were made to improve the performance of the model.

RESULTS AND DISCUSSION

The results with PutuRun were very unsatisfactory for both the CON and IRWH treatments. IRWH maize yields especially were very poorly predicted ($R^2 = 0.002$; $d = 0.38$; $RMSE_u/RMSE = 0.53$). These results indicate complete failure of PutuRun. Further investigation revealed that there are serious programming errors in the maize yield prediction component of the model.

CONCLUSION

PutuRun is unsuitable for maize yield predictions produced under IRWH in its present form. If the identified errors can be rectified then this model has the potential to become a valuable practical tool for IRWH decision making and to support meaningful extrapolation to other semi-arid ecotopes.

Keywords: PutuRun, in-field rainwater harvesting, maize, Glen/Bonheim ecotope

DETERMINATION OF THE EFFECT OF HIGH AND LOW GRADING FACTORS ON THE FIELD AND QUALITY PERFORMANCE OF WHEAT

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INTRODUCTION

An increased demand for wheat seed, especially in the irrigation areas, forced many producers to plant their fields with farmer-saved seed during 2008. Each year, following a growing season that is characterized by drought, extreme heat during a sensitive stage in crop development, excess moisture, an early frost, plant disease, or other problems, some low quality grain enters the market channel. During years when vast geographical areas are affected by unfavourable growing conditions and seed multiplication sites are negatively affected, a large quantity of low-grade grain may be available as seed for the next season. No information is currently available on the suitability of low-grade grain for seeding purposes.

In this study we aimed to determine whether grain with low grading factors such as protein content, hectolitre mass and falling number, when used as seed, negatively effects germination, emergence, yield and the grading characteristics of the following crop.

MATERIALS AND METHODS

Seed with high and low values of the three most important grading factors were planted over a two year period under dryland and irrigation conditions to determine the effect of these seed quality parameters on the yield and quality of the following crop.

RESULTS

Data from this study showed that there were no significant differences in the mean average germination percentages of most cultivars with high and low grading factors over a two year period. There were also no significant differences in the number of seedlings per meter row length due to any of the grading factors in either the dryland or the irrigation trials. However, mean emergence percentages calculated from the number of seedlings per meter row length, indicated significantly lower emergence in seeds with low hectolitre mass in both the dryland and irrigation trials. Emergence percentages were decreased by between 17% and 23% when seed with low hectolitre mass was planted. This can be explained by the fact that the lower the HLM, the more seeds are planted per unit area.

DISCUSSION

The data from this study confirmed that germination was not affected by low grading factors. Field emergence, however, was significantly influenced by low hectolitre mass. In dryland cultivars a 17.3% decrease in emergence was observed in the low hectolitre mass plants, while the irrigation cultivars had a 23% decrease in emergence percentage compared to the high hectolitre mass seed. When calibrating a planter according to kg/ha, more seeds per hectare will be planted with low HLM seed than with high HLM seed. Emergence is often somewhat lower with low HLM seed, but in the end the stand should be about normal.

The end results indicated that using seeds with low grading factors as sowing material does not have a negative effect on the yield and quality characteristics of the crop. The proviso is however that the seed be pure and disease free in order to maximise yields and therefore it is imperative that producers should only use certified seed for planting. Planting farmer-saved wheat should be the last option for seed.

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Keywords: grading regulations, hectolitre mass, falling number, protein content, wheat

TIME OF INITIATION OF MAIZE REPRODUCTIVE STRUCTURES AS AFFECTED BY SOIL FERTILITY STATUS IN A LONG TERM FERTILIZATION TRIAL

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INTRODUCTION

Accurate identification of growth stages in crops is essential for sound management decisions. Maize reproductive development begins with the initiation of the tassel at the elongated transitional stem tip (Bonnnett, 1954). It coincides with the time the basal internodes of the main stem begin to elongate. Maize performance is influenced by stress and stress management practices at different growth stages. In general it has been seen that environmental stress prolongs the period from planting to silking. Existing information on the effect of nutrient stress on the development of reproductive organs of maize is limited. Whether the effects can be observed directly after organ initiation and persist to influence grain yield is not clear. This study examines the effect of soil fertility status on the initiation and development of the reproductive organs of maize.

MATERIALS AND METHODS

Development of the reproductive organs of maize was monitored on treatments O (no fertilizer), PK (nitrogen deficient), NK (phosphorus deficient), NP (potassium deficient), NPK (balanced nutrient), and WNPKM (balanced nutrient + organic manure) of the Long-term trial on the Experimental Farm of the University of Pretoria during the 2005/2006 season. Two plants per plot for each of the four replicates were sampled weekly from the third till the eighth week after emergence. The apical meristems of the main shoots were microscopically inspected and photographed to identify the time of tassel initiation and subsequent differentiation. The axillary shoots were dissected to record ear development. The developmental stages of the reproductive organs were identified according to the guidelines of Cheng *et al.* (1983). (1983).

RESULTS AND DISCUSSION

Tassel development was earlier in the WNPKM treatment and was at the last stage of development at fourth week after emergence. Initiation of the embryonic tassel only occurred after the third week after emergence in the other treatments. Tassels of the PK and NP treatments completed their development between the fifth and the sixth week after emergence. The NK treatment resulted in the slowest rate of embryonic tassel development and completed development later than the seventh week after emergence. Embryonic ear development followed the same pattern. Ear initiation and differentiation started in the fourth week after emergence for the WNPKM treatment and later in all the other treatments. The WNPKM treatment reached the final phase of ear development by the seventh week. At the eighth week, the PK treatment was at a more advanced stage of ear development than the NP and NPK treatments. Generally, ear initiation occurred by the time the embryonic tassels started to develop basal branches (Bonnnett, 1954).

CONCLUSIONS

Soil fertility status affected reproductive development of maize. The well-balanced treatment (WNPKM) resulted in earlier development of larger reproductive structures which emerged ahead sooner than those of the nutrient deficient treatments. The timely completion of all the stages of reproductive development enables synchronization of tasseling and silking. Of all the nutrient deficient treatments, the phosphorus deficient treatment (NK) resulted in the slowest development rate. This will lead to late emergence of inflorescences.

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Keywords: developmental rate, nutrient deficiencies, tassel, ear

THE EARLY CHANGES IN THE ANTI-OXIDANT STATUS OF AVOCADO MESOCARP IN RESPONSE TO ETHEPHON

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INTRODUCTION

Avocado (*Persea americana* Mill.) is a climacteric fruit which releases copious amounts of ethylene during ripening. External ethylene, either naturally released from surrounding fruit or synthetically applied, stimulates ripening (Adato, 1974; Blumenfeld *et al.*, 1986) and is used commercially to hasten ripening. However the presence of ethylene in the storage atmosphere is detrimental to fruit quality (Pesis *et al.*, 2002). Breaks in the cold chain during refrigerated transport from the production area to the consumer can result in the initiation of the climacteric (Biale, 1941) which will result in prematurely soft fruit of low quality and limited shelf life (Dodd *et al.*, 2007; Undurraga *et al.*, 2007).

Ethephon [2-chloroethyl phosphonic acid (Goudey *et al.*, 1987)] is a ripening promoter used in a number of horticultural crops. In this study ethephon is used to simulate the effect of breaking the cold chain and fruit entering the climacteric prematurely. It has been found that significant changes occurred in mangoes (also a climacteric fruit) with respect to reactive oxygen species (ROS), anti-oxidant capacity and lipid peroxidation (LP) during the first day after Ethephon dipping (Singh and Dwivedi, 2008). This study aims to explore the changes in total anti-oxidant capacity (TAOC), ROS and LP, as well as the sugar profile of fruit, sequentially through a 24h period after Ethephon dipping.

MATERIALS AND METHODS

Fruit (cv 'Hass') were obtained from a grower in Karkloof on 23/7/2008 and 12/8/2008. Treated fruit were dipped in a 50mL.L⁻¹ Ethephon solution for 5min and allowed to air dry. Five fruit were used in each treatment per harvest. Fruit were sampled from 1, 2, 4, 6 and 24 hours after dipping. Samples were taken sequentially from the same fruit and the fruit sealed with petroleum jelly to prevent oxidation (Kanellis *et al.*, 1989). Carbon dioxide, ethylene, individual sugars, ROS, TAOC and LP were measured for each sample.

RESULTS & DISCUSSION

The Ethephon treated fruit showed significantly higher rates of respiration and ethylene evolution after 6h. LP peaked at 4h but was significantly higher after just 2h. The control fruit showed an active reduction in the ROS but the treated fruit did not. Mannoheptulose showed a rapid decline over the 24h period, declining approximately 30% for the control and treatment. Perseitol decreased slightly.

CONCLUSION

Significant changes occur in ROS, TAOC, LP and sugar profile of avocado just one day after the application of Ethephon. While the fruit appear to actively repair the cellular damage caused by an increase in ROS, the main energy source (mannoheptulose) is reduced which may result in the failure of the fruit to ripen.

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Keywords: Cold chain, C7 sugars, lipid peroxidation, reactive oxygen species, Ethrel, anti-oxidant

CRITICAL EVALUATION OF INDICATORS DESCRIBING WATER PRODUCTIVITY IN SEMI-ARID AREAS

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INTRODUCTION

South Africa has limited cropping potential, largely due to low, erratic and inefficient rainfall. The need for increased food production to feed a growing population increases the pressure on the natural resources. There is, therefore, an increasing need to use rainwater more productively in crop production. The technical solutions must focus on “more crop per drop” (of rain). Key questions are: (i) How can rainwater be used more productively to produce more food with the same amount of rainfall? and (ii) How can this be measured?

The aims of the study were to: a) identify the best parameter to determine “more crop per drop” and b) evaluate maize production in terms of “more crop per drop” on the Glen/Bonheim ecotope by comparing conventional tillage (CT) and in-field rainwater harvesting (IRWH) techniques.

MATERIALS AND METHODS

Indicators to measure the productivity of rainwater include: (a) Precipitation use efficiency based on the fallow and growing seasons (PUE_{fg}). This refers to how effectively rainwater is stored in the soil and converted into grain yield; (b) Rainfall storage efficiency (RSE). This refers to how much of the rain enters the soil (infiltrability) and is retained in the soil (largely determined by texture and depth). Low infiltrability means high runoff losses and low retention means high drainage losses; (c) Water use efficiency (WUE). This refers to how effectively the stored water is used by the crop. Crop type and root development and root efficiency largely determine this parameter; (d) Rain water productivity (RWP). This refers to how effectively rainwater is stored in the soil and converted into grain yield. These indicators were evaluated and tested with data obtained from the Glen/Bonheim ecotope over a period of four growing seasons with maize as crop. The treatments were CT and IRWH techniques, replicated three times. Rainfall was measured by an automatic weather station. Soil water content was measured with a neutron water meter. Grain yield was determined.

RESULTS AND DISCUSSION

It was found that PUE_{fg} is too complex and needs complicated measurements or calculations. It was also found that PUE_{fg} and RSE are negatively influenced by better water conservation practices and that WUE is more a crop parameter. It was concluded that RWP is the most uncomplicated, reliable, appropriate and acceptable way to describe the effectiveness with which rainwater is converted into grain. RWP values for CT and mean of the IRWH treatments were 3.22 and 6.85 kg seed ha⁻¹ mm⁻¹ rain over the four consecutive seasons, respectively.

CONCLUSION

RWP is considered to be the most appropriate parameter for evaluating the effectiveness of a water conservation production technique. It is concluded that IRWH is a technique that uses rainwater more productively to produce more food with the same amount of rainfall than CT.

Keywords: rainwater productivity, water use efficiency, in-field rainwater harvesting

A PILOT STUDY LINKING INDIGENOUS AND SCIENTIFIC KNOWLEDGE IN LAND EVALUATION OF THE EZIGENI AREA, UMBUMBULU (KWAZULU-NATAL)

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INTRODUCTION

Land evaluation plays a vital role in land use planning, management and development. It is key to sustainable land management due to the predictions it gives about long-term land performance, enabling farmers to match their land use practices to soil types. Scientific land evaluation and soil classification methods have had great impact in South Africa and world wide. Research has shown the importance of integrating indigenous knowledge and basic scientific approaches to land evaluation to benefit small-holder farmers. The study investigated the possibility of integrating scientific knowledge and indigenous knowledge of agricultural land evaluation at Umbumbulu, KwaZulu-Natal.

MATERIALS AND METHODS

For scientific land evaluation a soil survey was conducted using the taxonomic soil classification system for South Africa as a basis to produce land suitability and capability maps. For indigenous land evaluation, interviews and transect walks were conducted with members of the local community. Descriptions of land and soil evaluation by local farmers were used to produce a map of suitable soils for traditional crop production as perceived by the farmers. The maps, based on scientific soil surveying and indigenous soil classification and evaluation, respectively, were compared to determine the relationship between scientific and indigenous knowledge-based evaluations.

RESULTS AND DISCUSSION

Scientific land evaluation showed that the Ezigeni area was characterized by a wide range of soils, with Hutton, Inanda and Oakleaf (Capability classes I to IV), being the predominant soil forms and suitable for cropping. Class V, predominantly soils of the Glenrosa and Mispah forms, is suitable for intensive grazing only. Suitability maps, produced by means of scientific evaluation, for dry beans (*Phaseolus vulgaris*) and amadumbe (*Colocasia esculenta*) as the dominant traditional crops of Ezigeni, showed higher suitability of the area for dry beans than amadumbe (~ 60:40). Dominant soils meet the soil requirements for dry beans (good drainage and effective rooting depth of at least 500 mm). In contrast amadumbe is a wetland crop grown by the farmers of Ezigeni under upland conditions. Therefore amadumbe require very deep soils to accommodate the agronomic practice of ridging to improve corm yield. By virtue of being a wetland crop it is likely to tolerate poor drainage conditions.

Indigenous land evaluation showed that farmers use the same properties as scientific land evaluation when classifying their soils, but soil texture and colour are dominant classification properties in the local approach. This is also the case with effective indigenous soil classification and land evaluation by farmers elsewhere in Africa. In addition to soil texture and colour, farmers also use cropping response from many years of trials, weed-soil associations and soil micro-organisms to determine land suitability. For example nutgrass (*Cyperus esculentus* and *C. rotundus* L) are generally associated with land suitable for amadumbe production whereas Quick weed (*Galinsoga Parviflora* L) was mainly found in land suitable for dry beans. Contrary to the scientific evaluation, indigenous systems identified about 80 % of the land as being suitable for amadumbe. The main difference between the two systems was that the local system is not based on soil genesis but truly reflected the adaptation of agricultural practices of farmers to different soils, as based on generations of experience.

CONCLUSION

Overall, this study showed that the two soil classification and land suitability evaluation systems have some common principles and goals. The scientific approach gives a deeper understanding of land and soil characteristics. The indigenous knowledge approach allows a better understanding of the local agricultural practices and culture that influence land use. This study raised an argument as to whether the current degradation in the areas of South Africa occupied by subsistence farmers can be improved by incorporation of formal science and indigenous knowledge. It is recommended that similar studies be undertaken in all traditional rural farming areas in South Africa.

Keywords: Land evaluation

COMMUNICATION OF BEST PRACTICES FOR THE USE OF TWO PESTICIDES IN THE SA SUGAR INDUSTRY

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INTRODUCTION

Pest control problems identified by extension specialists have directed research efforts at SASRI. Such participation has allowed research outcomes to be relevant and effectively adopted. A range of industry-specific communication channels has been used to achieve this objective. This is discussed in the context of the commercial use of two agrochemicals, Fastac®, to control a sugarcane borer, *Eldana saccharina* Walker (eldana) and Arsenal®, to control a creeping grass, *Cynodon dactylon* (L.) Pers. (cynodon). Infestations of eldana can result in total crop destruction, while cynodon inhibits the establishment of plant and ratoon crops and reduces yields.

MATERIALS AND METHODS

Best practices for insecticide and herbicide application have been disseminated by researchers in co-operation with extension specialists and BASF South Africa. The adoption rate of Fastac® (alpha-cypermethrin 100 g a.i. L⁻¹) and Arsenal® (imazapyr 250 g a.i. L⁻¹) was assessed from 2001 to 2008.

RESULTS AND DISCUSSION

Initial chemical control research was based on ground application and results from these trials led to Fastac® being registered for such use. Best practices developed for the use of Fastac® included timing (application over the August to November period), rate (200 ml product/ha) and frequency (six to eight times) of application. Important best practices for chemical control of cynodon include summer application of glyphosate 360 g a.i. L⁻¹ (8L ha⁻¹ plus adjuvant), or paraquat 200 g a.i. L⁻¹ (1.5-3 L ha⁻¹) plus diuron 800 g a.i. L⁻¹ (2.5 L ha⁻¹), or, most recently, Arsenal® (4 L ha⁻¹) for verge control.

A particularly effective vehicle for the dissemination of Fastac® research findings was extension specialists, who promote adoption of technology generated by SASRI. They identified the need for aerial application. In response, SASRI conducted trials which resulted in the registration being extended to include aerial application. To promote adoption of the new practice, the North Coast extension specialists monitored the use of Fastac® on a commercial scale. Surveys showed that eldana levels on average were reduced from 24 to 5 larvae /100 sugarcane stalks over three years. In 2008 adoption of Fastac® by growers with more than 10 000 ha sugarcane ranged from 30% to 90%, depending on the cutting cycle.

For Arsenal®, initial research (six trials) established rates (0.8 L⁻¹ ha⁻¹) and duration (9 months) for 95% control of cynodon. Five demonstration verge control trials and three in-field trials were conducted during 2007/2008. RESULTS were presented by the researcher, extension specialists and BASF South Africa at seven grower days during 2008. Since Arsenal® is already registered for use in areas including servitudes, the immediate adoption at 4L ha⁻¹ for verge control of cynodon has been promoted. Significant amounts of Arsenal® have been sold this first season for cynodon control on verges.

Because of the seriousness of eldana and cynodon, and the efficacy of these products, a potential problem was that adoption might precede finalized research findings. To mitigate this risk, extending registration to aerial application of Fastac® was rapid, timely and successful. For Arsenal®, use restrictions and warnings of in-field use to the growers have been emphasised by research and extension specialists, BASF South Africa and the suppliers of the product.

CONCLUSIONS

It is concluded firstly, that the communication of Fastac® and Arsenal® best practices via demonstration areas, grower days, and exploiting the strong co-operation between research, extension, and an agrochemical company has successfully promoted a rapid and successful adoption of these new practices. Secondly, potential risks associated with the products were mitigated through this co-operation. The aim is good stewardship, allowing for the judicious, legal, appropriate, and responsible use of agrochemicals in the industry.

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Keywords: alpha-cypermethrin, *Cynodon dactylon*, *Eldana saccharina*, imazapyr, technology transfer

NEAR INFRARED CALIBRATION MODELS FOR SOUTH AFRICAN TRITICALE (X *Tritosecale* WITTMACK) CULTIVARS

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INTRODUCTION

Triticale (x *Tritosecale* Wittmack), the first cereal grain to be produced by humans by a deliberate action, is a cross between durum wheat (*Triticum durum* sp.) and rye (*Secale* sp.) (Ammar *et al.*, 2004). It exhibits several advantages when compared to wheat, including resistance to drought and other adverse environmental and soil conditions (Ammar *et al.*, 2004). As a result of these characteristics, triticale could expand into marginal lands, thereby providing farmers with an additional cropping option and greater alternatives for production (Mergoum *et al.*, 2004). This makes it a very promising cereal crop for the 21st century, especially considering the impending worldwide grain shortage. Due to limited information available regarding the compositional and functional quality of South African triticale cultivars, we carried out research investigating a number of commercial cultivars and breeding lines for a range of quality traits. These results were subsequently used for the development of near infrared (NIR) spectroscopy calibration models.

MATERIALS AND METHODS

Five cultivars from each of five different localities in South Africa were evaluated over two growing seasons for protein, moisture and ash content, as well as the α -amylase activity, gluten strength and grain hardness using conventional AACC approved methods (reference methods). The samples were subsequently scanned using the Büchi NIRFlex N-500 (Büchi Labortechnik AG, Flawil, Switzerland) and the Bruker MPA Bruker Optics GmbH, Germany) Fourier transform NIR spectrophotometer. The obtained reference and spectral data was used to develop calibration models using Unscrambler (Version 9.2, CAMO, Oslo, Norway) and OPUS (Version 6.5, Bruker Optics GmbH, Germany) software.

RESULTS AND DISCUSSIONS

For the developed calibration models, R^2 values of between 0.25 and 0.73 were obtained for the quality traits. Corresponding standard errors of prediction (SEP) values ranged from 0.11 – 5.09, and ratio of standard error of prediction to standard deviation (RPD) values were between 1.27 and 2.05. Based on the latter results these calibrations would be adequate for screening in a breeding program. It is expected that with the addition of data from subsequent harvest seasons, preferably with a range falling outside that of the current model, the R^2 , SEP and RPD values will improve, resulting in improved calibrations.

CONCLUSION

This paper reports the first NIR calibrations for flour quality attributes for South African triticale. The best calibrations were for protein, moisture and hardness. These calibrations will provide an early screening tool for the breeding program. Further work is required, including expansion of range in reference values and growing environments, to improve the calibrations for sedimentation and ash, before these could be used for breeding selections.

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Keywords: triticale, quality, NIR

DIFFUSION OF CONDITIONING WATER IN SINGLE WHEAT KERNELS: EVALUATION BY NIR HYPERSPECTRAL IMAGING

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INTRODUCTION

Near infrared (NIR) spectroscopy is a single point spectroscopic method where the NIR region (700–2500 nm) of the electromagnetic spectrum is utilised (Miller, 2001). NIR hyperspectral imaging is a novel technique which provides a chemical map of the obtained sample imaged. Thus the chemical information and distribution of chemical compounds present are both captured (Grahn & Geladi, 2007).

Conditioning, a pretreatment for milling wheat grists, consists of rapid saturation of the pericarp with water, followed by equilibration throughout the grain which can take hours (Hoseney, 1994). The conditioning process prepares wheat for the milling, by strengthening the bran layer and softening the wheat endosperm (Hoseney, 1994).

Conditioning depends on the protein content of the wheat kernel, endosperm structure, wheat hardness, mealiness and the grain moisture content as all of these characteristics influence the rate of moisture penetration into the kernel (Bass, 1988).

This study aimed to evaluate the diffusion of conditioning water into different wheat types (soft, bread, durum) by means of near infrared (NIR) hyperspectral imaging which allowed for a quick overview of water diffusion into the wheat kernel.

MATERIALS AND METHODS

Whole wheat kernels of three different hardness classes were conditioned to 15% moisture content.

The experimental design used the categorical variable wheat type (soft, bread and durum) and the continuous variable conditioning time (0, 3, 6, 9, 12, 17 hours). For each conditioning time, the same wheat kernels were reused and NIR hyperspectral images were obtained using an Spectral Dimensions NIRmatrix InGaAs camera (Malvern Instruments Ltd., UK). The transformation to absorbance used Spectralon reflectance standards and the ISys (v.4.0) software. Evince v.2.0.18 software (UmBio, Umeå, Sweden) was used for image cleaning (removing background, shading, dead pixels, specular reflection) on principal component analysis (PCA), score plots and score images. Cleaned images were further subjected to exploratory interactive multivariate analysis (Evince v.2.0.18) using PCA.

RESULTS AND DISCUSSION

Principal component (PC) 1 showed an average score image without significant chemical detail. Clustering in PCs 2 and 3 indicating water presence in the kernels (17 hours) and this was confirmed by the study of loading line plots. It was confirmed in the score images that water permeates more quickly into soft wheat than into harder and more vitreous wheat.

CONCLUSION

PCA was found to be an effective tool for data exploration, identification and classification of clusters in tracking conditioning water equilibration into a wheat kernel. PC2 explained the variation due to the chemical difference in durum, bread and soft endosperm, as well as water bound to endosperm. It was expected that water diffusion into soft endosperm would happen quicker than in bread or durum endosperm; this could be seen in the classification image. Loading line plots assists in explaining the movement of conditioning water into the wheat kernels of different hardness at different rates.

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Keywords: Near infrared hyperspectral imaging, wheat conditioning

CROPPING SYSTEMS AND MANAGEMENT PRACTICES BY SMALLHOLDER FARMERS IN ZANYOKWE IRRIGATION SCHEME, EASTERN CAPE PROVINCE

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INTRODUCTION

There is general agreement in irrigation literature that smallholder irrigation schemes in South Africa have performed below expectations with regards to improving incomes and sustaining the livelihoods of smallholder farmers. The poor performance has been largely attributed to socio-economic and design factors. However, little or no attention has yet been given to the management practices by farmers, which might also contribute to the poor performance. In addition, most studies on smallholder irrigation have relied on farmer interviews and have failed to explain the relationship between many of the factors cited and the observed low level of crop performance. A monitoring study was therefore conducted to investigate crop management practices by smallholder farmers.

MATERIALS AND METHODS

The study was conducted from the 2005 summer season to the 2008 winter season in Burnshill and Lenye villages of Zanyokwe irrigation scheme in the Eastern Cape province of South Africa. The sample size was 20 farmers, representing 39% of the 51 farmers in the scheme. Zanyokwe is about 560 ha in size and the average land size per farmer is 4.2 ha. The farmers use sprinkler irrigation. Visits were made to the scheme on a fortnightly basis to collect records on cropped area, cultivars, fertilizer levels, plant stands, weed and water management and yield.

RESULTS AND DISCUSSION

Farmers do not fully utilize their land resulting in low cropping intensities averaging 43.5%. This is 22 to 29% of the potential of 150 to 200% in the area. Weed management was the most important factor limiting productivity of main crops (maize and butternut). The problem of weeds in butternut is worsened by the absence of registered herbicides that can be used and farmers have to rely exclusively on hand weeding. Farmers tend to plant their maize from November until as late as mid-March while crop stands achieved in maize average 25 880 plants ha⁻¹ which is far below the potential of 40 000 to 90 000 plants ha⁻¹ possible under irrigation depending on cultivar. Farmers apply low rates of fertiliser, with an average of 47.6 kg N ha⁻¹ for maize, which is about 22% of the recommended rate. Farmers observe condition of soil and plants to determine when to irrigate, leading to over- or under-irrigation depending on crop stage. Different stand pipe lengths and sprinklers and uneven nozzles are sometimes found in single laterals, thereby reducing the efficiency of the system. Average yields obtained by farmers are 2.4 t ha⁻¹ for maize and 6 t ha⁻¹ for butternut, which are far below potential of 7 – 12 t ha⁻¹ for maize and 20 to 30 t ha⁻¹ for butternut.

CONCLUSION

The study indicated that smallholder farmers lack basic technical skills pertaining to irrigated crop production. The poor performance of smallholder irrigation in South Africa is partly as a result of poor agronomic management practices by farmers. The growing scarcity of water in South Africa means that increasing water productivity (water-use efficiency) in irrigated agriculture is of paramount importance. The Department of Agriculture should launch “back to basics” training programs to farmers in the areas of crop and irrigation water management practices as part of the ongoing revitalization of smallholder schemes in the country.

ACKNOWLEDGMENT

This work was funded by the Water Research Commission through WRC Project No K5/1477//4.

Keywords: smallholder irrigation, farmers, poor management

EFFECT OF DIFFERENT SOIL CULTIVATION PRACTICES ON SOIL TEMPERATURE IN THE 0-200 MM SOIL LAYER OF A MEDIUM TEXTURED VINEYARD SOIL

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INTRODUCTION

Mulches reduce overall mean soil temperature (Hartley & Rahman, 1997) and seasonal variation (Wooldridge, 1992). Soil temperatures between 15 °C and 30 °C are beneficial to soil organisms, which increases the release of nitrate (McNab & Dick, 1995). The effect soil management on soil temperature needed clarification.

MATERIALS AND METHODS

The trial was conducted from April 1993 to March 1999 on a medium textured soil in a four year old Chardonnay/99 Richter vineyard near Robertson (33°50'S, 19°54'E). Five soil cultivation treatments, namely (1) chemical control in the vine row (CCV) and mechanical control in the work row from bud break (early September) (2) No cover crop, full surface chemical control from bud break (FCC) (3) full surface straw mulch and FCC (4) a winter growing grain annual sown in the work row and FCC, as well as (5) a perennial grass sown in the work row and CCV were applied. Temperature sensors were placed at a depth of 200 mm in both the vine row and the work row. The temperatures (°C) were monitored from April 1995 to March 1999 on an hourly basis (MCS 120EX data loggers) on two replications per treatment.

RESULTS AND DISCUSSION

From mid-September to end of March the soil temperature in the vine row of the mulched soil was between 1 °C and 3 °C cooler than that of the bare soil. From the end of December to early February the soil temperature in the vine row of the bare soil exceeded 25 °C. The soil temperatures in the vine row were below 15 °C from late May until 8 September and 16 September for the bare and mulched soil, respectively. Except for a small period in November, the lowest temperature was observed in the work row of the soil covered with a straw mulch and never exceeded 25 °C. The soil temperature of the treatment in which the weeds were controlled chemically from bud break frequently exceeded 25 °C in the work row from the end of November to early March. This also occurred in the mechanically cultivated work row from late December to mid-March, as well as in the treatments with a permanent and winter cover crop from the beginning of January to mid-February. The soil temperature in all the treatments, with the exception of the straw mulch, exceeded 15 °C in the work row during the second week of September. This was observed in the straw mulch treatment during the first week of October.

CONCLUSION

Although a mulched soil takes between one and three weeks longer to reach temperatures conducive to soil organism activity during early summer than soils subjected to other management practices, it protects the grapevines against high soil temperatures that may hamper grapevine performance from berry set.

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Keywords: Soil temperature

EVALUATION OF SUMMER COVER CROPS FOR RAINFED SMALLHOLDER CROPPING SYSTEMS OF THE EASTERN CAPE PROVINCE

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INTRODUCTION

Conservation agriculture (CA) is being promoted in the Eastern Cape to address problems of soil erosion of arable and grazing lands. The introduction of cover crops through conservation agriculture is therefore an important option for sustainable crop production. Cover crops that can produce large amounts of biomass (dry matter) and suppress weeds need to be selected for the challenging rain-fed conditions of the Eastern Cape. The objective of the study was to evaluate summer cover crops for biomass and weed suppression in maize based smallholder cropping systems.

MATERIALS AND METHODS

The trial was conducted at Fort Hare Research Farm (UFH) (32°46' S, and 26°50' E) and Musobombvu (MSBV) (32°44' S, and 26° 55' E) village under rainfed conditions. Five summer cover crops i.e. cowpea (*Vigna unguiculata*), dolichos lablab (*Dolichos argenteus*), sunnhemp (*Crotalaria juncea*), buckwheat (*Fagopyrum sagittatum*) and forage sorghum (*Sorghum bicolor*) were evaluated with a bare-fallow treatment as control. The trial was laid in randomized complete block design replicated three times. Cover crop dry matter (DM), and weed counts and dry matter were measured at two weeks intervals.

RESULTS AND DISCUSSION

Rainfall received at both sites was above the long term seasonal average of 413 mm. Forage sorghum significantly accumulated the highest DM ($p < 0.05$) of 9.5 t ha⁻¹ at UFH and 8.2 t ha⁻¹ at MSBV, than other cover crops. Only forage sorghum accumulated higher than 6 t ha⁻¹ DM, considered the minimum biomass level for success of conservation agricultural systems. Sunnhemp produced DM of 5.4 and 5.7 t ha⁻¹ at UFH and MSBV respectively whereas cowpea produced final biomass of 4.5 t ha⁻¹ at both sites. Buckwheat and dolichos produced 4.1 t ha⁻¹ and 3.9 t ha⁻¹ respectively at UFH. At MSBV, buckwheat and cowpea produced DM of 4.8 t ha⁻¹ and 4.7 t ha⁻¹ respectively, whereas dolichos produced the lowest DM of 3.9 t ha⁻¹. There were no significant ($p > 0.05$) differences with respect to final weed species number at UFH. At MSBV, forage sorghum resulted in significantly lower weed species numbers ($p < 0.05$) than other cover crops. This was probably as a result high biomass production which influenced more competition against weeds for nutrients and moisture. Sunnhemp and buckwheat resulted in the highest number of weed species which were not different ($p < 0.05$) to the bare fallow. Cover crops had significantly lower ($p < 0.05$) weed DM than the no-cover crop plots at both sites. At UFH dolichos had significantly the highest ($p < 0.05$) final weed DM, whereas the other cover crops did not differ ($p > 0.05$). There were no significant differences ($p > 0.05$) across cover crop species with respect to final weed DM at MSBV.

CONCLUSIONS

Forage sorghum can be used as a cover crop for high biomass production under rainfed conditions. Forage sorghum offer opportunities for weed suppression which other cover crops also achieved despite having produced low biomass levels. Follow up studies need to consider the degradation of the cover crop residues for purposes of nutrient cycling and moisture conservation.

Keywords: Conservation agriculture, dry matter, weeds

THE EFFECT OF PLANTING DATE, INTERCROPPING STRATEGY AND COVER CROP SPECIES ON WEED DYNAMICS, COVER CROP DRY MATTER, AND MAIZE YIELD UNDER DRYLAND CONDITIONS OF THE EASTERN CAPE

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INTRODUCTION

The Eastern Cape faces challenges in maintenance of soil cover. Identification of appropriate cover crops and rotations is important to address soil degradation problems in small-scale farming systems. One challenge to the introduction of cover crops is to find strategies that do not compromise production of staple cereals on limited landholdings. Intercropping offers the opportunity to grow both staple foods and cover crops. The objective of this study was to determine the interactive effects of planting date, intercropping strategy and cover crop species on weeds, cover crop dry matter and maize yield in small-scale farming systems in the Eastern Cape.

MATERIALS AND METHODS

The study was carried out at the University of Fort Hare Research Farm located at a latitude of 32°46' S, and longitude 26°50' E, with an altitude of 508 m near Alice Town. The trial was laid out as a 2³ factorial arranged in a split-split plot design. Main plot factor was cover crop planting date where the cover crop was planted either simultaneously with maize or two weeks later. Sub-plots had strip intercropping and between-row intercropping and sub-sub-plots had cover crop species, Dolichos lablab (*Dolichos argenteus*) and Cowpea (*Vigna unguiculata*). Sole maize and sole cover crop plots (controls) were planted at the same time with intercropped maize. Weed counts and dry matter (DM), cover crop DM and maize DM were measured at two weeks intervals.

RESULTS AND DISCUSSION

Interaction effects of planting date x intercropping strategy x cover crop species with respect to weed counts and DM, cover crop ground cover and DM and maize DM were not significant ($p > 0.05$). Planting date significantly affected weed DM ($p < 0.05$) 42 days after planting (DAP). Weed DM was reduced by 29 % with simultaneous planting relative to delayed planting of the cover crop. Simultaneous planting of cover crops with maize could result in early weed suppression and alleviate weeding efforts by small-scale farmers. Cow pea and Dolichos lablab had similar effects on weeds.

The main effect of planting date significantly ($p < 0.05$) affected cover crop DM. Simultaneous planting resulted in a DM yield of 3.9 t ha⁻¹ whilst delayed planting produced 0.8 t ha⁻¹. Dry matter yields from simultaneous planting however, fell short of the six ton norm for conservation agricultural systems possibly because of competition for moisture under dry-land conditions. Significant ($p < 0.05$) differences existed across cropping systems with respect to maize partial land equivalent ratios (PLERs) and grain yield. Between-row intercropping resulted in a 40% depression in maize PLERs and grain whereas strip intercropping was comparable to the sole maize control (average yield of 2.7 t ha⁻¹).

CONCLUSIONS

Strip intercropping offer the opportunity to introduce cover crops without compromising maize grain yield under rainfed conditions.

Simultaneous planting of cover crops with maize can enhance total crop biomass and improve weed suppression than delayed planting.

Further studies need to assess the overall success of these systems where maize stover is retained, together with monitoring of soil moisture.

Keywords: Conservation agriculture, interaction, cropping system, PLER

FUNGAL DIVERSITY AND VARIATION IN NEMATODE POPULATIONS AS A MEASURE OF SOIL IMPROVEMENT IN THE DEVELOPMENT OF A NEW BIOLOGICAL FARMING SYSTEM

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INTRODUCTION

Biological farming methods present a viable means of producing high quality, nutrient-rich produce without the use of inorganic fertilizers or pesticides. The availability of phosphorous and calcium, in combination with an active and diverse soil microorganism population, is essential in developing and maintaining productive and sustainable plant growth. Despite this, most agricultural practices such as continuous cultivation, over-reliance on pesticides, and excessive application of conventional fertilizers hinder the availability of these nutrients and have a negative impact on the size and diversity of the microbial population in the soil. The development of nematode and soil microbe populations were monitored to determine any improvement in soil structure and health at the trial site.

METHODS AND MATERIALS

Soil samples were collected randomly in each trial area at a depth of 15-20 cm and analysed for eggs, larvae and adults as well as for the presence/absence of predatory (saprophytic) species. Soil samples were also collected for the analysis of the development of soil microbe populations in composted and non-composted areas. The trial sites were the same as for the nematode samples. Standard microbiological methods for bacterial and fungal culture were employed. Samples were collected and analysed on a quarterly basis for nematodes and soil microbes.

RESULTS AND DISCUSSION

The results of the nematode analysis in areas not yet planted to crops indicated that nematodes were present in all areas sampled. The most significant finding was the fact that saprophytes were detected in the composted areas over time compared with no saprophytes at the beginning of the trial. A range of lifecycle stages was detected for various species over the trial period. Soil samples for nematode analysis were collected in a tomato trial, in both the composted soil areas as well as in the non-composted areas. Saprophytes were detected in both samples, with three times more saprophytes being detected in the composted soil compared with the non-composted soil indicating that the composting process appeared to promote the population of these beneficial organisms.

Soil bacteria were detected at all trial sites at the start of the trial, however, fungi were only present in the composted sites and at extremely low densities. Fungal diversity increased markedly over the time period under investigation (9 months) and was higher in the composted sites than the non-composted sites.

CONCLUSIONS

Within 6 months, fungal populations and diversity increased significantly in the composted trials sites. An increase in soil microbes provided an indication that the soil structure and health started improving thereby encouraging the build-up of soil fertility through microbial recycling of organic matter and nutrients. Furthermore, although pathogenic nematodes species were present at the trial site, saprophytes also became established, particularly in the composted sites. In the tomato trial, although infected with nematodes, the plants' roots were able to outgrow the nematodes, and productivity could be maintained.

Keywords: biological farming, fungi, nematodes, soil

CONTROL OF *Botrytis cinerea* IN ROSA CV. GOLD STRIKE BY MEANS OF CHEMICAL POSTHARVEST DIPS AND SO₂ TREATMENT

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INTRODUCTION

Botrytis cinerea is a major post-harvest disease in a variety of ornamentals, including roses. *B. cinerea* negatively impacts on the visual appearance of the flower, whilst collapsing of the flower significantly reduces vase life. Disease symptoms occur as necrotic lesions on the flower buds within 24 hours after harvest at temperatures of 18-25°C and high humidity (above 93%) or in the presence of a thin layer moisture, such as when condensation occurs. Control of *Botrytis* can be achieved by sanitation, chemical control or cultural practices. However, often the efficacy of pre-harvest fungicide applications is limited by suboptimal spray conditions, or when flowers which may be closed at the time of treatment, are harvested before the next spray.

Fungicide treatments applied as a post-harvest dip may offer an additional method for *Botrytis* control during the storage, transport and vase life period. This study aims to evaluate a range of fungicides for their suitability as post-harvest dips, as well as SO₂ sheeting, for its efficacy to control *Botrytis* under wet or dry transport conditions.

MATERIAL AND METHODS

Six hours after harvest, commercially grown stems of *Rosa* cv. 'Gold Strike' were treated with one of the following post-harvest sprays: control (no spray), distilled water, Teldor (Fenhexamid), Switch (Cyprodinil & Fludioxonil), Polar, Rovral (Iprodione), Biotexx (a biocide) or wrapped in SO₂ sheeting (Uvasys). Immediately following treatment, stems were sleeved into bunches of 10 roses per treatment, with 10 replicate bunches per treatment. Within a treatment, five bunches were either transported vertically with their bases in water containing Vitabric (sub-treatment A) or horizontally, dry, and in transport cartons (sub-treatment B). Following overnight transportation at 8°C, the roses were re-cut and re-hydrated, after which they were kept under retail conditions (20°C, full light). Daily assessments started on the 'sell-by-date' (day 6 after harvest) and included the monitoring of flower- and foliage quality, prevalence of *Botrytis* and the cause of vase life termination of each individual stem.

RESULTS

Vase life was significantly extended for stems dipped in Teldor and Switch, with stems treated with Uvasys sheets or dipped in Bioxx showing the shortest vase life. The average day of first rose removal was earlier on the wet transported stems compared to dry transported stems. Serious incidences of *Botrytis* was recorded more frequently on the wet transported stems than dry transported stems, especially in the control, distilled water dip, Polar and Bioxx treatments. Stems treated with Switch of both wet and dry transported sub-treatments showed the best quality foliage throughout the evaluation. SO₂ sheets caused the flowers and foliage to bleach thereby promoting *Botrytis* infections.

DISCUSSION

Treatment with Teldor extended the vase life of 'Gold Strike' 10 days beyond the 'sell-by-date'. Stems treated with Switch had a lower flower vase life, although the foliage quality was still optimal. The use of SO₂ sheets, as an alternative treatment to a chemical post-harvest dip, requires more product development to avoid or prevent bleaching of the petals and foliage.

CONCLUSION

Fungicide dips with Teldor or Switch show promise for controlling *Botrytis* post-harvest in 'Gold Strike'. The use of safer, more economical and environmentally friendly alternatives for disease control in cut roses should receive more attention in future research.

ACKNOWLEDGEMENTS

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Keywords: *Rosa*, *Botrytis cinerea*, post-harvest control, fungicides, sulphur dioxide sheets

EFFECT OF PLANTING DATE, PLANT DENSITY AND CULTIVARS ON GROWTH PARAMETERS OF SHORT AND ULTRA-SHORT GROWTH PERIOD MAIZE CULTIVARS

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INTRODUCTION

In general, yield reduction in most dryland maize growing areas of South Africa occur because seasonal rainfall distribution is erratic with annual variation that cannot be predicted accurately. Cultivar selection, planting date and plant density are other factors that consistently affect maize yield. Long growing season maize cultivars are higher yielding, particularly under conditions of good moisture and nutrient supply. However, as both moisture and nutrient availability becomes more limiting, yield tends to decline. Short growing season maize cultivars could yield more than long season counterparts because they can maximize the growing season and potentially reach the critical flowering stage before traditional midsummer droughts occur. However, there has been no previous effort to evaluate the effects of planting dates and plant densities on yield and yield components of these short and ultra-short growth period maize cultivars. This prompted research in the 2004/05 growing season.

The aim of the study was to evaluate the response of short and ultra-short growth period maize cultivars to planting dates and plant densities at two localities with distinct environmental conditions. The effects of planting date, plant density and cultivar on leaf area index, dry matter accumulation and plant height were investigated.

MATERIALS AND METHODS

Two field experiments were conducted under dryland conditions at two selected areas (Bethlehem & Potchefstroom) in the "Maize Triangle" of South Africa. At both localities, the experimental design was a randomized complete block (RCB) in split-plot arrangement, with three replications. Three planting dates (early, optimum and late) served as main plot treatment. Three planting densities (low, optimum and high) were assigned as subplot treatments and on sub-subplots there were five cultivars: ENERGY (hybrid, ultra-short cultivar), DKC63-20 (hybrid, ultra-short cultivar), PAN6017 (hybrid, short-cultivar), PHB3203 (hybrid, ultra-short cultivar) and SAM 49 (open-pollinated, short-cultivars). The growth parameters measured were; leaf area index, dry matter yield and plant height.

RESULTS AND DISCUSSIONS

At both localities, leaf area index (LAI), dry matter accumulation and plant height were affected by planting date, plant density and cultivar. At both localities, leaf area index, plant height and dry matter yield were affected by planting date and plant density, with optimum planting date and optimum plant density contributing to highest yield components and yield. Cultivars, PAN6017 and PHB3203 produced the highest LAI, dry matter yield and plant height at both localities, while SAM49 produced the lowest. In general, PAN6017 was superior in terms of all plant growth parameters measured to the other cultivars at all planting dates and plant densities at both localities.

CONCLUSIONS

In general, PAN6017 produced the highest LAI, dry matter yield and plant height at both localities, while SAM49 produced the lowest. However, to generalize these findings, more research over a wider range of locations and seasons should be conducted.

In order to make findings from a study such as this applicable to the "Maize Triangle", more research on short and ultra-short growth period maize cultivars should be conducted over a wider range of locations and seasons.

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Keywords: Leaf area index, dry matter yield, plant height

NITROGEN MANAGEMENT STRATEGIES FOR LUCERNE (*Medicago sativa*) OVER-SOWN WITH ANNUAL RYEGRASS (*Lolium multiflorum*) IN THE SOUTHERN CAPE: PRELIMINARY RESULTS

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INTRODUCTION

Lucerne (*Medicago sativa*) dry matter production ($\text{kg DM ha}^{-1} \text{ day}^{-1}$) in the southern Cape, is characterized by a steep decline during the cooler winter months. Over-sowing lucerne with annual Westerworld ryegrass (*Lolium multiflorum*), in the Riversdale area during March and April resulted in an increase in dry matter production, however, the dry matter production was lower compared to pure ryegrass pastures. Application of fertiliser nitrogen results in increased ryegrass dry matter production. The effect of fertiliser N application on a lucerne/ryegrass mixture is however not well defined. The objectives of this study are: 1) to evaluate the effect of fertiliser N application during the cool seasons on the dry matter production of lucerne over-sown with a Westerworld ryegrass and 2) to develop N fertiliser norms for lucerne over-sown with Westerworld ryegrass during autumn and winter.

MATERIALS AND METHODS

A suitable stand of established lucerne (cv. Aurora) was identified at the Oakdale Agricultural High School, Riversdale. The experiment was laid out as a randomized complete block design. Treatments were replicated four times.

To facilitate grazing, a plot size of 15 x 15 m was chosen. After the lucerne was grazed (diary cows) to a residual height of $\pm 50\text{mm}$, Westerworld ryegrass, cv. Energa, was seeded (sown by hand or drilled using a fine seed planter) at a rate of $20 \text{ kg seed ha}^{-1}$. The ryegrass was allowed 35 days to germinate and establish, where after the pasture was grazed (referred to as the first re-growth cycle after over-sowing). Five fertiliser N levels (0, 20, 40, 60 and 80 kg N ha^{-1}) were applied after each grazing, during the period April to August. Dry matter production (kg DM ha^{-1}) and pasture composition (% ryegrass and lucerne) was determined before each grazing.

RESULTS AND DISCUSSIONS

Dry matter production

Preliminary results for the 2007 and 2008 seasons showed a relatively low increase in dry matter production as a result of fertiliser N application. Various 80 kg N ha^{-1} treatments resulted in slightly lower yields compared to the 60 kg N ha^{-1} levels, suggesting a suppressive effect on pasture productivity as a result of too high fertiliser N levels.

Pasture composition

Although the hand sown treatments resulted in higher grass content during the second regrowth cycle, the drilled treatments usually resulted in higher grass content during the later regrowth stages during late winter and early spring. Mean ryegrass dry matter content also tended to increase as the season proceeded to re-growth cycles two to four, possibly an accumulative effect of ryegrass development and fertiliser nitrogen carry-over at the higher N rates. Increased fertiliser N rates resulted in lower lucerne contents in the pasture during the cooler months.

CONCLUSIONS

- The drilled treatments usually resulted in higher grass content compared to the sown treatments. The possible reason is that the more favorable conditions created by drilling, resulted in stronger grass seedlings.
- Nitrogen fertiliser application did not dramatically increase pasture dry matter production. It is possible that high soil nitrogen contents as a result of nitrogen mineralisation may contribute to the lack of pasture response to nitrogen fertiliser application.
- The data collected suggests that nitrogen application rates between 40 and 60 kg N ha^{-1} could be applied to increase pasture dry matter production during the cooler seasons.

ACKNOWLEDGMENT

Oakdale Agricultural High School (Riversdale) for the research facility.

Keywords: dry matter production, pasture composition

ASSOCIATION BETWEEN SEASONAL CLIMATIC TRENDS CONTRIBUTING TO RWA, *Diuraphis noxia* (KURDJUMOV) OCCURRENCE IN WHEAT IN THE EASTERN FREE STATE

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INTRODUCTION

Sporadic reports of RWA damage were received from localized areas in the central Free State in 1996 and eastern Free State in 1998. Both years exhibited a wet summer followed by a mild winter. After widespread reports of RWA in the eastern Free State in 2005, scientists anticipated a new RWA biotype but also suspected favourable climatic conditions contributing to the outbreak. Although the existence of a new RWA biotype (RWASA2) has since been confirmed, accompanying climatic trends for 2005 and the preceding seasons are investigated and reported in this poster presentation.

MATERIAL AND METHODS

Wheat field trials were planted at Bethlehem (2003 to 2006), Glen (2004), Ladybrand (2003) and Qwa-Qwa (2005 and 2006). Climatic data for the localities were sourced from the ARC-Small Grain Institute weather station (Bethlehem locality), AgroMet section of the ARC-Institute for Soil, Climate and Water in Pretoria (Qwa-Qwa locality) and the SA Weather Service's historical database (Glen, Clocolan, and Ficksburg localities). No data exists for Ladybrand and rainfall and temperature from Clocolan and Ficksburg respectively was used as substitution. Long-term data for Bethlehem was obtained from the ARC-SGI weather station and for Glen from the SA Weather Service's historical database.

In order to distinguish between above normal, normal and below normal conditions in the pre-seasons and in-seasons for 2003 to 2006 categories were established by applying the 1999 to 2003 averages for Bethlehem and Glen as mean standards. Rainfall deviations of more or less 50mm and temperature deviations of 1°C for minimum and maximum temperatures were used to distinguish between categories.

RESULTS AND DISCUSSION

Percentage Russian wheat aphid infested tillers were very high to medium at Bethlehem and Ladybrand (2003) and Bethlehem and Glen (2004). Rainfall during the pre- and in-seasons in both years was below normal and minimum and maximum temperatures were generally normal to above normal. Infested tillers in 2005 and 2006 were generally low to high at Bethlehem but high to very high in Qwa-Qwa. Rainfall during the pre-seasons and in-seasons in both years was normal to above normal but minimum temperatures were generally warmer and maximum temperatures cooler.

CONCLUSIONS

Moisture and heat stress in wheat is conducive to RWA population development and consequent plant injury resulting in grain yield loss. Two important conclusions emerging from the results are that during 2003 and 2004 below normal rainfall and above normal maximum temperatures occurred. The drier conditions will have reduced growth vigour in wheat and higher temperatures affected RWA life cycles by increasing aphid population size and rate of development. Secondly, RWA infestations was very high during the 2003 and 2004 seasons characterized by abiotic stresses except for the 2006 season in Qwa-Qwa. The very high infestation in Qwa-Qwa in 2006 may be the result of population development dynamics for RWA.

Keywords: Russian Wheat aphid, Climatic trends, Dryland wheat, Host plant resistance

ADDITIVE MEAN EFFECTS AND MULTIPLICATIVE INTERACTION ANALYSIS OF MAIZE YIELD TRIALS IN SOUTH AFRICA

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INTRODUCTION

Dryland maize production in South Africa varies considerably from year to year, depending on the amount and distribution of rainfall. Where environmental conditions vary considerable, genotype x environment interactions (GEI) may also be expected to be greater. As a result it is not only average performance that is important in genotype evaluation programs but also the amount of the interaction. The presence of GEI is of major concern to plant breeders, since large interactions can reduce yield and complicate identification of superior genotypes.

Assessment of the stability and adaptability of a genotype to different environments is useful for cultivar recommendations and should be a requirement in breeding programs. Consequently, selection procedures based on the mean yield of cultivars in a given environment are less efficient. Multi-location yield trials are conducted with many genotypes grown in a number of environments and usually play an important role in plant breeding and agronomic research. The total sum of squares (SS) for the yield data can be partitioned into three general sources: the genotype main effect, the environment main effect, and the GEI. Main effects are additive, and the interaction non-additive. The Additive Mean effect and Multiplicative Interaction method,(AMMI) which combine analysis of variance and principle components analysis into a unified approach can be used to analyze multi-location trials. The objective of this study was to determine the yield performance and stability of different maize genotypes in different regions of South Africa by using the AMMI statistical model.

MATERIAL AND METHODS

Thirty five maize hybrids were evaluated over 98 environments for genotype x environment interaction (GEI) and yield stability under dry land conditions during the 2003 to 2006 seasons in South Africa. An analysis of variance (ANOVA) was performed on the yield data of each individual trial. The main effects in the additive part of the AMMI model are analysed using ordinary ANOVA. The AMMI) statistical model was used to describe the GEI, yield stability and adaptation to certain environments.

RESULTS AND DISCUSSION

The AMMI statistical model has shown to be effective in understanding complex GEI's in the national cultivar trials. The AMMI 2 combined analysis of variance (ANOVA) indicated highly significant differences among hybrids and environments as main effects. The environment and GEI contributed more towards the total variation. CRN 3604 and PAN 6611 were the most stable hybrids in the eastern region while PAN 6966 and PAN 6146 were the most stable hybrids in the western region. DKC 80-12B and DKC 80-10 were the best adapted hybrids for high potential environments in the eastern region while DKC 78-15B and DKC 80-12B were the best adapted hybrids for high potential environments in the western region. Caracal and to lesser extend Saffier were the best adapted hybrids for low potential environments in both the eastern and western regions.

CONCLUSIONS

Tested maize hybrids performed differently under different environmentsdemonstrating the high influence of environments on the yield of maize. Plant breeders, agronomists and producers can easily select from a biplot those entries that are high yielding and stable and also those entries that yield well in specific environments.

AMMI Stability Value, derived from the AMMI model would be the most appropriate method to measure the yield stability of specific genotypes.

Keywords: AMMI model, genotype x environment interaction, maize hybrids

EFFECT OF ARTIFICIAL SUBSTRATES ON THE NUTRITIONAL AND CHEMICAL COMPOSITION OF CULTIVATED SHIITAKE MUSHROOM (*Lentinula edodes*)

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INTRODUCTION

Lentinula edodes (shiitake) is the second most popular edible mushroom in the world because of its flavour, taste, and quality. Furthermore, shiitake is best known to possess medicinal properties. These properties include antitumor polysaccharides activity and glycoproteins, antiviral nucleic acids, platelet agglutination inhibitive substances, and anti-cholesterol active substances.

Shiitake can be grown on artificial logs as well as natural logs. Different substrate formulations have been developed in different countries, depending on the availability of raw materials. Growers generally select best and the least expensive, locally available crops. Agricultural wastes can be used alone or in combination with other wastes in shiitake cultivation. South Africa is known to possess a wide variety of agricultural wastes. The objective of this study was to investigate the effect of selected artificial substrates on the chemical composition and on nutrition of shiitake mushroom.

MATERIALS AND METHODS

Two independent trials were conducted at ARC-ITSC. The first trial investigated the effect of artificial substrates on the nutritional composition of cultivated shiitake mushroom. Shiitake was grown on four different substrates namely; eucalyptus sawdust (EU); pine sawdust (CP); EU + CP and corn cobs (CC) + wheat straw (WS) + EU. The other trial investigated the effect of artificial substrate on the chemical composition of cultivated shiitake mushroom. Substrates included EU, CP, EU + CP and oak sawdust (CO).

RESULTS AND DISCUSSION

Results of the trial on the effect of substrate on nutritional composition of shiitake were as follows: Energy content (KJ/100g) - CC+WS+EU (1397), CP (1366), EU (1389) and EU+P (1382). Carbohydrate content- EU+P (65.19 %), CP (63.86 %), EU (58.52) and CC+WS+EU (58.08). Dietary fibre per substrate was 39.68 % for EU, 36.14 % for CP, 33.43 % for EU+P and 33.28 % for CC+WS+EU. The study also revealed an effect of substrate on both the fat and protein contents. CC+WS+EU had the highest protein (24.10 %) and fat (0.92 %) contents followed by EU which had 23.20 % protein and 0.73 % fat. Substrates CP and EU+P had lower protein and fat content. CP had 16.50 % Protein and 0.71 % fat while EU+P had 16.10 % protein and 0.67 % fat contents.

Results from the other study gave the following results: Nitrogen content-Shiitake cultivated on substrate CO had higher N content (5.01 %) followed by CP (4.03 %), EU+P (3.98 %) and EU (2.13 %). P content was 1.07 % for CO, 0.95 % for EU+CP, 0.84 % for CP and 0.53 % for EU. The highest K content was found in CO (2.44 %), followed by EU+P (2.13 %), CP (1.86 %) and EU (1.72 %). Calcium content: CP, EU+P, CO and EU were 0.14 %, 0.06 %, 0.02 % and 0.01 % respectively. Zinc content was highest in CP (94 %) and the least in EU (49 %). CO had a zinc content of 93 % followed by EU+P with 91 %. The highest copper content (17 %) was from CO and the lowest was from EU+P with 6.0 %. CP had Cu content of 8.0 & followed by EU with 7.0 %. Fe was 99.0 % for CO, 71.0 % for CP, 54.0 for EU+P and 37.0 for EU.

CONCLUSIONS

This study indicated that substrates have an effect on both the nutritional and chemical composition of the shiitake mushroom. In order to achieve higher nutrient and chemical compositions one needs to carefully select a good substrate. Furthermore substrates made from a combination of various raw materials may produce mushrooms with better yields and quality.

Keywords: Shiitake Mushrooms, Chemical composition , Nutritional composition, Substrate

EVALUATION AND MAPPING OF THE SPATIAL VARIABILITY OF SELECTED MICRONUTRIENTS AT ZANYOKWE IRRIGATION SCHEME USING PRINCIPAL COMPONENT ANALYSIS (PCA) AND GEOGRAPHICAL INFORMATION SYSTEM (GIS)

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INTRODUCTION

Crop production in small-scale irrigation schemes is low mainly as a result of a decline in soil fertility. Most cultivated soils in South Africa are deficient in nitrogen, phosphorus and micronutrients. Understanding spatial variability of nutrients is important in order to group soils into manageable units which can then be subjected to appropriate management practices. Evaluation of spatial variability involves handling large amounts of data that may be difficult to handle using conventional statistics. Techniques, such as GIS and Principal Component Analysis, that are tailor-made for such purposes are therefore used to map soils and explain the variability.

GIS allows users to create interactive queries to analyze the spatial information, edit data maps and present the results of all performed operations (Aronoff, 1989). With the aid of the geostatistical extension, analyst, a continuous surface can be created in GIS using geostatistical interpolation culminating into the production of prediction maps (ESRI, 2007).

Principal Component Analysis allows for a simultaneous study of several independent soil parameters from many locations as a function of other experimental conditions (Fox *et al.*, 2005). The objective of this study was to evaluate and map the spatial variability of copper, manganese, zinc and iron at Zanyokwe Irrigation Scheme (ZIS) in the Eastern Cape Province using GIS and PCA.

METHODS AND MATERIALS

A fixed 50 X 50m grid sampling method was used to collect 454 samples. The geographic coordinates of each sampling point were recorded using Global Positioning System (GPS). The samples were analyzed for EDTA-extractable copper, manganese, iron and zinc. Soil pH analysis was also done using 1:2.5 soil/ water (w/v) ratio. The sampling points were displayed in ArcMap and then mapped using Geostatistical Extension Analyst. PCA was used to further explain spatial variability.

RESULTS AND DISCUSSION

Maps showing spatial distribution of micronutrients showed deficient levels of Zn ($< 5 \text{ mg.kg}^{-1}$) and adequate but not toxic levels of manganese ($50\text{-}500 \text{ mg kg}^{-1}$), copper ($> 0.75 \text{ mg kg}^{-1}$) and iron ($5\text{-}200 \text{ mg kg}^{-1}$). Soil pH mainly ranged between 5.0 and 7.0 which is ideal for most crops. Data analysis using PCA showed that Principal Component (PC) 1 accounted for 31% of the total variance for all the measured parameters. It showed that pH (loading of 0.90) had the greatest influence among the parameters. PC 2 accounted for 21% of the total variance while copper and zinc (loading of 0.68) had the greatest influence. Soil pH was a redundant variable in PC 2 suggesting little influence on the measured parameters. PC 3 accounted for 15% with manganese having the greatest influence (loading of 0.68). The PCs accounted for 67% of total variance which suggested that there are other factors that influenced spatial variability of micronutrients.

CONCLUSION

GIS and PCA were effectively used to map and explain soil micronutrient variability at the Zanyokwe Irrigation Scheme. The surveyed area had adequate levels of Mn and Fe and Cu but was deficient in Zn. Future studies should examine effects of parent material and soil texture on micronutrient availability.

The impact of zinc deficiency on crop growth at the scheme needs to be established.

Keywords: micronutrients, spatial variability, principal components, soil pH

THE POTENTIAL NEGATIVE EFFECT OF WHEAT STRAW ON THE GROWTH OF OYSTER MUSHROOMS (*Pleurotus ostreatus*)

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INTRODUCTION

Wheat straw is used as a growing medium for producing oyster mushrooms (*Pleurotus ostreatus*). Wheat straw is said to contain growth inhibitors, such as phenolic acid, hydroxamic acid and various short-chain fatty acids. This property of wheat has potential for the management of weeds, pests and diseases (Wu *et al.*, 2001). Jobidon *et al.* (1989) demonstrated that water extracts of wheat straw inhibited propagule growth of the common forest weed red raspberry by 44%. This study used a lettuce seed bioassay to assess the potential growth inhibition of wheat straw extracts on the growth of oyster mushroom and storage of wheat straw limit some growth inhibition. Wheat straw was used for these trials due to its availability to poor rural farmers.

MATERIALS AND METHODS

The study was carried out at the ARC-ITSC, Biotechnology Laboratory. A growth chamber with 16 h light, 8 h dark and, 25 – 27 °C was used for the study. Wheat straw was boiled for an hour and the leachate was collected using Schott bottles of 100 ml. The extracts were diluted as follows: undiluted extracts; 3:1; 1:1; 1:3 and a dH₂O control. The lettuce seeds were washed using NaOCl and rinsed three times with distilled water. For the germination experiments, 20 replicates of 25 seeds were placed in petri-dishes lined with filter paper and wetted with 5 ml of extract. Placement of seeds and evaluation was performed on a laminar flow bench (Fibratron) to minimize contamination. Ethanol at 70% was used as sterilizing agent during seed placement. The germination percentage was determined every 24 h for four days and the circumference of the seedlings. The trials were repeated three times with a space of three months intervals. Trial 1 was conducted on 25.03.08, trial 2 on 23.06.08 and trial 3 on 06.10.08. Similar methods and procedures were used in all the trials, using the same batch of wheat straw. The mineral nutrients were analysed for each trial.

RESULTS AND DISCUSSION

The dH₂O control had a germination percentage of 76 after 24 h, as compared to undiluted leachate where no seeds had germinated after 24 h. The inhibition of growth with the undiluted extract was probably due to the freshness of wheat straw. It also showed by a high EC of 3686 µs/cm in Trial 1. The undiluted extract was significantly inhibited the germination of seeds from 24 h to 96 h.

The undiluted extract had germination after 48 h in Trial 2 as compared to no germination with undiluted extract in Trial 1. It indicates that the stored wheat straw begins to lose their strength of inhibition. The ageing of wheat straw had an effect in the germination or no germination of seeds. The undiluted extract shows germination after 24 h in Trial 3 as compared to Trial 1 and 2. As time progresses the wheat straw leaches out the chemical responsible for inhibiting the germination of seeds.

Both the dH₂O control and 1:3 ratio shows similar trend of growth after 24 h to 96 h. There was no growth with the ratio of 1:3; 3:1 and undiluted extract from all the hours in Trial 1. The fresh wheat straw had a strong inhibition of growth in Trial 1. The 1:1 ratio overlap the ratio 1:3 with growth from 24 h to 72 h whereas the ratio 1:3 was suppose to follow the control in Trial 2. It shows that the dilutions were weakened by ageing of the straw. The ratio 1:1 begins to overlap the 1:3 ratio after 48 h in Trial 3 as compared to Trial 2.

CONCLUSION

Wheat straw possesses compounds that can inhibit seed germination. It might important to leach out these compounds prior to inoculating with the mushroom spores. Because of this result, subsequent trial will look at growing mushrooms in wheat straw which is leached and not leached.

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Keywords: Bioassay, inhibitors, leachate, oyster mushroom, phenolic acid, wheat straw

YIELD RESPONSE OF SIX CHICKPEA GENOTYPES TO VARYING PLANTING DATES IN MPUMALANGA, SOUTH AFRICA

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the world's third most important food legume crop. It is grown in over 11m ha, mainly in Asia, Australia, North and Latin America, and Eastern and Northern Africa (FAOSTAT 2008). In South Africa, chickpea is consumed as whole grain or *dhal* and is regarded as a health-food. However, chickpea production in South Africa is currently insignificant; the entire domestic requirement is imported. Preliminary studies show a huge potential of chickpea in the dry environments of Limpopo and Mpumalanga provinces (Mathews *et al.*, 2005; Thangwana *et al.*, 2008). Nevertheless, the optimum planting date of chickpea in these dry environments has not been investigated adequately.

MATERIALS AND METHODS

A study to assess the effects of planting date and genotype on the growth and yield of chickpea was conducted at Kliplaatdrift (25° 15' 0" S, 29° 1' 48"E, altitude 1069 m), Nkangala region, Mpumalanga in 2006 and 2007. The experiment was designed as a split-plot (replicated 3 times) with date of planting (DOP) as the main plots and chickpea genotypes as the sub-plots. In 2006, the DOP were March, April and May. In 2007, the DOP were six consecutive months starting in February. Depending on seed availability, a combination of four genotypes, from a set of six, (ICCV86102, ICCV92311, ICCV92318, ICCV92944, ICCV95423 & ICCV96030) obtained from ICRISAT, was used in each season. Seeds were sown at 10cm intervals, in rows 40cm apart. Plant growth (data not provided) was assessed throughout the season while grain yield was determined at harvest maturity. Analysis of variance was performed using MSTAT-C statistical package (Michigan State University, MSTAT-C, 1983).

RESULTS AND DISCUSSION

In 2006, grain yield was greater (but non-significant) in the April (711 kg ha⁻¹) and May (877 kg ha⁻¹) plantings compared with the March planting (625 kg ha⁻¹). In contrast, in 2007 grain yield was significantly (P<0.001) greater in the May planting (662 kg ha⁻¹) compared with the March (310 kg ha⁻¹), February (435 kg ha⁻¹) and June/July (377 kg ha⁻¹) plantings. Similarly, grain yield was significantly (P<0.001) greater in the April planting (839 kg ha⁻¹) compared with the February, March and June/July plantings. The consistently low grain yields recorded in the March plantings could be attributed to low temperatures that coincided with flowering and podding of March planted crop (Singh *et al.*, 1989).

CONCLUSION

These preliminary results indicate that there could be an optimum DOP for chickpea in Nkangala region. However, the study should be conducted, over a number of seasons using more genotypes, before definite conclusions can be drawn.

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Keywords: chickpea, grain yield, planting date, growth

EFFECT OF CATTLE MANURE CURING ON WEED SEED VIABILITY IN THE LOWER ZAMBEZI VALLEY

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INTRODUCTION

Viable weed seeds have been reported to be added to the existing soil seed bank each year through in situ seed production and cattle manure. It has been reported that 75 100 weed seeds/ 1000kg of cattle manure of both narrow and broad leaves are found in cattle manure. Informal and formal surveys conducted in the Zambezi valley indicated that farmers in the area do not apply manure in their fields to improve soil fertility because they associate manure with increased weed problems in their fields. The use of kraal manure however is advantageous for improving soil fertility but cattle manure has been found to be a serious source of weeds. The objectives of the study were to determine the effect of manure curing and duration of curing on weed seed viability and nutrient release.

MATERIALS AND METHODS

Three sites were chosen in the Zambezi valley from which samples of manure were collected. Manure was heaped and pitted beside each farmer's kraal and the other lot was left in the kraal. Samples of manure were collected after each month for three months and incubated in the greenhouse. Weed seedlings were identified, counted, recorded and removed from the trays. Manure samples were then disturbed after a month to allow germination of dormant weeds.

RESULTS AND DISCUSSION

Heaping and pitting manure as curing methods have the same effect in reducing weed seed viability but it is associated with nutrient release. Seed viability of some weed species like *Urochloa panicoides* and *Eleusine indica* were reduced significantly as the duration of curing was increased from one month to three months. Kraal manure was least effective in reducing weed seed viability but was associated with a higher percentage of N-P-K nutrients after three months of curing than heaped or pitted manure. Heaping or pitting manure generates high temperature within the manure heap or pit and is accompanied by release of toxic gases such as ammonia and methane that kill weed seeds within the heap or pit. Heap size and pit depth are also important variable in determining temperatures attained within the heap or pit and therefore mortality of weed seeds within.

CONCLUSION

Heaping and pitting methods proved to be the best curing methods for reducing weed seed viability. Also, at least three months of curing are required to significantly reduce weed seed viability.

Keywords: Cattle manure, weeds, weed seed viability, seed bank

A GREENHOUSE EVALUATION OF THE EFFECTIVENESS OF COAL ASH AS AN AMENDMENT FOR ACID SOILS

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INTRODUCTION

Soil acidity is one of the greatest limitations to crop production in the world. The high cost of transporting conventional liming materials usually from distant sources has made it necessary to explore the possibilities of using more readily-available substitutes. In South Africa, 16 million hectares of land are naturally acid while on the other hand, the country's coal-fired power plants generate 28 million tons of mostly alkaline coal ash per year, the disposal of which is becoming increasingly difficult. The use of coal ash as an agricultural soil amendment solving the liming needs of local farmers may present a safe and more economical disposal option. A greenhouse experiment was carried out to evaluate the effectiveness of coal ash as an agricultural liming material.

MATERIALS AND METHODS

Fresh unweathered coal ash from Duvha power station, dolomitic lime and Calmasil® (calcium silicate slag) were applied to an acidic sandy loam soil (Bainsvlei form) in the presence or absence of phosphogypsum. Both calmasil and dolomitic lime were applied at rates of 0, 0.5, 1, and 2 g/kg. Rates of 0, 4, 8, and 16 g/kg of ash were used. The rates represented a control, half the lime requirement, the lime requirement, and double the lime requirement of the soil and were based on the determined calcium carbonate equivalence (CCE) of the materials. Each treatment was replicated thrice, and the whole set of treatments was duplicated on soils amended with 2 g/kg phosphogypsum. The soils were placed in 1 litre pots and maize seeds were planted and daily watered to field capacity. After 28 days, plants were harvested, and soil samples were analyzed for pH, exchangeable acidity, ammonium acetate extractable cations and water soluble anions and cations. Maize dry matter yield and uptake of basic cations were also determined.

RESULTS AND DISCUSSION

All the liming materials increased soil pH and improved soil nutrient status and plant uptake of basic cations. Calmasil had the greatest effect and coal ash the least. Coal ash at the highest treatment level of 16 g/kg increased pH_{KCl} from 3.64 to 3.85, decreased exchangeable acidity from 13.0 to 6.67 mmolc/kg, increased ammonium acetate extractable Ca levels from 200 to 379 mg/kg, and increased Mg levels from 25.9 to 42.0 mg/kg. It also raised nitrate levels from 4.4 to 14.8 mg/kg which is hypothetically as a result of the increase in the activity of nitrifying bacteria following a decrease in soil acidity. Maize yield was not significantly affected by liming. The sufficient watering and consequent elimination of aluminium-induced drought stress is put forward as having masked crop responses to acidity. However, plant uptake of Ca and Mg was enhanced by ash and the other liming materials. Gypsum had little effect on soil acidity and maize yield, but it resulted to an increase of water-soluble Mg from 9.5 to 21.0 mg/kg suggesting a displacement of Mg by Ca ions and a possible acceleration of Mg leaching under field conditions.

CONCLUSIONS

Coal ash was effective as a liming material and as a source of plant nutrients although its liming effects were lower than that of calmasil and dolomitic lime. The viability of using ash as an agricultural soil amendment will therefore depend on proximity to the ash source, especially because of the relatively higher rates of ash required to obtain significant soil and plant responses and the consequent increase in transport and handling costs.

ACKNOWLEDGMENTS

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Keywords: Soil acidity, liming, coal ash, gypsum

A FIRST APPROXIMATION OF THE RELIABILITY OF THE 14-DAY RAINFALL PROBABILITY FORECAST FOR THE FARMER

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INTRODUCTION

Response Farming, (the planning of cropping and the adaptation of the day-to-day crop management as function of the climate and weather forecast) has gained enormous impact by new types of forecast which became available; particularly by the availability of the fourteen-day rainfall probability forecast, now available on several WEB sites.

The 14-day rainfall probability forecast can be a great help both for dry-land farming and irrigation. Five years in-field experience for Response Farming showed that it is quite good, but how good? Comparing of this forecast with actual on-farm rainfall, and its probability, is complicated. Comparing this forecast and real daily data proved that the forecast is less correct for the 2nd week. Evaluation for the 'general' user has been done. The general user wants to know whether there is rain on a specific day, the farmer rather wants to know whether there will be rain, and how much, in a certain period. Earlier or later than the given forecast isn't a major problem. Rainfall availability is more important for him than the time of occurrence.

The ENSAMBLE 14-day forecast, with probabilities for respectively more than 1, 5 and 20 mm rain, is particularly useful for farming, because it shows clearly whether dry, normal or humid periods are expected. It is useful to know how consistent the initial forecast is, compared to the later versions for the same day. It would be ideal to compare the forecast with the real situation. But the complications of estimation of probabilities, rather than fixed values, and the need to take the spatial variability into account make such a study very complex. A first approximation by comparing the last forecast for a given day with the previous could show if the consistency is good enough to justify a more complex study.

MATERIALS AND METHODS

The processed forecast maps, are received daily from the SAWS. These maps include maps made for the 6th till the 14th day from forecast day.

A sample set of clusters of pixels relatively near to each other, and for several periods of the year, was chosen, to verify the consistency of the forecast from the 14th till the 6th day. A weighted approach is used to include those values which correspond to similar values in the next days or slightly earlier or later.

RESULTS AND DISCUSSION

Preliminary results at a small scale, showed that there are periods with less and with more consistency. The variability for the days from the 14th to 6th day is in 80% of the cases less than 30% in difference, and in 25% of the cases both forecasts are similar. Hence these forecasts could be valuable to irrigation farmers to better manage irrigation scheduling during sharp mid-summer droughts at sensitive crop stages. The existence of periods with different consistencies justifies the effort to establish these periods and regions such as to inform the farmers in those regions about the 'skill' of these forecasts.

CONCLUSIONS

The results of a preliminary study has proven that there is a reasonable consistency between the succeeding forecasts. Hence it is worthwhile to engage in the determination of the consistency and reliability of the rainfall probability as function of the area and the period of the agricultural season.

ACKNOWLEDGEMENTS

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Keywords: 14-day forecast, agrometeorology, rainfall probability

EFFECT OF SOIL SURFACE MANAGEMENT PRACTICES ON THE MICROBIAL ENZYME ACTIVITY IN AN APPLE ORCHARD SOIL

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INTRODUCTION

Enzymes are known to play key roles in the biochemical processes of soil where they act as mediators and catalysts important in soil functioning, such as nutrient mineralization and cycling, soil organic matter formation and decomposition, as well as decomposition of xenobiotics (pesticides). Since microorganisms are the main source of enzymes in soil, enzyme activity is evidently higher in the zone where microorganisms thrive. This zone, which immediately surrounds the roots of plants and forms the interface between the roots and the bulk soil, and through which nutrients and water are drawn, is rich in root exudates and home to an extraordinarily diverse assemblage of fungi, bacteria and other organisms, plus the chemical products of their metabolic processes. Past research suggests that the activity and balance of the soil microbial community in this zone is dynamic, as is their enzyme activity, and may change quickly in response to practices such as mulching, the growth of cover crops, cultivation and irrigation. Three microbial enzymes that have been reported to be sensitive to such changes are β -glucosidase, urease and phosphatase. These enzymes are known to play critical roles in the C, N and P cycling in soil, respectively. Measurements of changes in the activity of these enzymes could provide a useful indication of changes in soil conditions as affected by different soil surface management practices, an aspect that has not been intensively investigated in apple orchards to date. Thus, the objective of this study was to assess the effect of various soil surface management practices on the β -glucosidase, urease and phosphatase activity in an apple orchard soil.

MATERIALS AND METHODS

The trial was initiated in 2003 and 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 (Pink Lady) 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 interface between the tree row and work row at 10-20 cm depth in spring 2007 and in summer 2008. Colorimetric assays were performed to measure the β -glucosidase, urease and phosphatase activity.

RESULTS AND DISCUSSION

During both spring 2007 and summer 2008 β -glucosidase activity did not differ significantly between the treatment combinations. In spring 2007 both the phosphatase and urease activities associated with the chemical control combinations, were significantly higher or in most cases tended to be higher than those associated with the mulch treatment combinations. Conversely, urease activity in summer 2008 was higher in the mulch treatment combinations than in the chemical control plots. Differences in soil temperature and/or moisture, associated with the different seasons, might have been responsible for these differences in urease activity between spring and summer. There are currently no data available on the summer 2008 phosphatase activities for comparison with the spring 2007 results.

CONCLUSIONS

Enzyme activity may be triggered differently under different soil surface management practices, depending on the season.

ACKNOWLEDGEMENTS

DFPT and the ARC for funding and for Frikkie Caltitz for the statistical analyses of the data.

Keywords: chemical control, microorganisms, mulch, tree row, weed, work row

EVALUATION OF THE MCG XPO FOLD-UL30 DISPOSABLE CRATES WITH SOUTH AFRICAN EXPORT AVOCADOS

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INTRODUCTION

Fresh commodities are perishable, and need considerable care to ensure they arrive in an export market in top condition. Packaging is one of the factors that will determine the condition of the produce, and is therefore one of the important decisions made in relation to exporting. Plastic crates are growing as a substitute for traditional fibre and styrofoam packaging for certain horticultural products. It is alleged that they have excellent export performance and tremendous air ventilation properties. A packhouse based trial was conducted to establish the rate at which the pulp of avocado fruit cools when stored in, respectively, conventional 8 kg cartons and folding plastic crates. This was followed by a commercial export trial to Europe. This was done to establish the pallet's mass versus volume characteristics and to determine how the pallet withstands typical sea export conditions.

MATERIAL AND METHODS

The packhouse based trial was done at the HL Hall and Sons packhouse in Nelspruit, where one pallet each of 8 kg cartons (currently used by HL Hall and Sons) and plastic crates (supplied by MCG Industries) were packed with counts 24 - 34 "Hass" avocados. The two pallets consisted of, respectively, 12 layers of boxes and 14 layers of crates. Each carton layer consisted of 12 x 8 kg boxes that were packed to the currently used pattern. Since the plastic crates were not designed to fit onto the currently used avocado pallets, they were packed in an unconventional pattern of 8 crates per layer with a small chimney in the middle. To measure the pulp temperature of the fruit, probes were inserted into one fruit each located in the two centre boxes. After packing, the pallets were placed in a commercial cold room set at 4.5°C. The pallets remained at this temperature until 11 July, when the packhouse filled the cold room with a large number of newly packed pallets, thus causing the cold room temperature to temporarily rise by about 3°C. The two pallets were removed from the cold room and placed in the passage at room temperature for 24 hours, and thereafter returned to the cold room and re-cooled. This was done to simulate a severe cold chain break. The commercial export trial was conducted in the packhouses of Westfalia in Tzaneen. One pallet each of 8 kg cartons and plastic crates were packed and then exported to Europe the same day.

RESULTS AND DISCUSSION

The pulp temperatures of the fruit in both the cartons and the plastic crates, as recorded over the 9 day period, indicated that considerable variation occurred with regard to the cooling rates recorded during the storage period. During the initial cooling phase, the pulp temperature of the fruit reduced by slightly more than half a degree centigrade per hour. After the warming of the cold room two days later, the re-cooling rate was about 10% of the above. After the major cold chain break, the cartons re-cooled at around 0.1°C per hour, while the plastic crates cooled at around 0.2°C per hour. The fruit in the plastic crates, respectively, cooled 1.33, 1.15 and 2.27 times faster than the cartons during storage.

CONCLUSIONS

The packhouse based trial indicated that the plastic crates have excellent heat exchange characteristics. The commercial trial demonstrated that the pallets are sturdy enough to be exported. It is envisaged that the rate of commercialization of the plastic crates will primarily depend on cost structure.

Keywords: Avocado, crates, cooling rate, export, hass

SOME CHALLENGES FACING THE SIYAZONDLA FOOD SECURITY PROGRAMME IN THE MBASHE LOCAL MUNICIPALITY, EASTERN CAPE

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INTRODUCTION

Vegetables play an important role in food security of households in terms of supplying the necessary vitamins and minerals needed in a diet (Van den Heever, 1995). Quality vegetable production is demanding of time, good management practices and planning (Allemann *et al*, 1996). Management practices in vegetable production include selection of suitable cultivars, weed and pest control, planting density, correct fertilization, availability of moisture and good crop rotation (Allemann and Young, 2001). In attempts to assist farmers to produce quality field and horticultural crops, the Eastern Cape Department of Agriculture introduced the Green Revolution Strategy which encourages farmers to grow a range of crops such as vegetables, maize, dry beans, sorghum, sunflower and wheat in their gardens and fields (Policy Speech 2006/2007). Although the strategy is in place, farmers still obtain low vegetable yields. Therefore the objective of the study was to find out whether the low yields were due to soil infertility, insufficient water and nutrient supply.

MATERIALS AND METHODS

The study was conducted in the Mbashe Municipality where three villages [Hobeni (coastal), Lota (inland) and Mndundu (between coastal and inland)] were selected based on their altitude and rainfall patterns. Soils and manures were sampled from gardens and kraals of 45 members of Siyazondla programme to determine their nutrient. Soils were analysed for major plant nutrients N, P, K, Ca, Mg and pH. Manures were analysed for nutrient content (N, P, K, Fe, Mg, Ca, Na, Cu, Zn, Fe and Mn) and characterized for quality.

RESULTS AND DISCUSSION

Farmers were not practising crop rotation and that resulted in low vegetable yields. Water stress and P deficient symptoms (purplish colour) were noticed on cabbages. To address that, the Department of Agriculture supplied 5000 L water tanks and chemical fertilizer to the farmers. These tanks run dry during winter as a result one farmer at Hobeni Village used thick grass mulch of approximately 25 ton ha. Cultivars planted in all sites had similar morphological features and were unknown to the farmers. Phosphorus levels ranged from 0 to 138 mg/kg in Siyazondla garden soils and the mean was 33 mg/kg. The K levels ranged from 96 - 700 mg/kg in Mbashe garden soils. To address the challenge of soil infertility, farmers use both kraal manure (sheep, cattle, goat and horse) and synthetic fertilizers. According to the farmers, the fertilizer supplied (single supers) was 5 kg per group of 15 farmers. The average nutrient content of the manures was 0.8% N, 0.13% P and 2.21% K. The nutrients supplied by the combinations did not meet the crop requirements.

CONCLUSIONS

Lack of water and low nutrient supply to Mbashe Siyazondla vegetables gardens resulted in low quality vegetables. Mulching is an alternative for soil moisture conservation. Adequate nutrient supply to vegetables will improve yields.

ACKNOWLEDGMENTS

Eastern Cape Department of Agriculture officials, and Mbashe farmers involved in the study are thanked.

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Keywords: Kraal manure, nutrients, vegetables

EFFECT OF FREQUENCY OF CHEMICAL SPRAYS FOR INSECT PEST CONTROL ON YIELD PERFORMANCE OF COWPEA AND LABLAB UNDER DRYLAND CONDITIONS

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INTRODUCTION

Cowpea (*Vigna unguiculata*) and lablab (*Lablab purpureus*) are important grain crops grown in many parts of Africa and are popular among smallholder farmers in the Limpopo Province due to their ability to withstand drought. A survey by Ayodele and Mariga (2006) revealed that insect pest problems were a major limiting factor to grain legume production at the Gabaza and Mafarana communities of Mopani district in the Limpopo Province. Hence, the objective of the study was to evaluate the effect of low chemical spraying regimes on the growth and yield of cowpea and lablab.

MATERIALS AND METHODS

Field experiments were conducted during the 2005/06 and 2006/07 seasons at the University of Limpopo's experimental farm (Syferkuil) and on-farm at Mafarana village near Tzaneen. The experiments were laid out as 5 X 3 Split-plot arrangements in a randomized complete block design with 3 replications. Four cowpea cultivars (Bechuana White, Brown Mix, "Shangane" and "Sepedi") and one lablab cultivar (Rongai Brown) were selected. The main plot factor was the spraying regimes. Insecticide (7.5 ml of Cypemethrin in 10L of water) application was done at 42 and 80 days after planting for insect pest control. Damage by insect pest was visually scored three times. No fertiliser was applied prior to planting and weeds were controlled by hand hoeing twice per growing season.

RESULTS AND DISCUSSION

Days to flowering in cowpea varieties ranged from 63 to 92 DAP and 61 to 90 DAP during 2005/06 and 2006/07 growing seasons, respectively. Bechuana White, "Sepedi" and "Shangane" were the earliest flowering, 63 to 85 days after planting. Rongai Brown took 136 to 152 and 130 to 144 days to flower during 2005/06 and 2006/07 growing seasons, respectively, at both locations. Limpopo Days to maturity for cowpeas ranged from 142 to 174 days after planting across the season at both locations.

During 2005/06 growing season, the damage by pests decreased with the increase (3-1) in pesticide application at both locations. Pest damage was very high at Mafarana (3-2) as compared to Syferkuil (2-1) during 2005/06 growing season. Rongai and Bechuana White were least affected by the pests across the seasons and the locations.

There was no significant difference in dry matter production across all the locations and growing seasons. Cowpea dry matter production varied from 477 kg ha⁻¹ to 6914 kg ha⁻¹ while lablab also varied from 608 kg ha⁻¹ to 7122 kg ha⁻¹ across the two seasons and locations. Shelling percentage was higher (28-59%) at Mafarana than at Syferkuil (19-44%) during 2005/06 but during 2006/07 Syferkuil had higher shelling percentage ranging from 25% to 68% compared to 18% to 25% at Mafarana.

CONCLUSION

Cultivar Brown Mix performed poorly. Cowpea yield was higher at Syferkuil in both seasons and that site also had less pest damage. Bechuana White and Rongai showed higher levels of pest resistance. The results suggest that spraying before pod formation effectively controls pest in legumes

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Keywords: Damage, Yield Components, Dry Matter production

FARMER MANAGEMENT PRACTICES AND PRODUCTION CONSTRAINTS IN DRYLAND MAIZE/BEAN INTERCROPPING IN CAPRICORN DISTRICT

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INTRODUCTION

Most smallholder farmers in Limpopo Province practice cereal/legume intercropping (Ayisi *et al.*, 2004). Most reported dryland intercropping research in Limpopo Province involves maize/cowpea intercrops. Fewer farmers in the province intercrop maize with bean compared to maize with cowpea. There are also no local records on the performance of maize/bean intercropping and the potential of that intercrop system is not well understood. The aim of the study was to identify agronomic practices used by smallholder farmers in maize/bean intercropping, observe planting patterns and densities used and understand their perceptions of the intercropping system, as well as identify production constraints they are facing.

MATERIALS AND METHODS

This study was conducted at Mamabolo and Molepo villages in Capricorn district of Limpopo province in the year 2008. The survey involved farmer interviews using a questionnaire and visits to farmers' fields to identify the cropping designs and visible production indicators, as well as to measure component crop densities. The survey sample comprised of 30 farmers, 15 randomly selected from each village.

RESULTS AND DISCUSSION

The results showed that most of the farmers who are engaged in farming are elderly females. Further 60% of the farmers plant maize and bean at the same time and only 40% plant bean few weeks after planting of maize. The farmers either intercropped maize with sugar beans or a mixture of sugar bean and white haricot bean. Most farmers intercropped their whole fields that ranged between one and two hectares. About 70% of the farmers planted maize using the same spacing as when intercropping maize with bean but 30% of the farmers reduced maize population when intercropping maize with bean. All the farmers interviewed applied compound fertilizers or super-phosphate in their fields. They had pest and foliar disease problems, notably termites on maize and aphids on bean plants, but only 12% of the farmers controlled the diseases and pests while 88% had no idea of how to control them. Thirty seven percent of the farmers, who had maize density between 20 000 to 29 000 plants/ha, believed that they had good yields. About 33% of the farmers had maize densities varying between 5 000 and 19 000 plants/ha. This latter group of farmers achieved low yields.

CONCLUSION

The study confirmed that most smallholder farmers in the study area have maize and bean diseases problems but they do not have any idea of how to control them and these leads to the achievement of low production of maize and bean. These study findings suggest that farmers need to be encouraged to use pesticides and to appropriately manage component crop densities.

ACKNOWLEDGEMENT

The authors are thankful to the National Research Foundation (NRF) for funding the study.

Reference

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Keywords: Management practices, Production constraints, maize/bean, Intercropping

THE EFFECT OF CALCIUM HYDROXIDE ON POSTHARVEST TOMATO QUALITY

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INTRODUCTION

Tomato is a climacteric fruit and its ripening process is highly regulated by ethylene production and its action at the physical, chemical and physiological levels (Lelièvre *et al.*, 1997). Some of the effects of ethylene are loss of firmness and change in fruit colour. Cell walls are made up of pectin, celluloses and calcium. During postharvest storage of tomato fruit, softening and the occurrence of decay is associated with ripening. These physiological changes are detrimental for tomato quality.

Most research is based on ethylene suppression to improve quality. In the current study, it was based on improving cell wall firmness by enhancing it with a calcium supplement. Research (Biggs *et al.*, 1997; Chun & Huber, 1998) has shown that calcium suppress polygalacturonases and thus cell wall softening. The supplement used in the current study was calcium hydroxide, and since it has a high pH (~11.2 in solution) it is strongly biocidal and can, therefore, reduce pathological disorders. Calcium hydroxide is a CODEX and FDA permitted additive in food (Anonymous, 2006).

MATERIALS AND METHODS

One percent food grade calcium hydroxide solution was made up in rinse tanks in the packhouse. Fruit was immersed in the solution and treated for 8-15 minutes. Control samples were treated with the usual postharvest dip. Fruit at stages 2, 3 and 4 colour were sampled and kept at room temperature for 14 days. Fruit was analyzed every 2nd day. Chemical (% Brix, pH, potassium and nitrate ion levels) and organoleptic parameters (viz. numerical scoring system for firmness, gel viscosity, form/shape, fruit shine, shoulder and texture) as well as taste (results not shown) were analyzed. Colour stage 3 showed the best results and is discussed further in this work. Five repetitions per initial colour stage were done.

RESULTS AND DISCUSSION

Calcium hydroxide treated samples visually showed improved quality and no signs of decay which was noted in the control samples for the same type of injury. Injury was not induced but defects on the fruit. Control samples developed fungal growth by Day 3 and loss total firmness by Day 7. $\text{Ca}(\text{OH})_2$ dissociates into Ca_2^+ and OH^- ions and according to Carlos and Roberto (2003) the action of these ions on tissues and bacteria explains the biological and antimicrobial properties of this substance. Calcium hydroxide treated tomatoes on the whole had a better outer appearance, even after 14 days when compared to the control samples. A notable difference was in shoulder texture. The results indicate that calcium hydroxide reduced softening, prevented decay, maintained pH and % Brix levels (results not shown).

CONCLUSIONS

Calcium hydroxide sealed cracks and wounds. It prevented decay. It improved fruit firmness but made the fruit slightly dull. It had a positive overall improvement on quality and shelf-life. Fruit breaker stage showed the best results with regard to visual and internal quality.

ACKNOWLEDGEMENTS

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Keywords: firmness, decay, softening

FARMER MANAGEMENT PRACTICES AND PRODUCTION CONSTRAINTS OF BAMBARA GROUNDNUT UNDER DRYLAND CONDITIONS IN LIMPOPO PROVINCE

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INTRODUCTION

Bambara groundnut (*Vigna subterranea* (L) Verdec.) is one of the most common grain legume crops grown by smallholder farmers in South Africa. Bambara groundnut is a rich source of protein (16-25%) and its seeds are valued for their nutritional and economic importance (Masindeni, 2006). Farmers in Limpopo province intercrop maize with bambara groundnut since it has the ability to fix nitrogen, improve soil fertility and also drought tolerant. There is however, little documentation on production practices and constraints in these small farming systems.

MATERIALS AND METHODS

A questionnaire which focused on agronomic management practices of dryland bambara groundnut production was administered to individual households at Mamabolo and Molepo villages, preferably to the household heads. Farmers' fields were visited for observations of the crops. The interviewees were stratified according to village, and within each village, 15 farmers were randomly selected, giving a total of 30 farmers. Information from each location was collated and analyzed using a software package, SPSS (Statistical Package of Social Sciences).

RESULTS AND DISCUSSION

Seventy four percent of the farmers interviewed in the two areas were female. The farmers ranged from 40 to 87 years in age. Eighty one percent were growing bambara groundnut as both intercrop and sole crop. Sole crop stands were small, less than 0.5 ha while intercropped land ranged from 0.5 to 4.5 ha. No significant differences were observed on land allocated to bambara groundnut, cropping systems and ages of the farmers between the two villages. There were significant differences on planting date, method of fertilizer application, yield and marketing of the crop between two villages.

Farmers at Mamabolo plant bambara groundnut from November to January while those at Ga- Molepo plant from October to December. Soils in the two areas show deficiency of phosphorus and other basic nutrients. Suggesting the need for right fertilizer with good measures and using the correct method of application.

Highest yield of 2000 kg ha⁻¹ was achieved at Ga-Molepo under sole planting and the yield at Mamabolo was too low. Heavy aphid and termite infestations, as well as foliar diseases, were observed in the field and these were not controlled. Poor stands caused by poor germination and dying of bambara groundnut plants were observed in the field.

There is large market for fresh bambara groundnut than for the dried seeds in both villages. Eighty percent of farmers at Mamabolo do not sell bambara groundnut seeds, whereas at Ga-Molepo 87% of the farmers sell the fresh and dried seeds as it can be stored easily. Price of bambara groundnut ranged from R10.00 to R20.00 per kilogram.

CONCLUSION

Bambara groundnut yield was low and the crop is considered minor relative to maize crop in the two villages. Reduction in yield at Mamabolo was caused by lack of improved seeds, poor germination, late planting, poor soil fertility, diseases and pests. Pest and disease are the major challenges which require urgent intervention in both areas. Timely planting, availability of improved seed, practice of seed priming and fertilizer application were considered to have potential to raise bambara groundnut yields.

ACKNOWLEDGEMENTS

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Keywords: Survey, smallholder farmers

TERMITE DAMAGE ON RESOURCE-POOR FARMERS' CROPS IN LIMPOPO PROVINCE

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INTRODUCTION

Termites are social insects that are widely known among the local people in Limpopo Province. Generally, termites are liked for their significant roles in the natural ecosystem such as decomposition and nutrient recycling. The main disadvantages derived from termites are crop damage and wood property damage. In Limpopo Province termites are viewed as food (protein supplement) by some people, whereas on the other hand they are problematic pests of important crops such as maize, sorghum and legume crops. Termites' damage has been reported in Limpopo province in 2007 through 2008 on smallholder farms. The objective of the study was to (1) investigate the extent of termite damage on resource-poor farmers' farms.

MATERIAL AND METHODS

The survey was conducted in Limpopo Province from April to July 2008. Limpopo was selected for this study because of high levels of concern regarding termite infestations. Villages selected for this survey includes; Gamashashane, Indermak, The Oak and Venda Mapakoni. The villages were randomly selected based on high concerns regarding the termite infestations in major municipality districts (Vhembe, Mopani and Capricorn) of Limpopo Province. A participatory rural appraisal approach (PRA) was used. At the beginning of each PRA meeting the farmers were informed about the purpose of the study, which was to generate information about problems affecting the cultivation of staple food crops on their farms. The researchers avoided any mention of termites at the onset of the meetings. This helped making farmers open up with the problems that they were facing, including termite damage. The farmers were then taken through a semi-structured questionnaire with the help of extension officers and temporary assistants who were appropriately briefed beforehand. The information required included types of staple food crops mostly planted on resource-poor farms, problematic pests, crops affected by termites, the extent of termite damage, and the time during which termite infestation was highest. Farmers were also briefed on termite collection methods they would use.

RESULTS AND DISCUSSION

The study revealed that maize, sorghum and legumes are the most planted and termite infested crops in Limpopo Province. The crop planting percentage ranged from 28% to 70% across the sampled villages. The crops are predominantly planted in an intercropping arrangement. The study confirmed that termite infestation is a serious concern in small-scale farming systems where subsistence farming is practiced under low rainfall conditions. Ninety-five percent of the resource-poor farmers from the areas surveyed stated that termite damage was the most important production constraint relative to other constraints. The incidence of damage caused by termites on staple food crops in 2008 at Mapakoni, Gamashashane and Indermak was 85 %, 78% and 67%, respectively. The time at which termite damage was highest varied across the surveyed but the majority of farmers at all locations consistently reported that termite damage was visible from December to March. This will help researchers to extend termite collection from December 2008 to March 2009.

CONCLUSION

Maize, sorghum and legume crops are the most planted and infested by subterranean termite damage in Limpopo Province. Termite damage incidence is high from December to March. Termite damage is the most important production constraint in maize, sorghum and cowpea producing areas under low rainfall environments.

ACKNOWLEDGEMENTS

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Keywords: Termite damage, Maize, Sorghum PRA

COVER CROP MULCH AND FERTILISER EFFECTS ON WEED DYNAMICS AND MAIZE PRODUCTIVITY IN THE EASTERN CAPE PROVINCE OF SOUTH AFRICA

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INTRODUCTION

In smallholder maize-based cropping systems in the Eastern Cape Province, weed control and soil fertility are major challenges faced by farmers. Ongoing work has documented the large negative impact of weeds on crop production. Conservation agriculture (CA) has been offered as a solution to some of these challenges. Conservation agriculture technologies can be adapted to meet different production challenges, depending on the cover crop grown. Optimal weed control is a very important consideration when introducing cover crops for CA systems in the Eastern Cape. The objective of this study was to determine the effect of mulch from different cover crop species and fertilisation on weed dynamics and maize productivity.

MATERIALS AND METHODS

The study was carried out at the University of Fort Hare Research Farm in the Eastern Cape Province of South Africa in the 2007 season. Four cover crops; *Avena sativa*, *Vicia dasycarpa*, *Vicia faba* and *Lupinus angustifolius*; were grown at two fertiliser levels, no fertiliser and at recommended rates for the respective cover crop species. There were also control plots where weeds were left to grow. Residues of the four cover crops and weeds were evaluated as mulches in a subsequent maize crop. Each cover crop plot was split for application of two fertiliser levels, (0 and 60 kg N /ha). The treatments were laid out as a 5 X 2 X 2 factorial in a randomised complete block design with three replications. Measurements taken include weed species and dry weights, maize plant heights, dry weights, yield and yield components of maize.

RESULTS AND DISCUSSION

Type of cover crop residue and fertilisation did not significantly affect maize plant heights. However, plots with *Avena sativa* and *Vicia dasycarpa* residues had significantly higher maize dry weights ($p < 0.05$) and lower weed dry weights ($p < 0.05$) than plots that had *Vicia faba* and *Lupinus angustifolius* residues. *Lupinus angustifolius* had the lowest cob length as well as number of grains per cob, while maize plots with *Avena sativa* residues had longer cobs and greater number of grains per cob. Fertiliser level did not significantly ($P > 0.05$) affect cob length and number of grains per cob. Plots with *Avena sativa* (6.8 t ha^{-1}) and *Vicia dasycarpa* (6.2 t ha^{-1}) residues had the highest maize yields compared to plots that had *Vicia faba* (4.9 t ha^{-1}) and *Lupinus angustifolius* residues (3.8 t ha^{-1}). Fertiliser application also resulted in higher yields.

CONCLUSION

Residues of *Avena sativa* and *Vicia dasycarpa* were more effective in reducing weed densities and increasing maize yields than those of *Lupinus angustifolius* and *Vicia faba*. Soil moisture needs to be monitored, as moisture conservation may have partly contributed to the yield differences observed.

Keywords: yield components, cover crop residues, weeds

EVALUATION OF BIOMASS YIELD AND WEED SUPPRESSION BY IRRIGATED SUMMER LEGUME COVER CROP SPECIES ON AN OAKLEAF SOIL TYPE IN THE EASTERN CAPE

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INTRODUCTION

Achieving high biomass yield of cover crops has been a challenge compromising the success of conservation agriculture practices in the Eastern Cape. Critical biomass levels of the cover crop have been found to be at least 6 t ha^{-1} per year. The use of cover crops to suppress weeds, improve soil fertility and water use efficiency can be explored as an entry point into conservation agriculture. Small scale farmers lack knowledge of which cover crops to use and their production benefits. A trial was conducted at Fort Hare Research Farm in the 2007/08 summer season to evaluate legume cover crop species for biomass yield and weed suppression under small-scale irrigation.

MATERIALS AND METHODS

Biomass accumulation was studied in four legume cover species, Sunnhemp (*Crotalaria juncea*), Mucuna (*Mucuna puriens*), Lablab (*Dolichos argenteus* var Highworth) and Cowpea (*Vigna unguiculata* var Agrinawa) at two sites at Fort Hare Research Farm in the 2007/08 summer season. Site 1 was planted on 10 December 2007 on a piece of land previously under a rotation of maize and potato. Site 2 was planted on 29 December 2007 on a piece of land previously planted to maize following 5 years of lucerne. The treatments were laid out in a randomized complete block design with three replicates. Sunnhemp was planted at a spacing of 0.5m between rows and a seeding rate of 25 kg ha^{-1} , mucuna and lablab were planted at a spacing of 0.9m x 0.3m whilst cowpea had a spacing of 0.75m x 0.1m. Fertilizer application was at the rate of 200 kg ha^{-1} of Compound 2:3:4 (30+Zn) for all cover crop species. Irrigation water was applied using the sprinkler irrigation system and the total amount of water received was 522.1 mm for Site 1 and 667.5 mm for Site 2. Cover crops were terminated using Erase 360 SL (Glyphosate (Isopropylamine salt) active ingredient) at flowering. Data was collected on weed species, weed dry weight and cover crop dry weight.

RESULTS AND DISCUSSION

At both sites there were significant ($p < 0.001$) differences in biomass accumulation amongst species tested at cover crop kill date which was 80 days after planting (DAP) at site 1 and 64 DAP at site 2. At site 1, biomass yields for sunnhemp, cowpea, lablab and mucuna were 11.6 , 8.2 , 5.2 and 4.0 t ha^{-1} respectively, whereas they were 11.5 , 7.9 , 6.1 , 3.7 t ha^{-1} respectively, at site 2. At both sites the dominant weed species were *Nicandra physaloides*, *Galinsoga parviflora*, *Cyperus esculentus*, *Portulaca oleracea* and *Eleusine indica*. No significant differences ($p > 0.05$) in weed species diversity were observed at both sites in the different cover crop plots. At site 1 significant differences were observed in weed dry weight ($p < 0.05$) between cover crops at 80 DAP. Cowpea and sunnhemp resulted in a weed dry matter of 1 t ha^{-1} , lablab 5.8 t ha^{-1} and mucuna 3.9 t ha^{-1} . However, there were no significant ($p > 0.05$) differences in weed dry weight between cover crop species at 64 DAP at site 2.

CONCLUSIONS

The experiment demonstrated the ability to produce yields of biomass that exceed limits of desired to ensure adequate cover to mulch the soil surface, conserve moisture and suppress summer weeds. Small-scale farmers can use sunnhemp and cowpea to effectively suppress weeds.

Keywords: conservation agriculture

EFFECT OF INTERCROPPING STRATEGIES AND TIME OF PLANTING LEGUME COVER CROPS ON WEEDS AND MAIZE YIELD UNDER IRRIGATION IN THE EASTERN CAPE

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INTRODUCTION

Conservation agriculture can be used to increase maize productivity. However small-scale farmers in the Eastern Cape who want to venture into conservation agriculture have small land holdings. They devote most of their land and effort to the staple crop, maize. Intercropping can be an option for incorporating cover crops into farmers' cropping systems. However, strategies that optimize biomass production with minimal yield reduction to maize in the intercrop system are not well researched. An experiment was conducted at Fort Hare Research Farm in the 2007/08 summer season. The experiment evaluated the interaction of cover crop planting date, intercropping strategies and cover crop species on weeds and maize yield under irrigated small-scale maize based cropping systems in the Eastern Cape.

MATERIALS AND METHODS

The experiment evaluated cover crop planting time, intercropping strategy and cover crop species in a split-split-plot design with three replications. Sole maize and sole cover crop plots were included to evaluate intercrop performance. Cover crop planting time was the main-plot factor, where the cover crop was planted either at the same time with maize or 49 days later. The sub-plot factor was intercropping strategy at two levels, strip intercropping (2 rows of maize alternating with two rows of cover crop) and between-row intercropping. Cover crop species, sunnhemp (*Crotalaria juncea*), mucuna (*Mucuna pruriens*) and lablab (*Dolichos argenteus* var Highworth) were the sub-sub-plot treatments. Data on weed species, weed dry weight and cover crop dry weight were collected

RESULTS AND DISCUSSIONS

Weed species and dry weight were significantly ($p < 0.05$) higher when planting of cover crops was delayed (49 DAP) than when planted simultaneously with maize. There was a significant interaction between planting date and cover crop species ($p < 0.001$) on cover crop dry weight. Planting cover crops at the same time with maize yielded more cover crop dry weight compared to planting cover crops 49 days after planting maize. When planted simultaneously with maize and at 49 DAP, cover crop yields were 4.8 and 0.09 t ha⁻¹ for sunnhemp, 2.5 and 0.05 t ha⁻¹ for lablab and 2.2 and 0.04 t ha⁻¹ for mucuna. Significant two-way interactions ($p < 0.05$) existed between planting date and intercropping strategy. Strip intercropping yielded more cover crop dry weight (3.4 t ha⁻¹) than between row intercropping (2.9 t ha⁻¹) for simultaneous planting of the component crops. For delayed planting of cover crops, strip intercropping yielded more cover crop (0.068 t ha⁻¹) than between row intercropping (0.06 t ha⁻¹). Sunnhemp produced significantly higher dry weight ($p < 0.001$) of 2.4 t ha⁻¹ than lablab (1.3 t ha⁻¹) and mucuna (1.1 t ha⁻¹). Strip intercropping resulted in significantly ($p < 0.001$) higher maize grain yield of 5.9 t ha⁻¹ compared to between row intercropping (3.4 t ha⁻¹). The partial land equivalent ratio (PLER) of maize for strip intercropping was 1.075 and 0.619 for between row intercropping.

CONCLUSIONS

Strip intercropping produced higher yields of legume cover crop species with minimal reduction of maize yield. The intercropping of cover crops with maize at maize planting increased cover crop biomass yields and weed suppression compared to intercropping at 49 days after planting maize.

Keywords: conservation agriculture , legume cover crop species

INVESTIGATING GLYPHOSATE AND PARAQUAT RESISTANCE IN FOUR RYEGRASS (*Lolium* spp.) POPULATIONS

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INTRODUCTION

Glyphosate, a nonselective, broad spectrum herbicide and paraquat, a potential substitute for glyphosate in some use patterns, are regarded as being the products of first choice in the control of ryegrass (*Lolium* spp.) in orchards and vineyards. Over-reliance on the use of these two herbicides to control ryegrass has resulted in the evolution of resistance to both products. Most studies have concentrated on the investigation of this phenomenon at population level. In such studies, different individuals of the same population are sprayed with either glyphosate or paraquat and the population is then classified as resistant or susceptible to one or both of these herbicides. However, this approach fails to identify the proportion of plants that exhibit resistance to both products. Sequential application of glyphosate and paraquat to the same individual might provide a better answer but spraying of one herbicide will probably cause physiological responses in a plant that may either benefit or compromise the action of a sequentially applied herbicide. Therefore cloning of plants and spraying the clones with both herbicides should provide a more precise picture of the resistance traits in a population. The objectives of this study were firstly to determine the occurrence of glyphosate and paraquat resistance in individuals of four ryegrass populations. Secondly, intra- and inter-population crosses between susceptible and resistant individuals will be made to determine if resistance to any of these herbicides will incur a fitness penalty in terms of number and viability of seeds produced.

MATERIALS AND METHODS

Ryegrass seeds from four confirmed resistant populations were obtained and these were denoted A, B, C and D respectively. The seeds were germinated and two weeks after establishment 32 individual seedlings from each population were transferred to pots in a glasshouse. Tillers of individual plants were cloned to obtain four or five clones of each individual plant. Clones of each population were sprayed with glyphosate at doses of 1.5 and 6 L ha⁻¹ respectively and with paraquat at doses of 2 and 8 L ha⁻¹ respectively. Plants were evaluated six and one week after spraying with glyphosate and paraquat respectively and classified as controlled (dead) or surviving (living). Individuals that died from the low doses applied were classified as completely susceptible (S) and individuals that survived the higher doses were classified as strongly resistant (SR). To investigate the influence of resistance on fitness of ryegrass plants, S X S, S X SR and SR X SR crosses within and between different populations will be made once the plants become reproductive. The number of seeds produced per plant will be investigated as well as the viability and vigour of the seeds.

PRELIMINARY RESULTS AND DISCUSSION

The results show that Populations B and C were only resistant to either glyphosate or paraquat. Populations A and D showed resistance to both herbicides at the population level and were therefore investigated further. In Population A 41% of the plants showed severe glyphosate resistance while 72% showed severe paraquat resistance. From these results, the calculated percentage of plants resistant to both herbicides could vary from 13% to 41%. However, the use of clones made it possible to determine more accurately that 34% of the individuals were severely resistant to both herbicides. In Population D 34% and 53% showed severe resistance to glyphosate and paraquat respectively. Again it meant that the percentage of individuals severely resistant to both herbicides could be anything between 0 % and 34%. Evaluation of the clones' response to the herbicides showed that 6% were severely resistant to both herbicides. In practice it means that it will be feasible to apply a sequential application of the two herbicides on Population D but probably not on Population A, because control of the ryegrass could not exceed 66%. Crosses between glyphosate and paraquat resistant and susceptible individuals will be made. The effect of these resistance traits on reproductive fitness will be reported at the congress since the plants are currently still in the vegetative phase.

CONCLUSION

More precise information on cross- or multiple resistance in individual plants can be obtained by applying herbicides to cloned plants. The feasibility of applying sequential applications of two or more herbicides can therefore be determined more accurately.

ACKNOWLEDGEMENTS

Thanks to the Department of Agronomy for financial support.

Keywords: Glyphosate, herbicide resistance, paraquat, ryegrass

EFFECT OF DEFICIT IRRIGATION ON ROOT DISTRIBUTION OF MALUS ×DOMESTICA 'GOLDEN DELICIOUS' APPLE TREES ON MERTON 793 ROOTSTOCK IN A SANDY SOIL IN THE KOUÉ BOKKEVELD

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INTRODUCTION

During seasons when winter rainfall in the Western Cape is less than normal and is followed by an exceptionally warm dry summer, irrigation boards are necessitated to impose water restrictions. Under such conditions it is important to utilize irrigation water optimally to ensure optimum fruit production and quality for export purposes as well as high water use efficiency. Knowledge of the response of apple trees to water stress could enable producers to manage their irrigation throughout the season in such a way that the trees maintain acceptable production and fruit quality and to save water for the periods when it is really needed.

MATERIAL AND METHODS

Full-bearing, micro-sprinkler irrigated commercial 'Golden Delicious'/M73 trees on the Koué Bokkeveld were subjected for three consecutive seasons to 15 deficit irrigation treatments which consisted of combinations of 45%, 70% or 88% plant available water (PAW) depletion, or no irrigation, during four phenological phases viz. vegetative growth and cell division, cell enlargement and fruit growth, fruit ripening and post harvest. Root distribution were determined after three seasons of deficit irrigation in selected irrigation treatments, randomly replicated in three blocks, using the trench profile method (Böhm, 1979). Roots were classed according to diameter as fine (< 2mm), small (2-5 mm), medium (5-10 mm) and large (>10mm).

RESULTS AND DISCUSSION

The Chi-square test indicated differences in frequency distribution of root classes between the deficit irrigation treatments as well as over soil profile depth. Data for the analysis of variance did not meet the requirement of normality of variances between root classes. Analysis of variance was therefore performed per root class. There were no significant differences between treatments in the amount of fine, small, medium or large roots, respectively (data not shown). The treatments with 45% soil water depletion and 70% soil water depletion allowed throughout the season, tended to have more roots compared to treatments that were exposed to drier conditions throughout, or at some stage during the season. There were significant differences between soil profile depths for the different root classes. All root classes showed in general the same trend in root distribution over the soil profile. Approximately 14% of the roots occurred in the top 200 mm of the soil profile, with the bulk of the roots (c. 58%) distributed uniformly in the 200 mm to 600 mm soil increment. Roots became less dense in the 600 mm to 800 mm soil depth increment (c.20%) and decreased to less than 12% of the total amount of roots deeper in the soil profile. Lack of significant differences between the root counts of treatments could be due to large variation in root distribution between soil profiles of replicate blocks and/or cool and wet weather conditions preventing induction of depletion levels during selected phenological stages of some seasons.

CONCLUSIONS

There were no significant differences between deficit irrigation treatments in the amount of fine, small, medium or large roots, respectively, mainly due to large variation in root distribution between soil profiles of replicate blocks. There were, however, significant differences between soil profile depths for the different root classes.

ACKNOWLEDGMENTS

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Keywords: Apple, deficit irrigation, root distribution

DEVIATIONS IN THE ESP-SAR RELATIONSHIP FOR SOUTH AFRICAN SOILS

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INTRODUCTION

Due to cost implications and technical reasons, soil ESP (Exchangeable Sodium Percentage) is often estimated as a function of the soil SAR (Sodium Adsorption Ratio). However, methods commonly used to determine ESP are unsatisfactory for some salt-affected soils.

MATERIALS AND METHODS

The 2 656 soil samples used in the study were derived from soil survey reports for irrigation and environmental planning from all nine provinces in South Africa. Soil samples were analyzed in the laboratories of the ARC-Institute for Soil, Climate and Water (ARC-ISCW) according to methods described by the Non-Affiliated Soil Analysis Work Committee (1991). A saturation extract was prepared and the values for Electrical Conductivity (EC), Na, Ca and Mg were determined. It was assumed that the 1 mol dm⁻¹ pH 7.00 ammonium acetate method for measuring CEC (cation exchange capacity) and Na gives uniformly reliable results for all the samples. The pH_{water} was determined for a soil in a 1:2.5 soil/water ratio suspension on a mass basis. Linear and power regression models for SAR versus ESP at different salinity and pH values were tested

RESULTS AND DISCUSSION

The relationship between ESP and SAR for all soils has traditionally been assumed to be similar to that developed by the United States Salinity Laboratory in 1954. However, based on this relatively large database of South African soils it is clear that this assumption does not hold true. The best models to predict ESP from SAR are the Double Square Root or Multiplicative Models and not the Linear Model. For this dataset the Linear Model was between the seventh and tenth best model out of 27 models tested to predict ESP from SAR.

With an increase in salinity classes from 10, 50, 100, 200, 400 to 800 mS m⁻¹, there was a constant decrease in the R-Squared statistic from 20.0 to only 1.1% if the Linear Model was used, while if the Double Square Root or Multiplicative Models were used for the same salinity classes the decrease in R-Squared statistic was from 52.5 to 4.8%. The positive correlation coefficient between ESP and SAR for salinity classes between 10 and 800 mS m⁻¹ changed to a negative correlation coefficient if salinity classes of 800, 1600 to 3200 mS m⁻¹ were used. The best model to describe the relationship for high salinity soils was the Square Root Model, but the R-Squared statistic was only between 1.3 and 5.4%. With an increase in soil pH_{water} classes from 3 to 9 the R-Squared statistic fluctuated between 46.4 and 53.6% for the Double Square Root Model and between 16.2 and 26.2% for the Linear Model. The correlation coefficient stayed positive for all the classes.

CONCLUSION

For South African soils the relationship between ESP and SAR is much more sensitive to changes in salinity than soil pH_{water}. This appears contradictory, because the analysis of ESP depends on an accurate measurement of the CEC, which is a pH-dependent measurement. The reason for this anomaly is probably due to the fact that the soil is highly saline and negative adsorption effects cause an over-correction for soluble sodium in the determination of exchangeable sodium. Alternatively, when the soil contains exchangeable sodium it is not replaceable by the relatively large fixable NH₄⁺ ion. This causes the ESP values to be lower than the actual values.

METHODS reasonably well suited to samples from one locality may not give readily interpretable results with samples from other localities.

Keywords: ESP-SAR, CEC, Salinity, Sodidity

SCREENING OF TEN POTATO LINES FOR DROUGHT TOLERANCE IN THE GREENHOUSE

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INTRODUCTION

Potatoes are adapted to mild temperatures and are grown in warmer condition in South Africa. The crop is grown commercially in almost all climatic regions of the world, with the exception of the tropical lowlands, though the highest tuber yields and best tuber quality are obtained in areas with temperate climates. Water stress is the most important physiological stress to potato production in most areas of the world. Greater attention has been paid to drought tolerance in the last few years and several evaluation techniques based on morphological, physiological, and adaptive traits have been developed. Breeding for drought tolerance has now become a major issue to be addressed by potato breeding programs. The main challenge is to find a simple technique for screening large numbers of early generation material for drought tolerance. The objective of the study was to determine the suitability of a greenhouse method for screening large number of early generation clones for drought tolerance.

MATERIALS AND METHODS

Potted plants in plastic pots were grown during the autumn season of 2007 in a greenhouse. Irrigation treatments included an irrigated control (R0) and progressive drought after tuberization, with a recovery period (R1). The trial design was a split plot with irrigation being the main plots and varieties being the sub plots. The varieties tested were Darius, Pentland Dell, 890/20, Hertha, BP1, Vanderplank, Up-to-date, Caren, Buffelspoort and Mnandi. Fresh and dry (dried at 60°C) foliage weight was determined in grams per pot. Fresh tuber weight per pot was determined immediately after harvest.

RESULTS

General results

Darius ranked first in terms of dry foliage and fresh tuber weight in grams per pot, and Up-to-date ranked last on fresh foliage and dry foliage weight. Irrigated plots gave high yield in all parameters compared to stress plots.

Fresh foliage weight

BP1 and Caren had the highest fresh foliage weight followed by Hertha, Darius and 890/20. Up-to-date was among those varieties which produced low fresh foliage weight. Fresh foliage weight of plants under full irrigation was statistically higher compared to plants which were stressed and given a recovery period.

Dry foliage weight

BP1, Hertha, Caren and 890/20 produced high dry foliage weight compared to Up-to-date and other varieties, such as Vanderplank. The dry foliage weight of the full irrigation treatment was higher as compared to the drought stress treatment.

Fresh tuber weight

Pentland Dell and Darius gave the highest fresh tuber weight, followed by 890/20 and Hertha. Fresh tuber yield under full irrigation was statistically higher compared to fresh tuber yield per pot under drought stress followed by a recovery period.

DISCUSSION

Darius, BP1, 890/20, Hertha and Caren had the highest fresh foliage weight and dry foliage weight. Darius, 890/20, and Hertha had the highest fresh foliage and dry foliage weight as well as fresh tuber weight, whereas Caren gave the lowest tuber weight yield per pot.

CONCLUSION

The screening procedure is suitable to select tolerant varieties (accessions) among a large number of entries in germplasm collections as a preliminary step in breeding for drought tolerance. This research also demonstrated the need to characterise the internal lack of uniformity in the greenhouse to allow for adequate experimental design. In general the technique is suitable, simple, with practical value for screening a large number of genotypes. RESULTS from this study, however, still need to be confirmed in the greenhouse, rainout shelters and field.

Keywords: Drought, Tolerance, Genotypes

EFFECT OF TIME OF APPLICATION OF THREE REST-BREAKING AGENTS ON ROYAL GALA AND GRANNY SMITH APPLES

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INTRODUCTION

Chemical rest breaking agents (RBA) may be used on deciduous fruit trees to alleviate the symptoms of abnormal growth and production, associated with sub-optimal winter and spring climatic conditions (Jacobs, Jacobs & Cook, 2002). The application of RBAs is often based on calendar dates, rather than on the physiological responses of the tree to climate. Various models have been proposed to quantify chilling accumulation, depth of rest, adverse effects of insufficient chilling and to predict the optimum application date of RBAs. As these models do not fulfill their objectives under SA conditions, a new locally based model is under development. A diverse range of chemicals elicit a rest-breaking response, with their efficiency being directly related to the physiological application date. Previously used, more toxic, commercial products have been replaced by less hazardous ones, but stricter environmental concerns have demanded improved use efficiency and still safer RBAs. The objective was to evaluate the effect of application date of two commercially used and a potentially new RBA on Royal Gala and Granny Smith apple trees.

MATERIALS AND METHODS

Dormex/oil (0.5%/3% v/v) and Lift^R (3% v/v) were applied as full volume sprays, and Symphony (16%N) (plus adjuvant Du-Wett^R) as half and quarter volume sprays. All applications were made using knapsack mist-blowers, to mature Royal Gala and Granny Smith trees in a commercial orchard in Elgin. Six applications were made between mid August and end September. One-year old shoots were collected just prior to spraying and bud burst recorded after forcing at 25°C. Control trees were left untreated. Five one-year-old shoots/tree will be used to monitor vegetative and floral bud burst and fruit set before and after fruit drop. Production per tree will be recorded at harvest. The response to the RBA will be used to modify the predictive capability of the apple dormancy progression model.

RESULTS AND DISCUSSION

Visible differences in bud burst between RBAs and application date were evident. Results will be presented.

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Keywords: budburst, chilling model, delayed foliation

PEACH BLOSSOM THINNING: IMPROVING EFFICIENCY AND REDUCING APPLICATION COST USING ADJUVANTS

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INTRODUCTION

Blossom and fruit thinning is necessary for normal production and an acceptable fruit size at harvest. Flower, fruit and shoot development depend on the earliness and severity of thinning and blossom thinning provides the best response (Myers *et al.*, 2002). Hand thinning, where manual labour is economically feasible, is the most common thinning practice as, although chemical blossom thinning may be cheaper, it is characterized by inconsistent results (Jimenez & Diaz, 2002). Commercial acceptance of chemical blossom thinning of peaches depends on reliability and application costs. The objective was to evaluate the effect of time of application and to reduce application costs by reducing spray volume through the use of adjuvants, on the canning peach Keisie in a commercial orchard in Ashton.

MATERIALS AND METHODS

The blossom thinning agent Armothin^R, at either 2% or 4% v/v, was applied as a full-volume spray without the adjuvant Du-Wett^R, or at half or quarter volume sprays, with Du-Wett^R at either 0.10% v/v or 0.25% v/v respectively. Control trees were left unsprayed. All treatments were applied at approximately 15% full-bloom (FB), 30% FB and 50% FB. Blossom stage of all blossoms on five shoots/tree was recorded before each spray date and again two weeks later. Fruit set/shoot was recorded before 40 days after full bloom (dafb) and again, together with fruit size, after normal fruit drop. Total yield mass and number of fruit will be recorded at harvest. A randomized blocks design with four replications was used.

RESULTS AND DISCUSSION

Armothin^R sprayed trees had visibly less fruit set 40 days after full bloom (dafb) than control trees. Further results will be presented.

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Keywords: fruit thinning fruit size, yield

EFFECT OF ROOTSTOCK, HARVEST DATE AND STORAGE TIME ON 'FORELLE' PEAR FRUIT QUALITY

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INTRODUCTION

The blushed pear cultivar 'Forelle', the second most important export pear cultivar in South Africa, may sporadically develop mealiness (a dry texture disorder) after cold storage. The cause is unclear and has been associated with the stage of maturity at harvest, high temperatures prior to ripening and/or insufficient cold storage prior to ripening. 'Forelle' requires a minimum of 12 weeks cold storage (-0.5°C) after harvest to ripen properly, and if harvested immature, does not reach a climacteric and does not ripen or ripen unevenly (Crouch *et al.*, 2005, Martin *et al.*, 2003). As pear rootstocks influence fruit quality at harvest (North & Cook, 2006), fruit from a rootstock evaluation trial were used to study the effect of harvest date and storage time on fruit quality and development of mealiness in 'Forelle' pears.

MATERIAL AND METHODS

Fruit samples were obtained from ten year old 'Forelle' on six different rootstocks within a commercial orchard in Villiersdorp. Randomly selected fruit were harvested a week before, during and after normal harvest date (07/03/08) and stored for either 10, 12 or 14 weeks under regular atmosphere (-0.5°C), and a further week at room temperature. Fruit quality (background (BG) colour, blush, firmness and Total Soluble Solids, (TSS)) were recorded at harvest. The presence of mealiness was recorded after cold storage, and again after storage at room temperature for up to seven days.

RESULTS AND DISCUSSION

Rootstock significantly influenced blush, colour, firmness and TSS, thus providing for the effect of a range of harvest maturities on quality after storage. There was also a significant harvest date (HD)/storage time interaction on blush, colour, firmness and TSS. Rootstock/storage time interacted significantly on TSS. BP1 and BP3 fruit generally were smaller, greener with less blush, firmer and with lower TSS than the rest at harvest. With later HD's, BG colour increased, blush did not change, firmness dropped at the second HD, while TSS increased at the third HD. Thus, later harvested fruit were generally more mature, irrespective of rootstock. The BG colour of fruit from the all HD's fluctuated during storage, suggesting that colour changes are influenced by colour at harvest. There was generally no change in blush with any harvest date or storage period. Fruit firmness from all HD's fluctuated during all storage times. The TSS of fruit from all HD's increased after 10 weeks storage and then remained constant, except those from the third HD, that decreased after 14 weeks. Fruit on BP1 and BP3 generally had a lower TSS at harvest than the rest of the rootstocks. Fruit on BP1 and BP3 increased in TSS after 10 and 12 weeks and then decreased after 14 weeks, while TSS of fruit from the rest of the rootstocks increased. Thus, changes in BG colour and TSS tended to represent expected changes in maturity during storage, while firmness did not.

There was no sign of mealiness from any harvest date or any storage time at -0.5°C, but all fruit showed mealiness after all storage regimes within one week at room temperature. Mealiness was difficult to quantify, but indications were that the less mature fruit from BP1 and BP3 did not ripen properly, remaining firm but without juice, while the more mature fruit softened rapidly and became dry (mealiness).

CONCLUSIONS

Rootstock influenced fruit quality at harvest which determined storage quality. There were no symptoms of mealiness after cold storage but all fruit were mealy within one week at room temperature.

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Keywords: Keywords: blush, colour, firmness, mealiness, TSS

THE EFFECTS OF AFRIKELP® LG-1, VERMICOMPOST LEACHATE, EFFECTIVE MICROORGANISM AND COMPOST TEA ON TOMATO SEEDLING HEALTH AND DEVELOPMENT

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INTRODUCTION

Compost tea, Effective Microorganism (EM), Vermicompost leachate and Afrikelp® LG-1 are natural products that have been used either as a crop protection tool or as liquid fertilizer. Vermicompost leachate and compost tea contain nutrients which are in a readily available form for the crops. Like EM, they both contain a huge range of microorganisms that are believed to play a vital role during nutrient mineralization and uptake. These microorganisms have been found to reduce the incidence of foliar and/or soil borne diseases. EM has also been reported to promote germination and ensure better plant development. Afrikelp® LG-1 and the compost tea contain a high cytokinin low auxin ratio which helps to stimulate root growth, susceptible to establish a strong healthy plant capable of resisting diseases. The aim of this study was to determine the effects of these crop protection tools on the germination and seedling growth of Nemo-Netta tomato seedlings following a seed application.

MATERIALS AND METHODS

The experiment was conducted in September 2008 at the Hishtill SA nursery, Mooketsi, Limpopo Province. Treatments consisted of three dilutions of Afrikelp® (1:100, 1:500 and 1:1000), compost tea (dilution 1:100), vermicompost leachate (dilution 1:500) and EM (dilution 1:500). Tomato "Nemo-Netta" seeds were first sown into cell plug trays filled with a mixture of peat moss and vermiculite before being drenched with a solution corresponding to a particular treatment (these were: Afrikelp low (1:1000 dilution); Afrikelp medium (1:500 dilution); Afrikelp high (1:100 dilution); Compost tea; EM (1:100 dilution); Vermicompost and a Control). Afterwards the trays were placed in the germination room for three days and then moved to the greenhouse. Plant nutrition, irrigation management, and pest and disease management followed the Hishtill SA protocols. Seedling emergence was monitored on average every third day. After four weeks, five plants were selected at random from each treatment and destructively harvested. The rooting material was washed away to expose the roots. The plant height (shoot length), root length and stem diameter (\varnothing) were measured. Plants were then separated between shoots and roots and then dried at 50 °C for 70 hours to obtain a dry root: shoot ratio.

RESULTS AND DISCUSSION

There were no differences in the percentage germination between the treatments and the control. The data showed that all seed applications increased plant biomass (root and shoot length) over the control. Both the Afrikelp® LG-1 medium (1:500 dilution) and the Vermicompost application produced significantly longer roots than the control ($p < 0.05$). All the treatments were significantly larger in shoot length compared to the control with the Medium Afrikelp® LG-1 treatment having the greatest effect ($p < 0.05$). There were no significant differences in stem diameter or dry root to shoot ratio.

CONCLUSION

All seeds benefited from a seed treatment, however the greatest benefit occurred with a medium (1:500 dilutions) Afrikelp® LG-1 application. This indicates that germination and seedling health can be improved through the use of crop protection tools.

ACKNOWLEDGMENTS

The authors wish to thank Hishtill SA, ZZ2 and Afrikelp for providing products and funding for this research.

Keywords: seaweed extract

THE EFFECTS OF AFRIKELP® LG-1 SPRAY AND DRENCH ON PLANT DEVELOPMENT OF TOMATOES

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INTRODUCTION

Commercial seaweed extracts have been proposed to have a wide range of effects on crop plants and the literature is full of these examples. AfriKelp® LG-1 is a locally manufactured seaweed extract made from *Ecklonia maxima* via a cool fragmentation technology. As this method differs from other seaweed extract technologies there may be differences in hormonal efficacy. The aim of these experiments was to determine the effects of different applications of seaweed extract (AfriKelp® LG-1) application on the shoots, roots and yield of Nemo-Netta tomato seedlings following transplanting.

MATERIALS AND METHODS

The experiment was conducted at the experimental farm of the Natuurboedery Research Center, Mooketsi Station Limpopo Province during the winter – spring period of 2008. Tomato seedlings Nemo-Netta were supplied by Hishtill SA nurseries after 4 weeks growth and an average height of 10 cm (\pm 1 cm). Treatments consisted of a control a dip for three minutes of 1:1000; 1:500 and 1:250 AfriKelp® LG-1 solution; this was then followed by spray applications of 2 or 4 Litres at twice weekly intervals. The trial was laid out in a linear fashion with each treatment having twelve replicates. Plant nutrition, pest and disease management followed ZZ2 protocols. Plants were destructively harvested at three-week interval. At each measurement period, plants were removed from the bags, the rooting material washed away to expose the roots. The plant height (shoot length), root length and stem diameter (\varnothing) were measured, plants were also dried 50 °C for 70 hours to obtain a dry root to shoot ratio.

RESULTS AND DISCUSSION

Shoot length showed the greatest increases compared to the control, with all applications having significantly longer shoots compared to the control (ANOVA $p < 0.05$). The root length data showed greater variability with indications that higher applications are more beneficial and increase root growth in a linear fashion the older a plant is, while younger plants showed great increases in root growth at lower application rates. All applications of AfriKelp® LG-1 had significantly longer roots compared to the control except the dip 1:1000 with a 2 L per ha spray application; this was the most dilute application. With regards to stem diameter all applications that received 4 L per ha were significantly larger than the control. As far as the fruit yield was concerned the best treatment was a 1:500 at transplant followed by 2 L of AfriKelp® LG-1 per ha application as a spray. This resulted in a yield that was double that of the control.

CONCLUSION

The best application to use in terms of fruit yield was a 1:500 drench followed by biweekly applications of 2 L of AfriKelp® LG-1 per hectare. This indicates that seedling health and plant development can be improved through the use of sea weed extract.

ACKNOWLEDGEMENTS

The authors wish to thank ZZ2 and AfriKelp® for providing products and funding for this research.

Keywords: sea weed extract

'N VERGELYKING VAN VERSKILLENDE ONKRUID BEHEERSTELSELS BY MIELIEVERBOUING IN DIE OOS VRYSTAAT

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INLEIDING

Die doel van die projek is om die doeltreffendheid en winsgewendheid van glifosaat onkruidbeheerprogramme te vergelyk met konvensionele metodes van onkruid beheer. Biotegnologie bied aan die gewasprodusent 'n reeks alternatiewe oplossings om somer onkruid in gewasverbouing te beheer.

MATERIAAL EN METODEDES

'n Feite proef met ses behandelings en vier kontroles word oor 'n periode van drie jaar aangeplant binne 'n monokultuur verbouingstelsel. Die proef word uitgevoer op 'n Avalon grond met 'n effektiewe diepte wat wissel tussen 70 en 90 cm. Reënval gedurende die groeiseisoen wissel van 600 tot 700 mm per jaar. Aanplantings is in 0.91 m rye gedoen teen 'n plantestand van 26 000 plante per hektaar. Bemesting bestaan uit 80N en 20 P per hektaar. Die kultivar DKC80-40BR word gebruik. Geen herhalings word gebruik nie, omdat die kontrole behandelings gebruik word om grond en ander verskille op die lokaliteit te neutraliseer.

Die kontrole behandeling bestaan uit 'n kombinasie van 2 vooropkoms onkruidodders, wat bestaan bespuiting met 'n drie weg mengsel van 2.5 l/ha (Atrasien, Terbutulasien en Asetochloor), asook 0.8 l/ha Asetochloor. Hierdie kombinasiebespuiting vind tydens die plantproses plaas. Die behandelings wat in die proef ingesluit is, sluit die volgende in: Geen onkruidbeheer; Een bespuiting met glifosaat @ 1.7 l/ha; Twee bespuitings met glifosaat @ 1.7 l/ha elk; Kontrole behandeling met meganiese onkruidbeheer; Kontrole behandeling met een bespuiting met glifosaat @ 1.7 l/ha en; Kontrole behandeling met twee bespuitings met glifosaat @ 1.7 l/ha.

Behalwe vir graanopbrengs, is die graanmonster ook ontleed om die aantal verbode onkruid te bepaal. Jaarliks is die aantal en tipe onkruid per behandeling bepaal. Onkruidpersele is in elke behandeling uitgemeet. Die persele is op 'n weeklikse basis geëvalueer en onkruid is fisies getel en geïdentifiseer. Sodoende is dit moontlik om die effektiwiteit van die verskillende metodes te evalueer en oor jare ook moontlike verskuiwings in die samestelling van die onkruidpopulasie te ondersoek.

RESULTATE EN BESPREKING

Die hoogste opbrengs in 2005/6 word by die kontrole behandeling met twee glifosaat behandelings behaal (7.29 t/ha) terwyl die behandeling waar geen onkruidbeheer toegepas is nie, die laagste opbrengs van 3.9 t/ha behaal het. In 2006/7 het die kontrole behandeling met twee glifosaat bespuitings die hoogste opbrengs behaal (3.80 t/ha), terwyl 'n opbrengs van 2.35 t/ha gerealiseer word by die behandeling waar geen onkruidbeheer plaasvind nie. Vir die 2007/2008 seisoen, waar die proefgemiddeld 5.21 t/ha is, behaal kontrole behandeling die hoogste opbrengs van 5.85 t/ha. Waar geen onkruidbeheer toegepas word nie, word die laagste opbrengs van 3.70 t/ha behaal.

Gedurende die 2005/2006 seisoen is 11 verbode sade in 'n 10 kg graanmonster by die geen onkruidbeheer behandeling gevind. Die kontrole behandeling het gemiddeld twee verbode sade opgelewer, terwyl die ander behandelings geen verbode sade gelever het nie. Hierdie tendens word in die volgende twee jaar voortgesit. Gedurende die 2006/2007 seisoen word 99 verbode sade in 'n 10 kg monster gevind by die geen onkruidbeheer behandeling.

Waarnemings op die onkruidpersele het gewys dat die persele waar twee bespuitings met glifosaat @ 1.7 l/ha en die kontrole perseel met twee bespuitings glifosaat deur die seisoen, die beste onkruidbeheer getoon het. Geel Uintjies (*Cyperus esculentus*) is die onkruid wat die moeilikste beheer is, maar 'n mate van onderdrukking is waargeneem by glifosaat behandelings.

Indien die winsmarges van die verskillende behandelings oor tyd vergelyk word, blyk die dat die kontrole behandeling jaarliks die hoogste winsmarge realiseer. Die verhoogde koste van glifosaat toedienings is jaarliks groter as die styging in die graaninkomste wat gerealiseer word.

SAMEVATTING

Daar bestaan 'n reeks alternatiewe na-opkoms onkruidbeheer programme wat gewasprodusente kan volg. Alhoewel onkruidbeheerprogramme waar glifosaat gebruik word hoër opbrengste lewer, is daar egter nie op die stadium 'n kostevoordeel om laasgenoemde praktyk te gebruik nie. Die voordeel lê egter in die effektiwiteit van die program. Moeilik beheerbare en verbode onkruid word uitgeskakel en onkruidbeheer deur die seisoen is beter. Die gebruik van die tegnologie sal ook oor tyd lei tot 'n afname in die onkruid saadbank in die grond.

BEDANKINGS

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Sleutelwoorde: glifosaat

EVALUATION OF HERBICIDES AND HERBICIDE APPLICATION TECHNIQUES FOR CHEMICAL CONTROL OF LEAF-ROLL INFECTED GRAPEVINES

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INTRODUCTION

A drastic increase in the occurrence of grapevines infected with leaf-roll virus has occurred. The virus has a pronounced negative effect on grape quality and the productive lifespan of vines. The virus being spread from infected vines to adjacent healthy vines necessitates fast and effective removal of infected vines. No herbicide is registered for the control of grapevines in existing vineyards or on soils to be re-planted with young vines.

The aim of this study is to determine grapevine control efficacy of selected herbicides and application techniques in order to supply information that may lead to the registration of a herbicide(s) and application method(s) for the control of leaf-roll infected grapevines.

MATERIALS AND METHODS

The trial was conducted from April 2006 to March 2008 on a medium textured soil in a 15 year old Chardonnay/99 Richter vineyard near Stellenbosch (33°55'S, 18°52'E) totally infected with leaf-roll virus. Thirteen treatments, consisting of six herbicides applied selectively by means of four application techniques, were applied post-harvest and during grapevine berry set (end of November). The herbicide treatments were compared to a control treatment in which no herbicide was applied. The treatments were replicated three times in a randomized block design. Herbicide efficacy was determined by visual evaluation of the above-ground growth, as well as visual evaluation of root health in one profile pit (1.5 m x 1.5 m x 1 m) per treatment replication during October and March.

RESULTS AND DISCUSSION

A post-harvest foliar application of Brush Off (200g/L metsulfuron methyl) controlled the above-ground vegetative growth up to 19 months after application. The roots of the grapevines in this treatment were dead or damaged to a depth of 350 mm and 500 mm as observed 19 and 24 months after application, respectively. Above-ground re-growth occurred 24 months after application. Although Plenum (80 g/L picloram & 80 g/L fluroxypyr) did not control the above-ground growth effectively, the roots were dead or damaged to a depth of 150 mm and 900 mm as observed 19 and 24 months after application, respectively. Foliar application (FA) of Garlon 480 EC (480g/L triclopyr) and Confront (90 g/L triclopyr & 270 g/L clopyralid) during grapevine berry set controlled the above-ground vegetative growth up to 11 months after application. Similar results were achieved with the cut stump treatments of Timbrel 360 SL (360g/L triclopyr), Confront and Brush Off applied during berry set. In the case of Garlon 480 EC (FA) the roots died back to a depth of 300 mm. Root growth was not affected by the other berry set treatments. All berry set treatments showed above-ground re-growth 16 months after application. The post-harvest application being executed one month earlier (26 March instead of 26 April) improved the efficacy of Garlon 480 EC, Confront, Plenum and Timbrel 360 SL.

CONCLUSIONS

Herbicide efficacy was affected by time of application, even during the same phenological phase. None of the herbicides tested in the trial controlled the 15 year old heavily infected grapevines effectively. The infection resulted in poor vegetative growth, which might have caused poor herbicide translocation to the target areas. The above-mentioned eight treatments should be evaluated in non-bearing, as well as full bearing grapevines infected with leaf-roll virus for less than two seasons, to determine whether more actively growing grapevines can be controlled effectively.

Keywords: leafroll virus, herbicides, Chardonnay/99 Richter

THE EFFECT OF TWO DIFFERENT GROWTH MEDIA ON TOMATO PLANT HEALTH

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INTRODUCTION

The type of media in which horticultural products are grown can affect the quality of that produce. Compost not only provides nutrients but also improves soil microbiology. According to Ingham (2006), compost is an important and effective method for delivering carbon, organic compounds, minerals and microbes to the field as a readily available organic fertilizer. ZZ2 produces approximately 42 000m³ of compost per annum. Another readily available growth medium is cocoa peat, which is produced sustainably without the environmental damage caused by peat mining (<http://en.wikipedia.org>) and thus conforms to the company's Natuurboerdery concept. Very little documented research has been done with cocoa peat as a growth medium for tomatoes. The aim of this study was to compare compost and cocoa peat as growth media for tomato plants.

MATERIALS AND METHODS

Tomato cultivar Nemo-netta was used for these experiments. Seedlings were grafted on different rootstocks (viz. Beaufort, King Kong and Kevric), but evaluation of rootstock type on plant health was not compared. Results were based on a combination of rootstocks. Grafted seedlings were planted directly into compost or cocoa peat in a semi-controlled tunnel (open side panels with fans). Plant spacing for compost medium was 27cm, while that of cocoa peat was 30cm or 50cm. Pesticides, fungicides, fermented plant extracts and foliar nutrient sprays were applied weekly as discussed in pest control meetings. The following parameters were measured: tunnel temperatures, %RH, leaf sap analyses and light intensity. Furthermore, pH, Ec, nitrate ions and potassium ions were measured in the irrigation water and leached water. Weekly averages for each of these parameters were determined.

RESULTS AND DISCUSSION

Addition of compost to the soil strongly influences the soil microflora and may increase microbial biomass (Albiach *et al.*, 2000; Darby *et al.*, 2006). This was visible by the presence of fungal fruiting bodies on the compost media, and from the Soil FoodWeb reports. Average tunnel temperatures of the compost were slightly lower than the cocoa peat, corresponding to the lower light intensity and higher relative humidity readings. The pH of water leached from cocoa peat was slightly lower than that of the irrigation water. This is expected as cocoa peat is generally acidic. The opposite was noted with the compost. The Ec of water leached from compost was slightly higher than the cocoa peat. Water leached from the cocoa peat had more potassium ions in it than that leached from the compost. Nitrate levels in water leached from the cocoa peat were higher than that of the compost. All parameters for the leaf sap were similar, with the exception of potassium and nitrate ion levels.

CONCLUSIONS

Plants grown in compost had higher levels of potassium ions than those grown in cocoa peat, while plants grown in cocoa peat had slightly higher levels of nitrate ions. Compost improved the soil microbiology, making it more fungal dominated. On the whole all other parameters were similar and plants grown in both media showed improved plant health and product quality.

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Keywords: compost, cocoa peat, tomato

EFFECT OF GREEN MANURE LEGUMES AND NITROGEN FERTILIZER ON MAIZE GRAIN YIELD AND WEED INFESTATION LEVELS IN A GREEN MANURE/MAIZE ROTATION

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INTRODUCTION

Maize (*Zea mays* L.) is the main crop grown by smallholder farmers in Limpopo province. However, grain yields are often very low because of poor soil fertility, exacerbated by low fertilizer inputs (due to high cost, and risks from erratic and limited rainfall), amongst other constraints. The integration of green manure legumes as cover crops into the maize-based cropping systems has the potential to enhance maize yields. Despite the widespread use of green manure legume cover crops by smallholder farmers in most tropical areas to improve soil fertility and control weeds, this practice is yet to take root amongst smallholder farmers in Limpopo province.

OBJECTIVES

To determine the effect of green manure legume cover crops and nitrogen fertilizer on (i) maize grain yield and (ii) weed infestation levels in a green manure legume/maize rotation.

MATERIALS AND METHODS

This study was conducted at the University of Venda's experimental farm on a deep Hutton soil. Five green manure legume (GML) cover crops, viz. mucuna, lablab, sunhemp, cowpea and butterfly pea were planted in plots measuring 5 m x 5 m. Two fallow plots were also included in the treatments. Treatments were arranged in a randomized complete block with three replications. At flowering, cover crop growth was terminated by slashing the above-ground biomass and leaving it on the surface. The following planting season, maize was sown in all the plots. Two fertilizer nitrogen treatments (0 and 100 kg N ha⁻¹ as LAN) were imposed on the two fallow plots, giving a (-N) and a (+N) control. Phosphorus (50 kg ha⁻¹) was applied uniformly to all the plots. Weed dry matter (dm) was determined in all maize plots at 6-8 weeks after planting (WAP) and at tasseling. Maize grain yield was determined at harvest. Data were analyzed using the general linear model (GLM) procedure of SAS software version 9.1 (SAS Institute, Inc.).

RESULTS AND DISCUSSION

Weed infestation levels

At 6-8 WAP, cowpea, mucuna, lablab and sunhemp plots had significantly lower weed dm (5.30, 11.97, 5.83, and 21.03 g m⁻², respectively) than the control (+N) (49.47 g m⁻²). No difference in weed dm was observed between the control plots and butterfly pea plots and between control (-N) and all the GML plots. At tasseling, there was no significant difference in weed dm between treatments (probably due to high coefficient of variation; 127%) but the GML plots had between 53 and 90% less weed dm than the control plots. The dominant weed species identified in the maize plots were *Ricardia brasiliensis*, *Cyperus esculentus*, *Rottboellia cochinchinensis* and *Striga asiatica*.

Maize grain yield

Grain yields were greater (by 77-134%) in (+N) control (7.9 Mg ha⁻¹), cowpea (8.0 Mg ha⁻¹), mucuna (8.4 Mg ha⁻¹), sunhemp (9.2 Mg ha⁻¹), butterfly pea (10.2 Mg ha⁻¹), and lablab (10.6 Mg ha⁻¹) treatments compared with the (-N) plots (4.5 Mg ha⁻¹). All the other treatments were significantly better than the (-N) treatment.

CONCLUSIONS

Green manure legume cover crops suppressed weeds better, compared with natural fallow, and increased maize grain yield as well and better than nitrogen fertilizer. Thus, use of GML cover crops in smallholder farms could be a viable option for increasing maize productivity.

Keywords: Green manure legumes, nitrogen fertilizer, maize yield, weeds, rotation

THE EFFECTS OF PLANT POPULATION AND RAINWATER HARVESTING ON MAIZE YIELDS IN THE LIMPOPO RIVER BASIN

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INTRODUCTION

The Limpopo River Basin in southern Africa is a semi-arid area dominated by rainfed subsistence agriculture. Maize is one of the most important cereal crops in southern Africa, especially in the rural areas. Plant population exerts a strong influence on maize growth and grain yield. In semi-arid areas, water use in crop production needs to be optimized because limited rainfall is received. Rainwater harvesting is one of the best methods to achieve this.

MATERIALS AND METHODS

Experiments were conducted during the 2007/2008 growing season to evaluate the effects of plant population and rainwater harvesting on maize yield in the Limpopo River Basin. A randomized block design with one replication per site and two replications per district was planted with a 25m x 9m plot size. Tied ridges were prepared every 90cm between rows and the ridges were 2m apart. The planting space was 90cm between rows, and 25cm and 50cm between planting stations with plant population of 44400 plants/ha and 22200 plants/ha respectively. Two seeds were planted per planting station then thinned to one plant per planting station when the plants were 15cm to 20cm tall. The Mopani and Capricorn districts were selected. The trials were laid out at Nkomo and Hleneki in Mopani district and at Ga-seema, Ga-Ramoshwana and Juno in Capricorn district.

RESULTS AND DISCUSSION

The use of tied ridges caused the maize yield to increase by 8% and 10% in Capricorn and Mopani, respectively, at a plant spacing of 50cm between planting stations. At 25cm between planting stations the mean yield increased by 15% and 26% in Capricorn and Mopani, respectively, when comparing the trial plots with tied ridges and those without. A farmer's awareness day was held in each of the two districts to demonstrate the results.

CONCLUSION

Sowing maize at 25cm between planting stations combined with tied ridges produced the highest mean yield increase when compared to the maize sown at 50cm between planting stations.

ACKNOWLEDGEMENTS

I would like to thank all the extension officers from the two districts for their continuous support in this project.

Keywords: Limpopo River Basin, Maize yield, Plant population, Rain water harvesting

KOMPOSTEE – 'N PLAASVERVANGER VIR KOPER IN DIE BEHEER VAN NA-OES SIEKTES OP AVOKADOS?

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Naoes siektes (Antraknose, Dothiorella, Cercospora vlek, Stingel end verotting) is van groot ekonomiese belang, veral met die groenskil avokado variëteite wat vir die uitvoermark bestem is. Verskeie vorme van koper (bv. koperoksied, koperhidroksied en koperoksichloried, ens.) is al in die verlede met wisselende mate van sukses vir die beskerming van die vrugte getoets. Met die toenemende bewuswording van die gevaar van besoedeling, het wetenskaplikes oor die jare, sonder veel sukses, verskillende middels beproef met die oog daarop om koper te vervang of die toediening daarvan te verminder.

Die gebruik van kompostee, 'n produk wat verkry word deur die eareobiese fermentasie van kompos, het nog baie min aandag ontvang. Die beskerming van die vrugte berus hier op die beginsel van kompetisie. Volgens Prof. Elaine Ingham (pers. med.) is goeie resultate in Amerika verkry waar 'n mikrobedekking van tussen 60 en 80 % op die blare en vrugte na herhaaldelike bespuitings met kompostee verkry is.

MATERIAAL EN METODEDES

Die navorsing is op 'n 20 jarige Fuerté boord in die Mooketsivalei uitgevoer. Die boord is in twee verdeel en die helfte het een Benlate bespuiting gevolg deur vier koperoksichloried + 'n hegtingsmiddel (3 kg en 150 ml per 1000 l water) bespuitings, teen 'n spuitvolume van 3000 l per hektaar ontvang. Die ander helfte het ses bespuitings van kompostee teen 400 liter tee per ha, (spuitvolume 2500-3000 liter per ha), ontvang. Met die derde bespuiting is die tee aangevul met 6.25 l molasse, 250g Blade (*Bacillus thuringensis*) en 3.75 l Zincmax (organiese gecheleerde Zn) per ha. Met die vyfde bespuiting is die tee verryk met 1% (v/v) molasse en 1% (v/v) Seagro. Met die sesde bespuiting is die tee met 1% (v/v) EM en 1% (v/v) molasse verryk. Blaarmonsters is na elke bespuiting en voor die sesde bespuiting getrek, vir die direkte tel van mikroses op die blare deur die SFI laboratorium.

Met oestyd is ses kartondose met 12 vrugte elk van albei blokke geoes. Hierdie vrugte is vir 4 weke by 6°C verkoel waarna dit by 18°C rypgemaak is. Nadat die vrugte "gebreek" het, is dit geëvalueer ten opsigte van na-oesbederf.

RESULTATE EN BESPREKING

Voor aanvang van die proef was daar 'n mikrobedekking van 3% op die bokant van die blare. Na vier bespuitings het die bedekking toegeneem tot 7% op die bo en 7% op die onderkant van die blare. Na die vyfde bespuiting is bedekkings van onderskeidelik 4 en 16% op die bo en onderkant verkry. Voor die sesde bespuiting was die telling onderskeidelik, 20 en 33% op die bo en onderkante van die blare. Op die bokant het dit hoofsaaklik uit bakterië bestaan en op die onderkant, uit ongeveer gelyke dele bakterië en fungi. Onmiddellik na bespuiting is die bedekking op die bokant verlaag na 16% en op dié op die onderkant na 6% en was daar slegs fungi op die blare. Met oestyd was die bedekking op die bo en onderkant van die blare onderskeidelik 29.7% (hoofsaaklik fungi) en 62.5% (gelyke hoeveelhede fungi en bakterië). Die vrugte het 'n bedekking van 54.7% gehad met 'n fungi tot bakterië verhouding van ongeveer 2:1.

Die komposteebehandeling was 100% suksesvol in die beheer van antraknose. Daar was 'n geringe mate van Dothiorella op die vrugte wat die komposteebehandeling ontvang het. Die resultate dui daarop dat die vestiging van 'n groot genoeg mikrobe-bevolking op die vrugte, die vrugte teen na-oes siektes kan beskerm. Verdere navorsing, veral in die vestiging van mikrobe-bevolkings, word egter benodig.

Sleutelwoorde: mikrobedekking, groenskil avokado, koperoksichloried, antraknose, Dothiorella

CURRENT STATUS OF HERBICIDE RESISTANCE IN SOUTH AFRICA

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INTRODUCTION

Herbicide resistance in weeds was recorded for the first time in the late 1950's to synthetic auxins. Since then the number of herbicide resistant weeds has escalated alarmingly and currently there are 322 resistant weed biotypes involving 186 species worldwide. In South Africa the first cases of herbicide resistance were recorded after 1980 when resistance to diclofop methyl in *Avena fatua* and resistance to triazines in *Amaranthus hybridus* were confirmed. Although the resistant *Amaranthus* biotypes occurred in the summer rainfall area, the resistance problem is mainly restricted to the winter rainfall areas with only a few cases recorded in the summer rainfall regions. Today herbicide resistance is one of the most important if not the most important factor that threaten sustainable grain and to a lesser extent, fruit production in the winter rainfall area. The objectives of this project are to verify suspected cases of herbicide resistance and to maintain a database to quantify the incidence and extent of herbicide resistance in South Africa.

MATERIALS AND METHODS

The incidence of herbicide resistance is monitored in two ways. Firstly, suspected herbicide resistant weed populations are tested at the Agronomy Department of the University of Stellenbosch under controlled conditions. Secondly, questionnaires are distributed to personnel of agrochemical companies in the winter rainfall region in which cases of suspected herbicide resistance are reported. These results are stored in separate databases.

RESULTS AND DISCUSSION

The incidence of resistance in South Africa is escalating at an alarming rate. The majority of the verified cases of herbicide resistance occur in the winter rainfall region. However, herbicide resistance in summer rainfall regions, particularly in irrigated crops, appears to be on the increase. The numbers of weed samples sent in for testing has increased from 8 in 1999 when the service commenced to 194 in 2003. In 2004, 2005, 2006 and 2007 the numbers of samples tested has decreased to 87, 67, 59 and 24 respectively, due to various factors including on-farm tests performed by agrochemical companies and acceptance of the fact that herbicide resistance is present on farms. Up to now herbicide resistance has been noted in 15 weed species and resistance to eight modes of action herbicide groups occurred. The most important herbicide resistant species in annual crops are *Lolium* spp. and *Avena* spp. In perennial crops the most problems are caused by *Lolium* spp. and *Conyza bonariensis*. Comparison of the results of questionnaires distributed to the same agrochemical personnel in 2003, 2005 and 2007 showed that the number of suspected herbicide resistant cases increased from 500 in 2003 to 599 in 2005 to 640 in 2007. The number of new reported resistance cases appears to be decreasing over the last 5 years. This may be a real trend but it may also be somewhat misleading. The number of new species and mode of action groups involved in herbicide resistance may not be increasing as fast as it used to be, but new cases of the same species and mode of action groups that are probably not considered worthy of reporting, are most probably still increasing at even a faster rate.

CONCLUSION

The results from this study showing a decreased rate of reporting of new herbicide resistance cases should not cause a false sense of security. Herbicide resistance is still and will continue to be a large factor hampering the sustainable production of annual crops in particular in the Western Cape.

ACKNOWLEDGEMENTS

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Keywords: herbicide resistance, South Africa, weeds

BASELINE DETERMINATION OF HABITAT FOR INDIGENOUS MEDICINAL PLANTS IN THE SEKHUKHUNE AND VHEMBE DISTRICT OF LIMPOPO PROVINCE

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INTRODUCTION

The sustainable production and conservation of medicinal plants is influenced by a number of factors, which are largely socio-economic and institutional in nature. The increasing demand for indigenous medicinal plants has led to increased pressure on wild populations, decreasing the gene pool in the natural habitat. The purpose of the study was to identify the natural habitat of indigenous medicinal plants and match these with other similar habitats to confirm their distribution and availability. Trials investigating the effects of geological patterns (location) on the growth and development of medicinal plants were conducted in the Sekhukhune and Vhembe districts of the Limpopo Province.

MATERIALS AND METHODS

The survey was conducted in the Sekhukhune and Vhembe districts. Areas in the Sekhukhune district included Marble-Hall, Groblersdal and Burgersfort, while areas in the Vhembe district included Makonde, Tshipise, Tshilapfene and Nzhelele. A hand auger was used to sample to a depth of 1.2 m or shallower, where indigenous medicinal plants occurred. The medicinal plant species were identified through field guides and with the assistance of traditional healers. Plant species that were identified in both districts included, among others, *Artemisia afra*, *Cotyledon orbiculata*, *Scilla natalensis*, *Warburgia salutaris* and *Tulbagia alliaceae*. The positions of the observation points were recorded with a hand held GPS device. Soil samples were analyzed in the ARC-ITSC laboratory according to methods described by the Non-affiliated Soil Analysis Work Committee (1991), and were then classified according to the Taxonomic System for soil samples. Samples were analyzed for particle size distribution (3 fractions), pH (H₂O), resistance (ohms), percentage carbon, percentage organic matter and exchangeable cations (acetate method). The ARC-ISCW database was queried to find matching geological, land-types, and broad soil patterns.

RESULTS

In the Vhembe district, the identified soil forms were Hutton and Augrabies with low S-values and organic matter. The soil types were sandy loam, loamy sand and sandy soil. In the Sekhukhune district, the soil forms were Mispah, Hutton, Clovelly, and Glenrosa with low and moderate S-values and low clay and organic matter. However, Tswenyane village which is also in the Sekhukhune district had Hutton soils with high S-values. Soils in the Sekhukhune district included pure sand, sandy loam, loamy sand, sandy and sandy clay loam.

The results of the database query indicated the following geologies: Nzhelele, Wylliespoort, Pretoria group, Lebowa granite, Malmani, Timeball Rooihooghte and Silverton. Nzhelele and the Wylliespoort geologies only occur in the Vhembe District, whilst the Pretoria group was found in Sekhukhune District. Lebowa granite, Malmani, Timeball & Rooihooghte, and Silverton are found in Gauteng, North West, and Mpumalanga Provinces of South Africa. The pottassic granite occurs in parts of Mpumalanga, KZN Provinces and also in Swaziland.

CONCLUSION

Primary drivers of local extinction of medicinal plants include, among others, unsustainable harvesting, civilization, agricultural development and climate change. In order to minimize extinction of these plant species it is necessary to cultivate them in other potential growing areas. To achieve this, there is a need to match the geologies, broad soil patterns and climatic conditions of various locations. In the second phase of this study similar medicinal plant species will be cultivated in different locations with similar geological patterns and climatic conditions.

Keywords: Geology, medicinal plants, unsustainable harvesting

RESPONSE OF LIMPOPO FARMERS TO SWEET POTATO NURSERIES

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INTRODUCTION

Sweet potato is an important food security crop in South Africa especially in rural communities. The major constraint is the shortage of planting material of disease free and improved cultivars. Nurseries in Limpopo were established after conducting research at the University of Limpopo in 2005/2006. ARC-VOPI, Limpopo Department of Agriculture and farmers from different areas of the province participated on the trial. At the end of the trial the selection of good varieties in terms of colour, size, taste and texture was determined for the establishment of nurseries.

MATERIALS AND METHODS

Nurseries were established in 8 locations of Limpopo province (Kgopane, Sansloot, Blouberg, Tshiombo, Thabazimbi, Sekororo, Moletji, and Ikageng) in 2006/2007. The cultivars used were Mokone, Monate, Ndou, Phala (cream fleshed), Excell, W-119, Khano and Hernandez (orange fleshed). Each location planted 4 different cultivars (2 cream fleshed and 2 orange fleshed) on 3m rows x 5m. The main objectives of the sweet potato nurseries in the province are as follows: to capacitate farmers in a way of knowledge transfer on nursery management, multiplication and distribution of sweet potato planting material especially the orange fleshed varieties and to generate income from selling vines.

RESULTS AND DISCUSSIONS

Farmers were selling vines at @ R0.60c – R0.80c each and other farmers were selling 25 kg at R50. Farmers are experiencing pests problem although not in all areas, at My darling (Blouberg) they have mole rat problem and it is destroying their tubers severely. Locusts are also a problem in areas like Moletji, but it is seasonal unlike the mole rat. Most farmers have water availability problem. An information day on one of the nursery sites (Kgopaneng) was organized and local farmers were invited. Sweet potatoes were harvested, cooked and tasted in this day.

CONCLUSION

Our farmers still need more exposure on nursery management and vine production. Limpopo province has potential on sweet potato production, the success of the projects is on farmers who are committed and support from the local extension officers.

Keywords: Sweet potato, Nurseries

OPTIMISATION OF DENATURING GRADIENT GEL ELECTROPHORESIS FOR LOCAL SOIL UNDER MAIZE PRODUCTION

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INTRODUCTION

In recent times approaches for studying soil microbes have moved from enzyme activities and microbial biomass towards the investigation of their diversity and community structure. One of the most commonly used techniques for studying changes in microbial community structure and diversity is the separation of polymerase chain reaction (PCR) amplicons using denaturing gradient gel electrophoresis (DGGE). Although successfully employed in soils elsewhere, optimisation of this technique for local agricultural soil poses a challenge. Soils present some of the most difficult challenges caused by soil chemicals (fulvic and humic acids), which are enzyme inhibitors to PCR amplification and the need for optimised DNA concentration that is required for a successful DGGE analysis. The recommended DNA concentration range for an environmental soil sample to effectively visualise DGGE bands is 10-100ng per 50µl PCR reaction. The question, however, remains whether this criterion applies for local maize-producing soil.

AIM

The aim of this study was to optimise DGGE for representative local soil under maize production by determining optimal PCR template concentration.

MATERIALS AND METHODS

Sampling

Soil was collected from a representative locality (Bothaville, 27.23°S, 26.67°E) in the northwestern Free State of South Africa. Samples were taken from the top 15cm of soil during the flowering stage of the maize crop and frozen at -80°C until further use.

DNA extraction and PCR amplification

DNA was extracted directly from soil using the ZR Soil Microbe DNA Kit for soil according to the protocol of the manufacturer (Zymo Research Corp., USA). For analysis of bacterial communities in maize-producing soils 16S rDNA was amplified using the PCR primers PRBA338F and PRUN518R. To establish optimal DNA concentration for DGGE, a dilution series for each soil sample was done for PCR ranging from 10 ng/µl to 10pg/µl.

DGGE analysis

Electrophoresis was done as described by Muyzer *et al.* (1993) with 8% (w/v) polyacrylamide gels. A denaturing gradient of 40 to 60% was used. The DGGE banding patterns (products) were visualised by GelRed staining and UV transillumination.

RESULTS AND DISCUSSION

Initial results showed that PCR products at concentrations of 10ng/ul soil bacterial DNA on DGGE gels yielded smears suggesting that lower concentrations could be a possible remedy. Also, attempts to clean-up DNA proved not to be the solution. By setting up a dilution range (10 ng/µl to 10pg/µl), clear banding patterns could be detected from as low as 1ng/µl to 100pg/µl of bacterial DNA.

CONCLUSION

The results of this study showed that by employing DGGE to effectively monitor changes or differences in microbial communities in our local maize soils, DNA of 1ng/ul or less should be used.

References

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Keywords: DGGE, PCR, soil microbes, maize production

EFFECTS OF AFRIKELP® LG-1 AND A STARTER SOLUTION ON REDUCTION OF TRANSPLANT SHOCK IN TOMATO SEEDLINGS

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INTRODUCTION

Commercial seaweed extracts have been used since the 1950's, and internet and literature searches reveal a wide variety of proposed benefits. One of the benefits is reduction of transplant shock of seedlings through promotion of root growth. Starter solutions are mixtures of soluble fertilizer and water used to get young plants off to a good start. The fertilizer material easily dissolves in water and the nutrients are readily available for plant uptake. Starter solutions are used primarily for transplanted vegetables such as tomato, eggplant, pepper, muskmelon, watermelon, cabbage, cauliflower and broccoli. There are numerous advantages to starter solutions in that they are easy to prepare, they are easily dissolvable with no residue, there is little risk of plant injury (burning), they contain no potentially harmful salts which accumulate and cause problems and the nutrients in starter solutions are immediately absorbed and utilized by plants, thus promoting rapid plant response and reducing plant transplant shock. The aim of these experiments was to determine the effects of different applications of seaweed extract (Afrikelp LG-1) and starter solution application on the roots of Nemo-Netta tomato seedlings following transplanting.

MATERIALS AND METHODS

The experiment was conducted at the experimental farm of the Natuurboedery Research Center, Mooketsi Station, Limpopo Province, during the winter – spring season of 2008. Tomato seedlings cv. Nemo-Netta were supplied by Hishtill SA Nurseries after 4 weeks growth and an average height of 10 cm (\pm 1 cm). Treatments consisted of a control, a dip for three minutes in 1:1000; 1:500 and 1:250 AfriKelp® LG-1 solution as well as the above repeated with a starter solution of H₃PO₄ + NH₄NO₃. The trial was laid out in a completely randomized design with each treatment having twelve replicates. Plant nutrition, pest and disease management followed ZZ2 protocols. Plants were destructively harvested at weekly intervals. At each measurement period, plants were removed from the bags, the rooting material washed away to expose the roots. The plant height (shoot length), root length and stem diameter (\emptyset) were measured, and plants were also dried at 50 °C for 70 hours for dry root to shoot ratio determinations.

RESULTS AND DISCUSSION

The results showed that a starter solution and AfriKelp® LG-1 solution helped to reduce transplant shock and to increase root growth over the control. Significant increases were observed in shoot height; root length; stem diameter; number of blossoms and fruit yield. However, the starter solution did not have as great an effect as the combination of AfriKelp® LG-1 and the starter solution or the AfriKelp® LG-1 alone. The best AfriKelp® LG-1 dilution to use was a 1:500 dilution, which resulted in tomato yield that was higher than the control, while a starter solution with an Afrikelp® root dip of 1:1000 dilution produced the next best yields over that of the control.

CONCLUSION

Starter solutions do have a benefit when applied to tomato seedlings. However, our data suggest that promotion of the root system through addition of a seaweed extract or other root promotion products, followed by starter solutions after 3 weeks will have the greatest benefit in reducing transplant shock and ultimately improving tomato yields.

ACKNOWLEDGEMENTS

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Keywords: Afrikelp®, seaweed extract, starter solution, transplant shock, tomato seedlings

DETERMINATION OF VITAMIN C LOSS AND SEED GERMINATION POTENTIAL OF GUAVA FRUIT PROCESSED BY SMALL-SCALE FARMERS IN THE EASTERN CAPE

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INTRODUCTION

Malnutrition and unemployment are major problems in rural areas of the former Transkei. Guava trees grow wild in the coastal areas and the fruit are known to be high in vitamin C (300mg/g) and other vitamins and minerals. Vitamin C is vital in strengthening the body's immune system, which helps combat diseases, making guava fruit ideal for inclusion in rural people's diets. However, as much as 90% of fruit is wasted due to its short shelf life and insect damage. Rural communities were taught to process guavas into juice, dried fruit and bottled fruit in order to increase fruit usage and to have it available for longer periods. However, teaching rural people guava processing raised two major concerns, namely 1) processing usually results in vitamin C destruction, and 2) a risk that the guava seeds, a waste product, may germinate in areas where guava is a declared weed. The aims of this study were therefore to determine 1) the loss of vitamin C during processing, and 2) the germination potential of seeds from processed guavas. In addition, the socio-economic status of community members participating in the processing training workshops was determined.

MATERIALS AND METHODS

To determine the socio-economic status of participants a questionnaire was to be completed by each participant, with a total of 1 000 questionnaires being completed in various villages in the OR Tambo district municipality.

For the seed germination study, 1 000 seeds from processed and fresh fruit were planted in seed trays and kept in a mist bed for eight weeks. After germination, the percentage germination was calculated. Fresh guava fruit were processed into pulp, juice, and dried fruit, and were also bottled. Vitamin C content was then determined for fresh guava fruit and all processed produce by titrating samples with 2,6-dichloroindophenol. Thirty replicates were used for each treatment.

RESULTS AND DISCUSSION

Participants of guava processing workshops were mostly unemployed females, between 30 and 49 years of age. They were mostly unschooled and dependant on government pensions and child support grants for income. Teaching these people processing skills held the potential for job creation and improved income generation for their homesteads.

Seed germination from fresh and processed guavas was 89% and 0.1% respectively. Processing probably killed the embryos, resulting in almost no germination. There is therefore no risk that problems with invasive weeds will arise from guava processing practises.

All processed guava products, with the exception of the pulp, had significantly lower vitamin C content than fresh pulp, which indicated vitamin C destruction during processing. However, all processed produce had higher vitamin C contents than the minimum recommended daily allowance, and was therefore still of high nutritional value.

CONCLUSION

High unemployment and poverty are realities in the rural areas of the Eastern Cape. Equipping people with skills, such as guava processing, can aid in job creation and income generation for unemployed people. Processing of guava fruit also improves usage of the highly perishable fruit, while the nutritional value of the fruit, in terms of vitamin C content, remains high. In addition, the risk that processing can contribute to the weed potential of guava is virtually nil.

Keywords: guava, processing, socio-economic, seed germination, vitamin C

CLAY MINERAL ASSOCIATIONS IN SELECTED SOILS OF THE CAPRICORN DISTRICT, LIMPOPO PROVINCE

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INTRODUCTION

Most soil clay minerals are secondary minerals formed by low temperature reactions through weathering. These minerals are highly reactive and greatly influence the chemical and physical properties of many soils. The Limpopo Province has a diversity of soils over a wide range of landscapes and climatic regions. This offers interesting research opportunities in terms of their physical and mineralogical properties. Weathering of the soil parent materials and soils has led to the formation of a wide variety of soil clay minerals. The main chemical reactions, such as hydrolysis, hydration, dehydration, oxidation, reduction and carbonation, take place in the solum as well as in the parent material and are responsible for the formation of new mineral products. Although a large volume of information is available on clay mineral associations in South African soils, site specific research and the implication of clay mineral suites to agricultural practices is still lagging behind. The objective of this study is to report on the distribution patterns of soil clay minerals and related agricultural implications from selected soils within Limpopo Province.

MATERIALS AND METHODS

A total of 21 samples were randomly collected from three soil types, namely Inceptic, Oxidic and Plinthic soils located in the Capricorn district. The soils developed from granites and gneiss parent materials. The collected samples were treated with sodium acetate buffer for the dissolution of carbonates and soluble salts. Hydrogen peroxide was used for the removal of organic matter. Separation of particle size fractions was achieved with the use of centrifugal and decantation methods. X-ray diffraction (XRD) analyses, X-ray fluorescence spectrometry (XRF) and scanning electron microscopy (SEM) techniques were used in determining the soil mineralogy and soil chemistry.

RESULTS AND DISCUSSION

XRD analyses showed that the clay fractions contain kaolinite, smectite and quartz with minor to trace amounts of feldspar and mica. Quartz was dominant within a range of 50% to 75%, followed by kaolinite (23% - 49%) and smectite (0% - 22%). XRF analyses revealed a general decrease in the amount of SiO₂ in the clay fraction as compared to the whole soil and rock fractions. Al₂O₃ and Fe₂O₃ showed an increase in the clay fraction with other elements in negligible amounts. The scanning electron micrographs of the clay fraction revealed hexagonally shaped thin platelets which are typical of kaolinite. However, these platelets were sometimes interbedded with semi-rounded particles.

CONCLUSIONS

The weathering of feldspar and mica played a governing role concerning the quantities of kaolinite and smectite in the samples. Mineralogical trends indicate that an alteration from primary to secondary minerals has taken place, but satisfactory conditions for complete weathering are still lacking. The booklet form of the kaolinite minerals in the area suggests their *in situ* origin whereas the smooth booklet form suggests a sedimentary origin. The dominance of quartz and kaolinite minerals is indicative of low soil fertility status, which will require fertilizer applications if increased crop yields are envisaged.

Keywords: X-ray diffraction, kaolinite, smectite, feldspar, mica

EXPLORING PHOSPHORUS EFFECTS ON MUCUNA PRODUCTIVITY ON A DEPLETED KAOLINITIC SAND SOIL IN ZIMBABWE

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INTRODUCTION

Phosphorus nutrition may increase symbiotic nitrogen fixation in legumes by stimulating host plant growth, nodule formation, root biomass and -function.

MATERIALS AND METHODS

The research work was carried out at the Grasslands Research Station, in Zimbabwe in 2007/08. The experimental design was a RCBD with 2 P treatments [P0 = 0 kg P ha⁻¹ and P40 = 40 kg P ha⁻¹] applied prior to planting a mucunacrop. The following parameters were investigated; biomass, leaf area index (LAI), nodulation data, N₂ fixed, foliar nutrient dynamics and yield indexes. Statistical analysis of the data was performed using the Statistica package (Software, version 8.02).

RESULTS AND DISCUSSIONS

The P40 treatment produced a significantly ($P < 0.05$) higher biomass (total dry mass) (95 g m⁻²) of mucuna than the P0 treatment (53 g m⁻²) at the flowering stage. The final pod yield was also 34 % higher in the P40 treatment (1.75 t ha⁻¹) compared to the P0 treatment (1.25 t ha⁻¹). There were significant differences ($P < 0.05$) between treatments in terms of pod quality as measured by protein and fibre content. Fibre content of the pods was 25 % higher in the P40 treatment while the protein content was 35 % higher. As was expected, N₂ fixation at flowering in the mucuna crop was highest (162 kg N ha⁻¹) in the P40 treatment compared to (89 kg N ha⁻¹) in the P0 treatment. This trend was also evident at maturity where the P40 treatment fixed 92 kg N ha⁻¹ compared to the 62 kg N ha⁻¹ fixed by the P0 treatment. The foliar P and Ca content also increased significantly ($P < 0.05$) in the P40 treatment compared to the P0 control while the N content increased by about 14.8%. This increase may be attributable to the positive effect of P on nodulation. Mg and K levels were higher (although not significantly) in the P0 treatment than in the P40 treatment. There were significant ($P < 0.05$) increases in Cu and Zn content in the P40 treatments. The results of this study on mucuna emphasized the important role of P in legume crops.

CONCLUSIONS

The results indicate that P plays a crucial role in mucuna productivity in a Kaolinitic sandy soil.

ACKNOWLEDGEMENTS

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Keywords: mucuna, productivity, P fertilizer

EFFECT OF HERBICIDES ON SORGHUM CULTIVARS AS AFFECTED BY SOIL TYPES

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INTRODUCTION

Grass control in sorghum is one of the most important aspects and presents a challenge to weed control. All the herbicides registered in South Africa for grass control in sorghum have to be applied pre-emergence with clay percentages possibly affecting severity of herbicide damage. A limited number of herbicides are registered for application on sorghum and dosage rates are to be applied according to registration to avoid damage to sorghum seedlings. Weed control in the first weeks after emergence is, however essential to obtain good stands and to minimize yield losses.

MATERIALS AND METHODS

A glasshouse trial was planted in soil collected from Bethlehem (19% clay) and Potchefstroom (35% clay). Cultivars planted included PAN8247, PAN8240 and PAN8609. Herbicides, applied pre-emergence, included S-metolachlor, alachlor and S-metolachlor/terbuthylazine at both standard and double the registered dosage rates. Control treatments received no herbicides. Time to germination, total seedlings emerged, visual phytotoxicity symptoms, plant height, chlorophyll fluorescence, chlorophyll content and dry mass per plant were measured.

RESULTS AND DISCUSSION

Visual symptoms observed during the observation period in sandy soil (19% clay) included whiplashing and thickening of the coleoptile. Cultivar effects were significant based on the PI_{ABS} values, chlorophyll content and mean plant height. Herbicide treatments and the cultivars X herbicide interaction had a significant effect on all parameters measured. Total seedling emergence was significantly lower where S-metolachlor (55.5%) was applied when compared to alachlor (67.2%), S-metolachlor/terbuthylazine (69.4%) and the control (68.1%) treatments. Mean germination time for the control, S-metolachlor and alachlor treatments was app. 8 days compared to only 6 days for seedlings in the S-metolachlor/terbuthylazine treatments. Mean plant height was significantly lower in all the herbicide treatments when compared to plants in the control treatment. The PI_{ABS} value was significantly lower in all sorghum cultivars treated with S-metolachlor/terbuthylazine (4.52), but PI_{ABS} values did not differ significantly between S-metolachlor, alachlor and the control treatments (9.85, 8.92 and 9.31, respectively). The latter indicates that plants treated with a triazine mixture were significantly more stressed when compared to herbicides containing only acetanilide as an active ingredient. PAN8247 had the lowest PI_{ABS} value of 4.09 for S-metolachlor/terbuthylazine treatments. The mean dry mass per plant was significantly lower for plants treated with alachlor (0.61g) when compared to the control treatments (0.96g).

Visual phytotoxicity symptoms in clay soil (35%) were observed as skew plants, rolled-up leaves, whiplashing and stunting. Most plants, however, out-grew the phytotoxicity symptoms and whiplashed plants were unfolded at 7 days after emergence. Cultivars had a significant effect on total seedling emergence, % phytotoxicity, plant height, dry mass per plant and PI_{ABS} . Herbicide treatments had a significant effect on phytotoxicity, dry mass per plant, chlorophyll content and PI_{ABS} . The cultivar x herbicide interaction was significant for phytotoxicity, dry mass per plant, chlorophyll content and PI_{ABS} . All cultivars emerged between 6 and 7 seven days after planting. Plants in control treatments had the highest mean dry mass per plant (0.5g) compared to those treated with S-metolachlor/terbuthylazine (0.4g). The same tendency with regard to the significance of PI_{ABS} values was observed in clay soil. PAN8420 had the lowest PI_{ABS} value of 0.993 in S-metolachlor/terbuthylazine treated pots. PAN8420 also showed the lowest dry mass per plant for all herbicide treatments.

CONCLUSION

Reaction of cultivars to herbicide applications differed between soil types when based on morphological parameters. Chlorophyll fluorescence (PI_{ABS} index), indicating physiological stress, was however significant lower in S-metolachlor/terbuthylazine treatments for all cultivars in both soil types.

Keywords: sorghum, herbicides, cultivars, soil type

RELATIONSHIPS BETWEEN SOIL CARBON AND SELECTED SOIL CHEMICAL PROPERTIES IN SOUTH AFRICAN SOILS

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INTRODUCTION

In South Africa, the arid climatic conditions lead to low inherent levels of carbon in soils. Management of soil carbon levels is therefore paramount to sustained agricultural production and the conservation of soil as a natural resource. The benefits of soil organic carbon (SOC) have been well documented. Links between SOC and other soil properties can improve the understanding of organic carbon in the soil and are important to the further investigation of the dynamics of SOC.

STUDY AIM

The aim of the study was to construct a generalized soil organic carbon map for South Africa and compare SOC levels with selected soil properties which included CEC, micro-nutrients and selected soil particle size fractions.

MATERIALS AND METHODS

Data were obtained from the ARC-ISCW Soil Information System. It came from various sources, mainly Land Type Survey samples. All the samples were from South African soils and only A-horizon data were used. Appropriate adjustments were made to the data to allow for the different methods of analysis used for some of the soil properties over the years.

Data were cleaned to remove any duplicate x- or y-coordinates and only samples with C-data were used. Data were used irrespective of land use and were further screened according to the selected soil parameters. A different set of data was used for correlation with CEC, micro-nutrients, particle size fractions, as well as the construction of the soil carbon map, respectively (four sets of data), since all the samples in the dataset did not contain analyses for all the selected parameters. Between 2278 and 4538 records were used for deriving correlations and construction of the soil carbon map.

STATISTICAL ANALYSIS

SOC was correlated with soil chemical and physical properties by means of quantile regression analysis. This does not indicate a direct relationship between the SOC and the measured parameters, but provides a range of expected values for the dependent variable that can be expected for each independent variable available on the graph.

RESULTS AND DISCUSSION

Strong positive correlations of SOC were found with CEC, micro-nutrients (Cu, Co, Mn and Zn), as well as the particle size fractions of clay, fine silt and fine-silt-plus-clay. The order of correlation with the micro-nutrients from highest to lowest correlation was: $\text{Cu}^{2+} > \text{Co}^{2+} > \text{Mn}^{2+} > \text{Zn}^{2+}$. In terms of the particle size fractions, the fine-silt-plus-clay fraction showed the strongest quantile regression relationship with organic carbon, followed closely by clay and fine silt.

CONCLUSIONS

The results of this study confirmed the important role that organic carbon plays in influencing the magnitude of general soil fertility parameters. This study indicated that there is merit in the investigation of the role of SOC in soil chemistry. This includes the potential alleviation of heavy metal pollution, and an increase in the general soil properties that would enhance the productivity of soil for agricultural use.

ACKNOWLEDGEMENTS

Thank you to the ARC-ISCW for funding this project and to Mrs. M. van der Walt for her help with extracting the requested data from the Soil Information System.

Keywords: Soil C, CEC, micro-nutrients, clay, silt

MAIZE (*Zea mays* L.) GRAIN YIELD RESPONSES TO INTERCROPPING AND WEEDS INFESTATION

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INTRODUCTION

Intercropping is normally practiced under limited soil fertility and low input conditions in the tropics. Its advantages include high overall yield, maximum usage of natural resources and efficient use of production inputs (Baldy & Stigter, 1997). Maize and cowpea are the major food crops grown by small-scale farmers in South Africa especially in the Limpopo province. Crops could suffer 40 to 53% yield reduction when exposed to weed infestation. Different maize yield responses to legume intercropping have been reported. Throughout southern Africa, yield is reduced by adverse weather conditions and droughts, resulting in low maize productivity by small-scale farmers (Myaka *et al.*, 2006). Therefore, there is a need to investigate the response of component crops to environment and weed infestation level. The aim of this study was to investigate the effects of intercropping different cowpea cultivars and weed infestation levels on maize grain yield.

MATERIALS AND METHODS

Field trials were conducted at Bethlehem and Potchefstroom during the 2005/06 and 2006/07 seasons in a randomized complete block design (RCBD) with three replications. The experiment consisted of 14 treatments combinations. Three cowpea cultivars with contrasting growth durations were used, namely, PAN311 (short duration), Glenda (medium duration) and Agrinawa (long duration). These were intercropped with the maize cultivar PAN6479 including sole crops for maize and each cowpea cultivar (main plots). The sub-plots consisted of two levels of weed infestation (weeds and zero weeds). The density for maize and cowpea were 18 000 and 66 000 plants ha⁻¹, respectively with 1.5 m spacing between the rows. Pre-plant nitrogen fertilization was applied by broadcasting LAN (28%) at a rate of 10 kg ha⁻¹ and Super-phosphate (MBONAFOS 10.3%) at 60 kg ha⁻¹ at both locations. All cowpea cultivars were inoculated with Akkerbonepak[®]50, at the rate of 700ml 50 kg⁻¹ seed before planting. At harvest, the two middle rows were harvested for all maize treatments and grain yield was determined. Data were subjected to analysis of variance (ANOVA), using the program Statistix Version 8.1 and the differences between the treatment means were separated using the LSD_{0.05}.

RESULTS AND DISCUSSION

At Bethlehem, maize grain yield was significantly affected by cropping system and weed infestation during both seasons. During the 2005/06 season, maize monocrop produced significantly higher grain yields (4615.0 kg ha⁻¹) than all the intercrop treatments, except for maize intercropped with PAN311 (4044.6 kg ha⁻¹). During the 2006/07 season, weed infestation resulted in a 41.7% reduction in maize grain yield. This gave a clear indication of the significant detrimental effects of intercropping and weed infestation on maize grain yield under limited rainfall conditions.

At Potchefstroom significant differences were observed in cropping system and weed infestation during the 2005/06 season, and by only the weed infestation treatment during the 2006/07 season. In the warmer and drier conditions of Potchefstroom yields were severely affected by the presence of weeds, especially during the 2006/07 season.

CONCLUSIONS

At both locations maize grain yield was significantly affected by cropping system with maize monocrop having higher yield than the intercrop treatments. In general, weed infestation reduced maize grain at Bethlehem and Potchefstroom by 26.4% and 8.4% respectively.

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Keywords: cropping system

GENETIC MAPPING AND QTL ANALYSIS OF FLOUR COLOR USING RECOMBINANT INBRED LINES IN HARD RED SPRING WHEAT

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INTRODUCTION

Flour color is an important trait used to assess flour quality. Flour color based on L^* (brightness) and b^* (yellow–blue) values is used to evaluate flour from hard red wheat. For bread making, a white flour with zero value for b^* and 100 for L^* is desirable. However, evaluation of flour color is often not practical for breeder's selection at the early stages of a breeding program. With the advent of molecular markers, breeders can select for this trait at an early stage of breeding.

In this study, quantitative trait loci (QTLs) affecting flour color were mapped in hard red spring wheat breeding lines adapted to the upper Midwest region of the U.S.

MATERIALS AND METHODS

Plant Materials: Mapping was conducted using a population of 140 recombinant inbred lines (RILs, F6:8) developed from the MN98550 x MN99394 cross. Field trials included parents, RILs, and three check cultivars grown in three Minnesota locations in 2006. Flour samples were evaluated for flour color based on L^* and b^* values using a Minolta Chroma CR-200 meter.

Marker Assay and QTL Analysis: A total of 212 SSR markers were assayed using the ABI 3130xl Genetic Analyzer and GeneMapper software. Genetic linkage maps were constructed using Mapmaker/Exp. 3.0b (Lander *et al.*, 1987) with centiMorgans (cM) based on the Kosambi mapping function. QTL analysis was performed using composite–interval mapping in WinQTL Cartographer v. 2.5 (Wang *et al.*, 2005). A QTL was declared when the LOD score was greater than a significant threshold level.

RESULTS AND DISCUSSION

A stable QTL on chromosome 5DS, closely linked to *Xbarc130*, explained up to 20% and 16% of the total variation in L^* and b^* , respectively. A second QTL on chromosome 3D, closely linked to *Xgwm383*, explained up to 8% of the total phenotypic variation in b^* and was detected in two of the three environments. Previous studies reported QTLs on chromosome arms 2DS, 3AS, 3BL, 4BS, 5BL, 7AL, and 7BL (see review by Marshall *et al.*, 2001).

Because some of the QTLs identified in this study were consistent across environments, the SSR markers linked to these QTLs may be useful in increasing the frequency of desirable alleles during the early generations of breeding.

ACKNOWLEDGEMENTS

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Keywords: Wheat, Flour color, Quantitative trait locus

PRELIMINARY STUDY ON THE EFFECT OF CONCENTRATION OF CORASIL E ON FRUIT SIZE AND YIELD OF DELTA VALENCIA AT ADDO RESEARCH STATION, EASTERN CAPE

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INTRODUCTION

Augusti *et al.* (1992) used 2,4-DP (Corasil E™) on 'Clementine' mandarin. At applications of up to 100 mg/L fruit size increased, when the treatment was applied just at the end of the physiological fruit drop period, and average fruit size of 'Clementine' was around 20mm in diameter at the time of 2,4-DP application. It was found that 50mg/L was most effective in fruit size improvement when 2,4-DP was applied to Clementine mandarin just before the end of the physiological drop period (Vanniere and Arcuset, 1992). Augusti (1994) applied 2,4-DP to 'Satsuma' mandarin and found that the response depended on time of application and concentration applied. When the auxin was applied at the end of physiological drop, 50 mg/L was the most effective treatment for increasing fruit size, with later application requiring higher concentrations. Their treatments did not thin the fruit, possibly because they sprayed too late (15 July 1988 and 01 August 1988, N.H.). This study aims at determining the effect of concentration of Corasil E on Delta Valencia oranges at Addo Research Station, in the Eastern Cape, in order to establish correct concentrations under different climatic conditions.

MATERIALS AND METHODS

The trial was conducted at Addo Research Station, near Addo. Nine-year old Delta Valencia budded to Carrizo citrange rootstock was used in the trial. The trial was laid out as a randomised complete block design with 4 treatments and 4 single-tree replications. Corasil E™ was sprayed at 0 mg/L, 50 mg/L, 100 mg/L, and 150 mg/L as a medium cover spray. Spraying was done on the 30 November 2008. At the time of harvest, yield and fruit size distribution was done using the research station's manual fruit sizing machine, with the fruit graded in different size classes.

RESULTS AND DISCUSSION

The average fruit size at the time of spraying was 20 mm in diameter. The 100 mg/L concentration of Corasil E™ resulted in an 8,7 % improvement in the size range 68 – 72 mm, and a 15 % size improvement in the size category 4: 73 – 77 mm. Yield tended to be highest with 100 mg/L, followed by 150 mg/L and was higher in the control than the 50 mg/L application.

CONCLUSIONS

Corasil E™ improved fruit size and increased yield on Valencia Delta oranges when applied at 100 mg/L concentration.

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Keywords: Fruit size, Fruit quality, Delta Valencia, Yield

DETECTION, QUANTIFICATION AND MONITORING OF PROSOPIS IN THE NORTHERN CAPE PROVINCE OF SOUTH AFRICA USING REMOTE SENSING AND GIS

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INTRODUCTION

Prosopis was introduced to South Africa from North America by 1880 to provide shade, wood for fuel and pods for fodder. *Prosopis* species and their hybrids became invasive in the arid northern parts of South Africa because of their adaptability, vigorous growth, seed production, seed banks, absence of natural seed-feeding insects and efficient seed dispersal mechanism.

There is evidence that *Prosopis* has spread at an alarming rate in South Africa over the past decades, but the rate and spatial extent have never been quantified. Serious consequences of the rate and spread of *Prosopis* in the Northern Cape Province include:

- The loss of agricultural potential of an already limited resource in this arid and semi-arid region of the country.
- Mono-stands of *Prosopis* have a negative impact on the already over-utilized drainage lines where it competes with other species and reduces the carrying capacity of the rangeland.
- *Prosopis* has a negative impact on the scarce water resources of the area because it is usually found in areas with higher groundwater reserves.

The objectives of the study are to:

1. Identify and quantify *Prosopis* at different spatial and temporal rates by means of remote sensing.
2. Determine the invasion history of *Prosopis* by accessing historical data over the past 30 years.
3. Reveal the spatial dynamics of *Prosopis* spread and the areas susceptible to future invasion.

Historical archives of imagery from a range of sensors with different spectral, spatial, temporal and radiometric resolutions, provide a unique opportunity to determine the effectiveness of remote sensing to detect, quantify and monitor *Prosopis* in the South African environment.

MATERIALS AND METHODS

The use of MODIS satellite data for quick assessment of the status of *Prosopis* distribution on a provincial level has already been done. This was based on the phenological growth patterns of *Prosopis*, which are measured by means of Normalized Difference Vegetation Index (NDVI) values obtained from MODIS satellite imagery.

RESULTS

A model was developed to analyze different data objects and identify relationships between them. This model derives new maps of the likely occurrence or magnitude of spread of *Prosopis*. The aim will be to assign four density classes within these probability classes.

Given the success of using a sensor such as MODIS to detect and quantify *Prosopis* stands, the possibility should be further investigated to use Landsat TM data and the NOAA archive, given it's availability over the last 20 years, to obtain an invasion history for *Prosopis*. The purpose of such work is to determine the dynamics of *Prosopis* encroachment over time.

CONCLUSIONS

This information, together with flow accumulation data, can be used to obtain an invasion risk index for an area. These results could assist with management interventions to control the spread of *Prosopis* and protect un-invaded high risk areas. It would further provide the information required to establish an effective permanent monitoring programme for *Prosopis* by stratifying a large area into more meaningful units to be used in a possible remote sensing or sampling approach.

Keywords: *Prosopis*, Remote sensing, GIS

SOIL BASED WETLAND DELINEATION OF THE VOGELSTRUISBULT WETLAND, SPRINGS

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INTRODUCTION

The Vogelstruisbult wetland in Springs has been impacted by a range of activities in the past that included gold processing and the subsequent spilling of acid gold tailings material into the wetland. In 2005 the Department of Water Affairs and Forestry (DWAF) published a manual entitled "A practical field procedure for identification and delineation of wetland and riparian areas" (DWAF, 2005). Although simple in its approach the application of the guidelines in pedologically and geologically complex areas poses numerous challenges (as was the case for the Vogelstruisbult wetland).

MATERIALS AND METHODS

A free grid detailed soil survey was conducted on the wetland site. Soil samples (60) were collected at points that were deemed to be representative of specific site conditions and submitted for chemical, physical and mineralogical analysis at the ARC-ISCW in Pretoria. Soil survey and analysis results were interpreted to provide a delineation of the wetland as well as classification of zones with specific management requirements.

RESULTS AND DISCUSSION

The general wetland area is characterised by three distinct soil zones namely: 1) dolomite derived deep Hutton and Lichtenburg soils in the north; 2) sandy and light coloured soils in the south and soils predominantly of the Rensburg soil form within the wetland. The bulk of the wetland area has distinct "Gilgai" character. The soils on the transition between apedal and vertic soils are characterised by significant colour variation that would usually be classified as of the Neocutanic B-horizon (Oakleaf and Tukulu soil forms).

The ingress of acidic gold mine tailings into the wetland has led to areas where vertic soils have been acidified. Large pH gradients were observed within soil profiles (decreasing vertically approaching the soil surface) as well as decreasing with increasing proximity to washed-in acidic tailings material. The pH buffer capacity of the vertic soils as well as the presence of "Gilgai" led to the isolation/conservation of the central part of the wetland with a subsequent high biodiversity value.

CONCLUSIONS

The survey results and their interpretation provide guidance on the future management and restoration of the Vogelstruisbult wetland. A major conclusion is that the presence of the highly buffered vertic soils has provided natural mitigation for the spilled acidic goldmine tailings material to such an extent that a significant part of the wetland can still be considered to be in almost pristine condition and that minimal impacts are expected on the Blesbokspruit. The survey results also point to a few critical flaws in the DWAF wetland delineation guidelines (DWAF, 2005) regarding the categorisation of vertic soils. Following from the study a number of recommendations are made regarding the categorisation of vertic soils during wetland delineation exercises.

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Department of Water Affairs and Forestry (DWAF). 2005. A practical field procedure for identification and delineation of wetland and riparian areas. DWAF, Pretoria.

Keywords: Wetland Delineation, Vertic Soils, Gilgai, Goldmine Tailings, Acidification

EFFECT OF SOIL AMENDMENT ON APPLE TREE GROWTH AND PRODUCTION IN FUMIGATED AND UN-FUMIGATED REPLANT SITES

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INTRODUCTION

There has been increasing interest in using soil microorganism amendments to improve plant productivity, but very few studies have been carried out in modern orchard systems (Neilsen *et al.*, 2003). Apple replant disease (ARD) may occur when new apple orchards are established on replant sites (Mazzola, 1998) and is characterised by slow tree growth and poor production. Due to a complex biological etiology, ARD may be controlled by fumigation using Methyl Bromide. A more acceptable treatment, both environmentally and economically, may be soil amelioration with biologically active soil microorganisms. The stimulation of the indigenous microflora can be a more viable option than the introduction of specific foreign microbial strains. By creating an environment that supports high and active populations of microorganisms, tree performance may be improved (Lockwood, 1990). The objective of this study was to evaluate a commercial preparation, developed to stimulate microbial activity in the soil, on two apple cultivars, in a fumigated and un-fumigated replant site in the Elgin area.

MATERIAL AND METHODS

Four concentrations of a microbial food source were applied monthly, for eight months during the growing season, to the root zone of poorly growing Sundowner and Fuji apple trees planted in un-fumigated and fumigated replant soil respectively. Tree growth and soil microorganism content were recorded before, during and after treatment, throughout the season and growth and production recorded at the end of the season. Leaf mineral content and fruit quality analyses were conducted.

RESULTS AND DISCUSSION

The highest treatment concentration resulted in visibly higher tree volume but tree growth differences measured as shoot length were not significant. There was also a tendency for the highest product concentration to give the best shoot and trunk diameter growth, but with poorer yield and production efficiency. This could have resulted in the better fruit size with the higher product concentrations. There were significant effects on leaf mineral levels and increased concentrations of N, and K were positively related with increased treatment concentrations. There were no significant treatment effects on growth or production of Sundowner. There was however, an indication that yield efficiency was highest with the second lowest dosage. There were positive responses in leaf mineral content for N, Mg and B, while P, K, and Fe decreased with increased treatment concentration. No differences were found in fruit quality for any of the parameters measured, for either of the cultivars. Soil microbial populations will be investigated.

CONCLUSIONS

Although there were significant changes in leaf mineral content, soil microbial food supplements had no clear effects on tree growth or production within one season and trends observed need to be investigated further. It is possible that higher treatment concentrations improved tree vigour, but only in the fumigated orchard.

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Keywords: apple replant disease, bacteria, fungi, soil fumigation

THE BENEFITS OF HAND THINNING NULES CLEMENTINE MANDARINS

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INTRODUCTION

Although hand thinning is a common practice in deciduous fruit production, not many citrus growers use it because it is very labour intensive. An economic premium is paid for larger fruit and the income from the smaller fruit is often less than the picking and transport costs. Previous results indicated that a large proportion of fruit must be removed in order to affect fruit size positively. Fruit thinning usually causes a certain reduction in total fruit yield, although the smaller yield may be of higher commercial value. The objective of this study was to determine if hand thinning results in any benefit other than an increased fruit size.

MATERIALS AND METHODS

Nules Clementine trees on Troyer citrange rootstock in the Porterville area were used for the study. On 7 December 2006, 12 single trees in a complete randomized block design were left un-thinned or all fruit <21 mm were hand thinned from 12 trees, respectively. The number of fruit removed and the time taken to thin each tree were recorded. Fruit on all tree replicates were tagged for monthly fruit size measurements. Total yield (kg/tree) and fruit size per tree were determined at harvest.

RESULTS AND DISCUSSION

Hand thinning increased fruit growth and fruit size significantly, but had no significant effect on yield, although it resulted in an 11% yield reduction. The total time taken to thin and harvest was the same for the two treatments, but harvest took longer on the un-thinned control trees compared to the thinned trees.

CONCLUSIONS

Therefore hand thinning, by removing small unmarketable fruit early in the season, reduced the harvest time of a slightly lower crop load of larger, more marketable fruit. This is especially important for harvesting Clementines in the Western and Eastern Cape, since these are harvested at the start of the rainy season.

Keywords: Fruit size, yield, harvest time, alternate bearing

HERBICIDAL CONTROL OF PINK TAMARISK (*Tamarix ramosissima* LEDEB.) BY CUT-STUMP AND COPPICE TREATMENTS

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INTRODUCTION

Pink tamarisk (*Tamarix ramosissima* Ledeb.), a native of Europe and Asia, was originally introduced into South Africa as shade and ornamental trees, but has become invasive in river systems and around dam sites, with potentially serious environmental and economic consequences. Due to a very high transpiration rate, mature plants can impact heavily on groundwater resources and by dropping the water table can drastically alter floristic composition in heavily infested areas. Furthermore, the leaves excrete salts that are deposited on the soil surface, which inhibits germination and growth of the endemic riverine vegetation. The congestion of waterways also promotes sedimentation, over-bank flooding and soil erosion.

In terms of the Conservation of Agricultural Resources Act (No 43 of 1983, amended 2001), pink tamarisk is a declared invader plant in South Africa. Yet, no formal guidelines exist for its control. Preliminary investigations showed that neither fire nor cutting will kill the plant and no herbicides are presently registered for individual plant control. The objective of this study was to evaluate the cost and efficacy of different herbicides, concentrations and application methods for control of pink tamarisk.

MATERIALS AND METHODS

The upper reaches of the Darlington Dam (30° 06'S; 25° 06'E) is one of the main areas of pink tamarisk invasion in the Eastern Cape Province, of which a section along the inlet of the Sundays River was chosen as the study area. Two methods of herbicide application were evaluated: (1) cut-stump treatment and (2) foliar treatment. For cut-stump treatment, random groups of ten plants were cut close to the ground and herbicide applied to the freshly cut surfaces at low pressure by means of a compression sprayer. Multiple stems deemed to originate from the same root system were collectively treated as one plant. For coppice treatment, some groups of ten plants were cut and left to sprout before herbicide was applied to the foliage at high pressure by means of a compression sprayer. Coppices were about 0.25 - 0.5m tall at the time of treatment. Different concentrations of the herbicides Imazapyr 100 SL, Triclopyr 480 OL, Fluroxypyr 200 EC and Glyphosate 360 SL combined with a sticker-penetrator (2% Complement) in water were applied individually to a group of test plants, either as cut-stump or coppice treatments. All treatments were replicated three times. Separate trials were conducted during early summer (November) and autumn (April) to test for seasonal variation in herbicide efficacy.

RESULTS AND DISCUSSION

Triclopyr (4%), Imazapyr (4%) and Glyphosate (66%) proved most promising for cut-stump treatment, while Fluroxypyr (1.5-3%), Imazapyr (1.5-3%) and Glyphosate (12%) proved the best for coppice treatment. These treatments killed more than 80% of the test plants, which was considered an acceptable level of control under practical field conditions. While the registration of a single product, like Imazapyr, for both cut-stump and coppice treatment is of practical significance, Fluroxypyr (1.5%) or Glyphosate (12%) would be environmentally more acceptable for foliar spraying in water courses. The average spray volume for treating all the cut surfaces in one hectare of dense infestation was 105 (\pm 43; n=4) litres. Not treating the cut stumps and allowing them to sprout required approximately 2.2 times more spray volume to treat all the coppice growth.

CONCLUSION

Based on economic and environmental considerations, Imazapyr is recommended as the herbicide of choice for cut-stump treatment and Fluroxypyr for foliar treatment of any surviving individuals or new plants originating from the soil seed-bank. Further trials with these products for the purposes of registration against pink tamarisk is strongly advised.

Keywords: tamarix, ramosissima, herbicide, control

CONTROL OF FLOWERING TIME IN PROTEA 'PINK ICE' BY MEANS OF EXOGENOUS CYTOKININ APPLICATION

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INTRODUCTION

Members of the genera *Protea*, *Leucospermum* and *Leucadendron* are predominantly grown in South Africa for export to Europe. A number of *Protea* species such as *P. magnifica* flower in the desired marketing window of September to January. However, many of the superior *Protea* hybrid cultivars currently available to growers, including *Protea* cv. 'Pink Ice' (*Protea compacta* X *Protea susannae*), flower only in late March to June. Nieuwoudt (2006), demonstrated plasticity in the bearing habitat of 'Pink Ice' during the development of a biennial pruning regime. Pruning in March advanced the normal flowering time to between December and January, but pruning in June, which gave the best income per plant, was commercially recommended. However, irrespective of pruning month, flowering rarely occurred (<4%) from June to November and was usually between December and May. This study reports on the effect of 'out of season' initiation of inflorescences, by means of exogenously applied cytokinin to the autumn flush, in order to advance the flowering time of 'Pink Ice'.

MATERIAL AND METHODS

The trial was conducted in a commercial orchard of *Protea* cv. Pink Ice, located in the Hopefield district, where a biennial pruning regime is used. MaxCel™ at 500mg.L⁻¹ with benzyladenine (BA), 1.9% active ingredient, was applied to the terminal bud of four flush shoots either in the dormant or the 'green point' phenological bud stage. Ten applications were made on a weekly basis from 27 March to 2 June 2008. On each date, ten shoots were treated within a block, with blocks replicated five times per each phenological stage. The phenology of treated and control shoots, such as percentage induced budbreak and inflorescence initiation, on the induced autumn flush, were recorded.

RESULTS

Benzyladenine (BA) successfully induced between 70-94% budbreak of dormant shoots when treated between 27 March and 24 April. Lower budbreak percentages of dormant shoots were recorded for later treatments. Shoot extension, following the application of BA to 'green point' bud stage shoots, proceeded normally. Flowering percentage on the BA-induced autumn flush varied significantly across treatment dates. A peak of 'out of season' inflorescence initiation of 46-56% occurred between treatment dates 10 to 24 April. Cytokinin application to shoots in the 'green point' bud stage had a higher efficacy than applications to dormant shoots.

DISCUSSION

'Out of season' inflorescence initiation in autumn could be achieved with varying success by BA application to four-flush shoots of 'Pink Ice'. As floral initiation was advanced by approximately five months, an earlier harvest time within the required September to November marketing period can be expected. Floral initiation on the autumn flush is dependent on the ability of the flush to be released from dormancy. Shoots however remained largely dormant from the end of April onwards, a condition that coincided with declining temperatures. BA application to 'green point bud stage' shoots had a higher incidence of floral initiation, as these shoots were more likely to be metabolically active, showing a higher responsiveness of the meristem to the presence of cytokinin.

CONCLUSION

The use of exogenous cytokinin to advance flowering time of 'Pink Ice' to fall within the pre-Christmas marketing period holds promise for commercial application.

ACKNOWLEDGEMENTS

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Keywords: Proteaceae, benzyladenine, flowering time, European markets

IN VITRO PROPAGATION OF PEACH SCIONS

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INTRODUCTION

The distribution of plant germplasm with desirable horticultural characteristics to foreign countries is becoming more important nowadays. Restrictive laws in many countries reduce the availability of imported plant material. *In vitro* propagation techniques can overcome these problems and allow for production of large numbers of genetically homogeneous and pathogen free plants. The availability of new cultivars from foreign breeding programs in has increased the interest in producing large quantities of peach plant material *in vitro*. Various factors influence regeneration from axillary buds and rooting in plant tissue culture. The aim of the study was to establish efficient micropropagation protocols for peach scions.

MATERIALS AND METHODS

Actively-growing shoots from a greenhouse-grown peach (*Prunus persica*) selection 1-1P were used for *in vitro* culture establishment. The shoots were established and proliferated on the basal salts of Murashige and Skoog containing 1 or 2 mg/L BAP and various vitamin supplements. The elongation of shoots on the same basal medium containing 0.1mg/l BAP and 1.00 mg/l IAA was tested, and rooting experiments were performed in a series of experiments using two sources of Fe, and two concentrations of the auxin IBA. All cultures were grown at 24°C under a photoperiod of 16 hrs light and 8 hrs dark.

RESULTS AND DISCUSSION

During proliferation, the addition of 1 mg/L BAP to the medium resulted in the best quality shoot cultures. The concentration at 2mg/L resulted in hyperhydricity of the shoot cultures. The elongation medium supported explants which suffered from tip die-back and therefore this step was discontinued. Rooting on the iron FeEDDHA source was 65%, whereas on FeEDTA the rooting was 43%. The IBA concentration at 0.3mg/L resulted in 69% of rooted plants, and at 0.4 mg/L 40% of shoots developed roots. The *in vitro* rooted plants were successfully acclimatized under greenhouse conditions.

CONCLUSIONS

Peach scion material produced good quality shoots on a medium containing 1 mg/L BA, and rooting was best on a medium containing FeEDDHA supplemented with 0.3 mg/L IBA.

Keywords: Tissue culture, *Prunus persica*

INDIRECT DETECTION OF FUSARIUM IN MAIZE BY NIR HYPERSPECTRAL IMAGING

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INTRODUCTION

Near infrared (NIR) hyperspectral imaging is an emerging analytical technique that integrates conventional digital imaging and NIR spectroscopy to attain both spatial and spectral information from an object (Koehler *et al.* 2002). It is, therefore, not only capable of identifying the chemical components and determining the concentration present in a sample, but it is also able to indicate location.

Fungal growth in maize (*Zea mays*) can occur during crop growth, harvesting or storage (Gelderblom *et al.*, 1984). When cereal grains are colonised by fungi (*Fusarium*), contamination with mycotoxins of these fungi can occur. These toxins are natural contaminants of cereal grains and mostly found in maize. Currently fumonisins are mainly quantified by HPLC. HPLC is an accurate, but slow and expensive analysis, requiring chemical reagents. The possibility of using a NIR hyperspectral imaging system to indirectly detect *Fusarium* infection in whole maize kernels, non-destructively, was evaluated.

MATERIALS AND METHODS

Whole maize kernels (uninfected, infected with no visible fungal growth, infected with visible fungal growth) were selected and NIR hyperspectral images were acquired using an InGaAs camera (Spectral Dimensions, Malvern) (960-1662 nm). The transformation to absorbance was made using Spectralon reflectance standards and the ISys (v. 4.0) software. Evince (v. 2.0.20) software was used for image cleaning on principal component analysis (PCA) score images and score plots. Cleaned images were further subjected to exploratory interactive multivariate analysis (Evince v. 2.0.20) using PCA and partial least squares-discriminant analysis (PLS-DA).

RESULTS AND DISCUSSION

By evaluating score plots and identifying clusters for projection onto the associated score images, it was possible to find regions of different histological composition in the kernels. This produced classification images that were clearly different for visibly infected and non-infected kernels. Similarly, the slightly infected kernels (no visible fungal growth) could be distinguished as being different from non-infected kernels. The interpretation of important wavelengths and their associated functional groups was confirmed in the corresponding loading line plots. After 10 PLS factors 28% of the variation had been modelled and predicted.

CONCLUSION

Differences between the various kernels can be seen using NIR hyperspectral imaging; however these findings need to be confirmed chemically. With additional research NIR hyperspectral imaging can be used to indirectly determine the possible presence of fumonisins on maize kernels and other cereal grains.

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Keywords: Principal component analysis, fungal infection, Partial least squares-Discriminant analysis

DETERMINATION OF WATER STRESS TOLERANCE IN WILD WATERMELON (*Citrullus lanatus*) DURING THE SEEDLING STAGE

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INTRODUCTION

Wild watermelon (*Citrullus lanatus*) is an indigenous crop of southern Africa. It is cultivated by subsistence farmers throughout the summer rainfall areas of South Africa and its flesh is used as a vegetable. Commercially, wild watermelon has a potential for marketing as a major ingredient of jam. Despite its importance as a food crop, studies of water stress tolerance in local germplasm of wild watermelon were not found in South Africa. Stress physiology studies conducted under controlled environment conditions in Asia showed that wild watermelon response to water stress can be determined by accumulation of citrulline (Kawasaki, *et al.* 2000). The objective of this study was to determine seed performance and water stress tolerance in the local germplasm of wild watermelon under controlled environment conditions.

MATERIALS AND METHODS

Seeds of wild watermelon were donated by subsistence farmers and used to produce fresh seed lots during the 2006/2007 season at Pietermaritzburg, KwaZulu-Natal (29°35'S 30°25'E). Three varieties differing in terms of seed colour (red, brown, and dark-brown) and rind morphology were germinated according to international seed testing rules (ISTA, 1999). Seed germination was monitored daily and six days after the final count (day 14), seedling size and normality were determined (AOSA, 1992). Three growing media (sand, pine bark and a mixture of sand + pine bark) were watered continuously to maintain three separate water content regimes at 75% FC, 50% FC and 25% FC. Seeds were planted in each medium to determine seedling emergence in a glass house maintained at 27/17°C day/night temperature and 60% RH. Emergence was determined by counting the number of emerged seedlings everyday for three weeks. Seedlings were then harvested and seedling length, shoot mass, root mass, and leaf area were determined.

RESULTS AND DISCUSSION

Seed germination was low, ranging from 40% to 59% across seed colours, and there were significant differences ($p < 0.01$) between seed types. Brown seeds displayed the lowest germination (40%) compared with the other two seed types (~ 59%), which were not significantly different. Interestingly, the highest seedling vigour was shown by brown seed seedlings, which were significantly ($p < 0.01$) larger than those of red and dark brown seeds. There were also significant differences among seed colours ($p < 0.01$) and water regimes ($p < 0.01$) with respect to seedling emergence, but there were no significant differences with respect to growing media ($p > 0.05$). Red seeds displayed the highest emergence (~ 51%) followed by the brown seeds (~ 44%) and dark seeds (~34%), respectively. Unexpectedly, 50% FC had the highest emergence (~50%) compared with 75% FC (~48%) and 25% FC (~31%) across all media. The mixture of sand + pine bark displayed similar total emergence to that of sand, which was better than that of pine bark alone. There was a significant media X FC interaction ($p < 0.001$). Seedlings planted in the mixture of sand + pine bark performed best when FC was 50%, but at 25% FC it was those that were planted in sand alone that showed the highest emergence. For seedling size, pine bark displayed the best performance, followed by mixture of sand + pine bark and sand alone, respectively.

CONCLUSIONS

The findings of this study showed that seed performance under laboratory conditions is not influenced by seed colour. However, seedling emergence and growth differ with seed colour under differing water regimes and growing media. Since colour represents local variety, this finding suggests differences in local germplasm, in terms of response to water stress early in plant development. Although dry conditions (25% FC) reduced seedling emergence and seedling growth, growing wild watermelon under water content levels greater than 50% FC may reduce emergence.

Keywords: Wild watermelon, germination, emergence, seed colour, field capacity, growing media

POTENTIAL USE OF DRY SPELL INFORMATION FOR FARMER IN-SEASON DECISIONS

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INTRODUCTION

In semi-arid areas rainfall is known to be irregular in its occurrence and the rainfall distribution is uneven through the season. Prolonged dry spells can have a noticeable negative effect on crop growth rate and development. Several prolonged (greater than 10 days) dry spells have occurred at Glen, which have caused evident decline in crop production under rainfed agriculture. The results show that there are at least three to four dry spells above 10 days in a period of two to three months. Sequences of dry spells occur in both wet and dry years. Prediction of prolonged dry spells can assist farmers in making informed decisions regarding which farming strategies to execute, e.g. when to plant, weed, apply fertilizers, determine whether the weather conditions favour insects and disease infestation, shear sheep, cut lucerne, select crop cultivars, etc. The study also looks at the correlation between monthly rainfall and the Southern Oscillation Index (SOI).

MATERIALS and METHODS

A long-term daily rainfall dataset of 49 years for Glen Agricultural College weather station was selected for dry spell analysis. The focus of this work is assessing the occurrence of dry spells on a seasonal basis. The INSTAT PLUS statistical package was used to predict the probabilities of more than 7, 10 and 15 days dry spell length with a 0.85 mm per day threshold. The long-term daily rainfall dataset for the Glen station was obtained from the ARC-ISCW databank. INSTAT PLUS was used to analyze dry spell length probability. The SOI values were downloaded from the International Research Institute for Climate and Society website. Focus groups were held to determine how the farmers cope with prolonged dry spells.

RESULTS and DISCUSSION

The prediction of a prolonged dry spell will allow the farmer to prepare for supplementary irrigation, do weeding, and apply mulch where possible. Farmers are advised to plant when the pre-planting soil moisture content is optimal. RESULTS show the SOI and monthly rainfall for the past 49 years as well as the probability of receiving dry spells of above 7, 10 and 15 days. Dry spells of greater than 10 days occur frequently in semi-arid areas. A prediction was found with a lead time of one month under the strong La Nina experienced in 1953-56 and a strong El Nino (SOI ≤ -2) in 1982-83. The SOI and rainfall correlation shows that, when dry conditions occurred at Glen the SOI values were strongly El Nino while wet conditions occurred at SOI values indicating La Nina.

CONCLUSIONS

Daily rainfall data can be used to predict dry spells for better strategic agricultural management.

Keywords: daily rainfall, dry spells, in-season decisions