ABSTRACTS
POSTER PRESENTATIONS

CROP SCIENCE

LISTED ALPHABETICALLY

(Nr.1)

GROWTH AND YIELD RESPONSES OF *Amaranthus caudatus* TO LIMESTONE AMMONIUM NITRATE FERTILISER APPLICATION

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INTRODUCTION

Amaranth is a C-4 plant that has ability to withstand drought and poor soil fertility conditions (Brien and Price, 2008); and hence described as a "poor peoples' resource". *Amaranthus caudatus* is a grain amaranth whose leaves are widely consumed as vegetables. The aim of this study was to assess the performance of *Amaranthus caudatus* following application of variable N fertiliser rates from LAN.

MATERIALS AND METHODS

A pot trial was conducted under a glasshouse at North-West University, Mafikeng Campus during 2015-summer and autumn growing seasons. Trial consisted of five levels of N fertiliser (0, 50, 70, 90 and 110 kg N ha-1) applied as limestone ammonium nitrate (28% N) at planting. The experiment was laid out in a complete randomized design with 3 replicates. Growth data (plant height, number of leaves, leaf area, relative leaf area and leaf area index) were measured according to (Blanco and Folegatti 2013; Chastain 2012) at 2-weekly intervals commencing from 4 weeks after plant emergence (WAE). Fresh marketable leaf yield was also collected at 8WAE. Data generated were analysed as complete randomized design using Statistix 10.0 package. Treatments and interaction effects were evaluated using Fisher protected least significant difference at probability level of 5%.and yield of grain amaranth

RESULTS AND DISCUSSION

Results revealed that application of 110 kg N ha-1 gave the highest number of leaves (13 and 17, respectively during summer and autumn) and tallest plants (42.70 cm) during autumn; while 50 kg N ha-1 rate gave the tallest plants (25.12 cm) during summer. Planting season by N rates interaction exerted significant (P = 0.05) effects plant height, number of leaves, leaf area and leaf area index. The highest leaf area was obtained from 90 kg N ha-1 throughout planting period. During summer, the 90 kg N ha-1 gave the highest fresh marketable leaf yield (120 g pot-1) while 50 kg N ha-1 gave highest yield (140 g pot-1) during autumn. There interaction effect of N rates and season on the harvested fresh marketable leaf weight was however not significant indicating that the substantial variation obtained was only related to N application.

CONCLUSION

Significant seasonal variation in growth and marketable leaf yield of *Amaranthus caudatus* was obtained following application of LAN. The 50 kg N ha-1 outperformed the other application rates and may therefore be considered as the most suitable rate for leafy *Amaranthus caudatus* production depending on the initial N level.

Keywords: amaranth, growing seasons, leafy vegetables, marketable leaf yield, N fertiliser, relative leaf area

(Nr. 2)

RESPONSE OF MANAGEMENT FACTORS ON MAIZE HYBRID SEED QUALITY UNDER RAINFED CONDITIONS

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INTRODUCTION

The seasonal changes in temperature and precipitation influence maize seed production season. The pressure to harvest seed before unfavourable weather arrives is also prevalent. This study focused on the interactive effect of different planting dates, stages of maturity and fertilizer application on the progeny seed quality of maize under small-scale farming conditions.

MATERIALS AND METHODS

Field trials were conducted at the University of KwaZulu-Natal's Ukulinga Research Farm during the 2014/15 summer season. The field trials were laid out as split-split plot design where planting date was the main factor, fertiliser the sub-factor and harvesting stage the sub-sub plots arranged in randomised complete blocks. The trials were replicated (x3). Seed were harvested at milk stage (R3), dent stage (R5) and harvest maturity stage (R6) and allowed to dry (< 12% moisture content). Thereafter, seed quality was evaluated using the standard germination (SG) test and vigour indices such as germination velocity index (GVI), fresh and dry mass (FM and DM).

RESULTS AND DISCUSSION

The results of the SG test showed highly significant differences ($P<0.001$) among planting dates, fertilizer levels and harvesting stages. The interaction between planting date and fertiliser levels was highly significant differences ($P<0.001$) for FM and DM. Seed from the early planted optimally fertilised trials harvested at harvest maturity had the highest seedling germination performance. This was associated with a long growing season (grain filling) and optimum production environment. For the same conditions, seed harvested at the dent stage showed higher GVI relative to seed harvested at harvest maturity. Seeds produced under low soil fertility showed poor germination and vigour.

CONCLUSIONS

Seed production is affected by agronomic decisions such as planting date selection, application of fertilisers and choice of harvest date. For optimal seed production, a longer growing season is recommended together with optimum fertiliser application and harvesting seed at harvest maturity. Future studies should evaluate the acquisition of seed quality for seed harvested at the different stages.

ACKNOWLEDGEMENTS

The National Research Foundation of South Africa is acknowledged for financial support through the Innovation Doctoral Scholarship (Grant UID: 90406).

Keywords: fertility, maturation, planting dates, seed germination

(Nr.3)

CHARACTERIZATION OF SELECTED MINERALS AND IMPORTANT WHEAT PARAMETERS IN SELECTED SOUTH AFRICAN WHEAT CULTIVARS

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INTRODUCTION

Malnutrition and other chronic diseases are caused by little or no intake of important nutritional constituents. The impact of these infirmities still remains a challenge in many countries. However, these infirmities can be curbed by regular consumption of a wide range of nutrients such as micronutrients and several bioactive compounds that can be obtained from various foods including wheat. The wheat grain houses a broad range of nutritional constituents that have increasingly shown to result in improved health upon regular consumption.

Little or no efforts have been made to understand the genetic basis of inheritance of important nutritional constituents in South African wheat cultivars as opposed to efforts and the progress that has been made in establishing the genetic variance of iron (Fe) and zinc (Zn) in various wheat species in other countries. Understanding the genetic basis of inheritance of selected nutritional traits/genes of interest is the key step in establishing biofortification to improve the nutritional quality of crops.

The main objective of this study was to characterize selected wheat parameters and the levels of minerals in white and wholemeal flour, and further explore the interaction between the minerals and selected traits. This is an effort to ensure that measures are taken to contribute to food security at all times.

MATERIAL AND METHODS

Twenty-two selected wheat genotypes have been grown under irrigation across two environments over two years. Yield data and other quality parameters were determined by the ARC-SGI wheat quality laboratory. The levels of minerals (Ca, P, K, Na, Fe, Zn, Mg and Mn) were determined using ICP-OES by the ARC-ISCW laboratory.

RESULTS AND DISCUSSION

There was some level of variance amongst the genotypes on the concentration of minerals as well as that of some yield and quality parameters. The average concentration of Fe and Zn in white flour samples across all environments was around 28.49 mg/kg and 18.94 mg/kg, respectively. However, most of the genotypes showed a highly significant interaction with the environment ($p<0.001$) for Fe and Zn. The average concentrations of Fe and Zn in wholemeal flour across two environments were substantially above 30 mg/kg. Most of the genotypes showed a highly significant contribution to observed variation in Zn in wholemeal flour. There were also some highly significant ($p<0.000$) positive correlations observed between some minerals and quality parameters. A principal component analysis also depicts that some minerals may be inherited with other traits.

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Keywords: food security, genetic variance, quality, wheat, yield

(Nr. 4)

ENHANCEMENT OF WHEAT GROWTH AND YIELD BY APPLICATION OF RHIZOBACTERIA

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INTRODUCTION

Wheat is one of the most important grain crops in South Africa with approximately two million tons of wheat produced on 748000 hectares in 2011. Soil fertility is a major constraint with fertiliser and lime comprising up to 30% of the total variable input costs. Although synthetic fertilizers can be used, the extensive use of inorganic chemicals is detrimental to the physical, chemical and biological properties of soil. It has been shown that plant growth promoting rhizobacteria (PGPR) can affect physiology of the plants by means of producing and releasing secondary metabolites (plant growth regulators/phytohormones/biologically active substances), reducing/preventing harmful effects of pathogenic rhizosphere organisms and/or facilitating the accessibility and uptake of nutrients to the plant. In accordance with international concerns there is a drive to develop environmentally friendly production methods and increase yield in a sustainable manner. Due to inconsistent results that are often experienced with biological products in the field, the aim of the current study was to optimize PGPR field performance through assessment of different dosages and application methods.

MATERIALS AND METHODS

The field trial was planted in June 2014 on the predominantly Huttons ecotope at Towoomba ADC, Limpopo Province. The trial was laid in a completely randomized design with each treatment replicated three times and each replicate consisting of a 20m2 plot. Treatments consisted of a mixture of three PGPR strains viz. Lysinibacillus T19, Paenibacillus A10 and Lysinibacillus T29, and a commercial product Brus® (Stimuplant©, Gauteng, RSA). These PGPR treatments were applied separately at two different dosages as a powder seed treatment and on a composted pellet carrier at a rate of 170kg pellet/ha. Control treatments comprised a) seed treatment with sterile perlite powder and b) pellet without PGPR. The trial was irrigated biweekly for one hour until grain maturity. Data collected consisted of bimonthly growth rate (measured from soil surface to apical leaf) and grain yield at 12% grain moisture.

RESULTS AND DISCUSSION

The growth rate of the different treatments were not significantly different from that of the controls. However when wheat grain yield was assessed, the treatments showed significant increases: the single dose PGPR pellet treatment increased yield with 43% compared to the control yield of 5.49t/ha. Yield of this treatment was followed closely by that of Brus® and PGPR single dose seed treatment resulting in 30.71% and 25.03% increases respectively, compared to the sterile powder seed treatment (control) yield of 5.57t/ha.

CONCLUSIONS

These results demonstrate the potential of PGPR in improving wheat grain yield in the field provided that factors such as soil type, PGPR formulation and inoculum dose are favourable.

Keywords: biofertilizer, pellet, Rhizobacteria, soil type, yield

(Nr. 5)

THE PERFORMANCE OF RETAINED SEED VS CERTIFIED SEED IN THE NATIONAL SOYBEAN (*Glycine max* L.) CULTIVAR TRIALS

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INTRODUCTION

Soybean (*Glycine max* L.) production is currently the fastest expanding grain commodity in South Africa. The soybean production area increased with 26.8% from 2013/14 to 687 300 ha during the 2014/15 production season. The demand for soybean seed by producers currently exceed the supply and producers have no alternative as to use retained seed. SANSOR reported that usually 80% of soybean plantings are done by using retained seed. Calculations done by GRAINSA showed that during the 2014/15 planting season there was only certified seed available for 360 000 ha of the 687 300 ha planted, thus 48% of the total soybeans planted was from retained seed. Producers also claimed that retained seed planted in the same environment is more robust and resulted in higher yields than new certified seed. The cost of certified seed can contribute as much as 15 - 25% of the total variable cost and therefore by using retained seed the profit can be increased.

MATERIAL AND METHODS

Cultivar evaluation trials have been planted at localities 22 localities representative of the main soybean production areas. A Randomised Latinised row/column design with three replicates was used as statistical layout for each trial. A combined ANOVA was done over the localities. Due to the daylight as well as temperature sensitivity of soybeans, the production area has been separated as cool, moderate and warm areas. Twenty nine commercially available cultivars from 5 seed companies were included in the trial as well as the retained seed from one of the cultivars (PAN 1521R) harvested during the previous season. The retained seed of PAN 1521R from each locality was used and treated as an extra cultivar. Each trial plot consisted of four, 5 m rows. Four metres were harvested from each of the middle two rows, in order to avoid border effects. All seeds were inoculated with *Bradyrhizobium japonicum* bacteria at planting.

RESULTS AND DISCUSSION

The main effects; cultivars and localities differed statistically at 1% at the different irrigation and region areas ($p<0.01$). From the results it is also clear that in the cool production area, under dry land conditions, only 3 cultivars (certified seed) yielded significant higher ($P>0.05$) than the retained seed from PAN 1521R. However, there was no difference between the certified and retained seed from PAN 1521R. In the moderate area (dry land) the retained seed had the highest yield but not significant higher than the certified seed from PAN 1521R. The best soybean seed regarding yield in the warm areas (irrigated trials) were PAN 1521R (3119.9 kg-1) followed by the retained seed of the same cultivar (3022.4 kg-1).

CONCLUSIONS

The results showed that retained seed from the cultivar (PAN 1521R) did not yield significantly different from the certified seed of the same cultivar in the first year after harvesting the retained seed. However this results are only based on the yield data and other risks like loss in vigour over time as well as a higher diseases risk were not monitored.

Keywords: grain yield, growth habit, maturity grouping, plant density, soybeans cultivars

(Nr. 6)

PHYLOGENETIC RELATIONSHIPS OF *Aproaemrema simplexella* (WALKER) FROM AUSTRALIA, *Aproaerema modicella* (DEVENTER) FROM INDIA AND THE GROUNDNUT LEAF MINER FROM SOUTH AFRICA AND MOZAMBIQUE BASED ON MTDNA COI AND ITS GENE SEQUENCES

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INTRODUCTION

Groundnut leaf miner (GLM) has since 2000 become a major pest of groundnut and soya bean on the African continent. The origin of the pest is uncertain as there are similar insect species known by different names on the Australia and Indo-Asian continents.

MATERIALS AND METHODS

The genetic relationships were investigated by comparing sequences of the mtDNA COI and the internal transcribed spacer (ITS) genomic regions between the soya bean moth from Australia and the GLM in Africa and India. Sequenced specimens included 44 collected from South Africa, 4 from Mozambique and 3 from India and Australia. MtDNA COI gene was PCR amplified with Lara C1 Seq primer. The ITS region was processed as one fragment sequenced from both direction (ITS-1 and ITS-4) that covers ITS-1, 5.8 rRNA and ITS-2, the primers used were TCCGTAGGTGAACCTGCGG and TCCTCCGCTTATTGATATGC. The evolutionary history was inferred using Maximum Parsimony method. MtDNA COI sequences were compared with those in the BOLD and NCBI gene banks.

RESULTS AND DISCUSSION

In both gene banks, the similarity matching of the specimens with A. *simplexella* sequences from Australia was 98-100%. Phylogenetic analyses of the two DNA regions revealed two groups. For mtDNA COI, group 1 was composed of all sequences of the specimens from South Africa, Mozambique, India and the A. *simplexella* sequence from the NCBI gene bank. Group 2 was composed of only sequences of specimens from Australia. For ITS, group 1 was composed of sequences of specimens from South Africa and Mozambique, and group 2 had all specimens from Australia, 2 from India and 4 from South Africa.

CONCLUSIONS

Phylogenetic analyses results of the current study indicated that GLM populations in Africa, India and *A. simplexella* in Australia are genetically related and presumably constitute a single species, with the Australian species showing the greatest genetic diversity.

ACKNOWLEDGEMENTS

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Keywords: groundnut leaf miner, mitochondrial DNA, nuclear DNA, soya bean moth

(Nr. 7)

EFFECT OF PRODUCTION WATER REGIME ON BAMBARA GROUNDNUT (*Vignia subterranea*) SEED QUALITY

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INTRODUCTION

Conventionally, farmers rely on seed material that has been subjected to a certification process to ensure acceptable quality. Bambara groundnut is cultivated using landraces which may be of good physical quality, but overall quality is reduced by unknown genotype x environment conditions. In this study, it was hypothesized that water stress during production of bambara groundnut affects seed quality of progeny seed. The objective of the study was to compare yield and progeny seed quality (viability and vigour) of a bambara groundnut landrace produced under rainfed and irrigated conditions.

MATERIALS AND METHODS

A bambara groundnut landrace was characterised into four distinct selections based on seed coat colour [plain red, plain cream, cream with brown speckles (brown speckled) and cream with black speckles (black speckled)]. The standard germination and electrolyte conductivity tests were performed based on International Seed Testing Association rules. Electron microscopy was used to determine seed coat thickness. Landrace selections were then used to establish a field trial under rainfed and irrigated conditions. Yield was evaluated and seeds harvested from the trials were used to evaluate seed quality.

RESULTS AND DISCUSSION

There were no significant differences among water regimes, landrace selections and the interaction between the two with respect to pod mass and number, seed mass and number and harvest index. Total biomass per plant was 106% higher ($P<0.05$) under irrigated compared to rainfed conditions. Highly significant differences ($P<0.001$) were observed between water regimes, landrace selections and the interaction between the two with respect to germination. Seeds produced under irrigated conditions had 6% higher germination than seeds produced under rainfed conditions. Electrolyte conductivity was significantly ($P<0.05$) higher (648 µs/g) for seeds produced under irrigated than rainfed conditions (521 µs/g). Seed coat thickness showed significant differences ($P<0.05$) among landrace selections.

CONCLUSIONS

Yield was lower under rainfed than irrigated conditions. Subsequent seed quality was better than initial seed quality. Viability was higher in seeds produced under irrigated than rainfed conditions. Bambara groundnut seed production requires optimum conditions and is negatively affected by water stress. This may affect farmers' yields under rainfed conditions.

ACKNOWLEDGEMENTS

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Keywords: germinability, irrigated, rainfed, viability, vigour

(Nr. 8)

WITCHWEED (*Striga species*) PREVALENCE AND CHALLENGES AMONG SMALLHOLDER FARMERS: A CASE STUDY IN MARONDERA DISTRICT, ZIMBABWE

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INTRODUCTION

Maize, a staple food crop in Zimbabwe, contributes towards food security and the economy. Its production rose from about 1.2 t ha-1 in the 1960s up to 1.6 t ha-1 in 1996 and declined to 0.88 t ha-1 in 2013 (FAOSTAT, 2014) mainly due to reduced fertiliser use (FAO, 2006) and frequent droughts. Declining soil fertility has increased witchweed (*Striga spp*.) prevalence. Witchweed can reduce maize yields in smallholder farming (Jamil *et al*., 2012) by up to 100% (Hassan *et al*., 1994). In Malawi declining soil fertility increased incidence and damage of witchweed in cereals (Nanthambwe and Mulenga, 2001). Not much research on witchweed has been done in Zimbabwe. This study investigated the prevalence and challenges of witchweed in maize production in Svosve-Wenimbi, Marondera District.

MATERIALS AND METHODS

A total of 131 farmers randomly selected from 4 wards in the district were interviewed. Data was analysed using the Statistical Package for Social Sciences (SPSS), (2007).

RESULTS AND DISCUSSION

Witchweed was a problem in the studied area affecting 71% of respondents. Seventy two percent knew witchweed, 48.5% reported stunting, chlorosis and wilting in maize, 7.6% low yield and poor quality grain, 4.1% death of plants and 46.6% were not sure of the effects.

CONCLUSIONS

Witchweed is a significant problem in Svosve-Wenimbi area that may be a nationwide problem requiring further investigation on national distribution and potential interventions.

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Keywords: food security, maize production, *Striga*, soil fertility

(Nr. 9)

PRODUCTION, DISTRIBUTION AND UTILIZATION OF MORINGA (*Moringa oleifera*) BY FARMERS IN LIMPOPO PROVINCE, SA

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INTRODUCTION

In South Africa, *Moringa oleifera* is produced in Limpopo Province, Mpumalanga, KwaZulu-Natal but majority produces it mainly for household purposes. Moringa in Limpopo province is grown by a limited number of farmers in their backyards and spaces around homesteads and recently the production area is expanding at alarming rates. There is currently very limited information on its commercial production requirements. Therefore, the aim of the study was to identify farmers who grow moringa in Limpopo province and to gather information on their knowledge of general production and the utilization of the tree.

MATERIALS AND METHODS

The survey was conducted from November 2013 to September 2014 in form of interviews in five districts of Limpopo province, namely: Capricorn, Sekhukhune, Waterberg, Mopani and Vhembe. A total of 30 farmers producing moringa in more than 0.25 ha were interviewed across five districts of Limpopo province. Data from the survey were subjected to analysis using Statistical Package for Social Sciences (SPSS 22). Descriptive statistics was used to achieve the study's objectives and to generate frequencies.

RESULTS AND DISCUSSION

The results indicate, that among these 30 farmers, the highest number was observed in Vhembe (38.7%), Mopani (22.6%) and Capricorn (19.4%) districts, while Waterberg and Sekhukhune had only 9.7% each. In terms of general perspective, it was known that Moringa is mainly produced in Sekhukhune district; however the findings herewith indicated that Vhembe is leading district. Although several farmers who produce moringa in Sekhukhune, majority of them are producing at household level where they only have =5 trees in their backyard. In all districts, Moringa is used in various ways and consumed in different forms due to its highly nutritious contents.

CONCLUSIONS

Moringa can play an important role in income generation for the farmers in Limpopo province. This crop offers a significant opportunity for the poorest people to earn a living because it requires minimum capital to produce and is regarded as ad miracle tree due to it high nutritional content.

ACKNOWLEDGEMENTS

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Keywords: farmers, *Moringa oleifera*, production, utilization

(Nr. 10)

RESIDUAL EFFECT OF NEMARIOC-AL AND NEMAFRIC-BL PHYTONEMATICIDES IN TOMATOES

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INTRODUCTION

The mean concentration stimulation range (MCSR) values for Nemarioc-AL and Nemafric-BL phytonematicides were empirically established as 2.63%, whereas the application intervals were 16 and 18 days, respectively (Pelinganga, 2013). Because the two products have different active ingredients, efficacies on nematode suppression were shown to be enhanced when the materials are combined, without establishing the potential residues in fruits. The objective of this study therefore, was to validate the efficacies of the two products on nematode suppression and plant growth and then assessed the potential residues.

MATERIALS AND METHODS

A field trial, using tomato cv. 'ZZ12/ZZ1 B/F', was established at the Green Technologies Research Centre, University of Limpopo. The treatments, viz., untreated control, Nemarioc-AL 3% phytonematicide, Nemafric-BL 3% phytonematicide and Nemarioc-AL 3% + Nemafric-BL 3% phytonematicides at 1:1 (v/v), were arranged in a randomised complete block design, with 25 replications. The products were applied at 14-day interval. At harvest, 66 days after initial application, fruit yield, plant height, stem diameter, chlorophyll content, shoot mass, root mass and nematode numbers were measured. Ripe fruits were oven-dried at 52ºC for 24 h, ground and cucurbitacin A and cucurbitacin B measured using isocratic elution Shimadzu HPLC Prominance, with detection using Shimadzu CTO-20A diode array detector.

RESULTS AND DISCUSSION

Treatments suppressed nematode numbers, but had no effects on other plant variables. The cucurbitacin residues in fruits were at undetectable levels. At low concentrations, cucurbitacins stimulate cell multiplication and therefore, the non-detection of residues in this trial was important.

CONCLUSION

Although the cucurbitacins were not detected in tomato fruits, we recommend that on-farm trials be conducted using the two products under conditions that will encompass soil, climatic and tomato cultivar types.

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Keywords: allelopathy, *Cucumis* species, *Meloidogyne* species, root-knot nematodes

(Nr.11)

A FRAMEWORK LINKING SATELLITE IMAGERY, SURVEYING AND CROP MODELS TO SIMULATE MAIZE YIELDS AT DIFFERENT SPATIAL AND TEMPORAL SCALES

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INTRODUCTION

Although most dynamic crop models have been developed and tested for the scale of a homogeneous plot, applications related to crop estimates and climate change studies are often at broader spatial scales that can incorporate considerable heterogeneity (Hansen and Jones, 2000). To simulate maize yields at different temporal and spatial scales, a framework was developed that links satellite imagery, surveying, and other spatial data sources as inputs to crop models allowing simulations to run at field scale and when linked to historic or projected climate data at different temporal scales.

MATERIALS AND METHODS

Crop models require inputs of climate, soils, management and genetics to run simulations. A framework was developed using GIS and the QUAD-UI tool (Porter *et al*., 2014) to collate all the inputs into crop model usable format for 130 000 fields that have been identified to have been planted to maize in South Africa. The field delineation was obtained by using Landsat and Spot images and digitising 14 million hectares of field boundaries. The field crop boundaries were used as basis for an aerial-survey, identifying fields planted to crops. The identified crop type per field was used for satellite image classification. For the maize crop, field level land cover of all fields that were identified to have been planted to maize were integrated into one database integrating four years of field classifications (2006-2009). To establish crop management input for crop modelling, samples obtained from objective yield surveying over a six year period (2008-2012) were used and assigned to the field proportionately. Fertilization was based on the average modelled 50 year yield potential of each field. The soil properties required for crop yield modelling were derived using the identified soil series suitable for maize production from terrain units of land type maps within a GIS framework and each field was assigned a unique soil profile. Pedo-transfer functions were used to calculate soil property inputs for the crop model. Climate data, representing historic or projected future time series were linked to each field. Simulations were made for single season (crop estimates) or multi-seasonal analysis (climate change).

RESULTS AND DISCUSSION

The framework developed, using GIS and the QUAD-UI tool, allows for the rapid assembly of large amounts of crop model input data that is representative of the maize cropping systems of South Africa, which was previously not possible. Using climate data from a single season up-to-date and projected climate using a weather analogue model allows for crop yield estimates to be made and summarised to provincial level as required by the Crop Estimates Committee. For climate change studies, using climate data representing historic and different future climate change projections based on different global circulation models (GCMs), it was found that the framework allows for the large amount of simulations required in these studies (~45 million) to be easily set up and run. The link to the GIS also allows for of these large amounts of simulation output data to be post processed enabling the field level data to be summarised to different spatial levels such as farms, catchments, district, provincial or national. This in turn can then be presented in table, graph or map format.

CONCLUSIONS

The framework developed, linking satellite imagery, surveying and crop models allows for the rapid assembly of large amounts of crop model input data to simulate maize yields representative of the South African cropping system, forecasting for different time scales and representing results at different spatial scales, which was previously not possible.

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ACKNOWLEDGEMENTS

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Keywords: crop models, GIS, maize, remote sensing

(Nr. 12)

INOCULATION AND PHOSPHORUS APPLICATION IN SOYBEAN

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INTRODUCTION

Soybean utilization is expanding in Mozambique creating the challenge of increasing production by over 20,000 metric tons from the present 50,000 metric tons per year. Management interventions on soils resources both inorganic and organic are necessary to increase the current average of 1.3 tons ha-1 per unit area production among the smallholder farmers.

MATERIALS AND METHODS

A study conducted to evaluate the response of soybean to phosphorus (P), nitrogen (N), inoculant and their interactions in four agro-ecologies across Mozambique. Two soybean genotypes (Storm and TGx 1904-6F) were established in 2010-2011, 2011-2012, 2012-2013 and 2013-2014 growing seasons using a split plot design with P rate (0 and 40 kg P ha-1) as main plot, inoculation application as subplots and N rate (0 and 40 kg N ha-1) as sub-sub plots with four replication per treatment. Data on yield and yield components analyzed for a combined and individual location analysis using PROC GLM in SAS 9.4 with season and location as random effects.

RESULTS AND DISUSSION

The effect of location was more dominant than the other factors accounting for 25 to 89% of the variations in the measurable responses. Grain yield across all the four seasons was highest in Ruace (3640 kg ha-1) and lowest in Sussundenga (1975 kg ha-1). The growing conditions were favourable in 2013-2014 season yielding 2903 kg ha-1 and poor during the 2011-2012 season 2281 kg ha-1. Phosphorus application in combination with inoculation improves nodulation and yields of soybean (Kamara et. al., 2007). Other response variables were distinct by treatment and environment. Mean 100-seed weight was 15.3 g for Storm and 12.5 g for TGx 1904-6F.

CONCLUSIONS

Production of soybean in Mozambique requires agro-ecologically specific interventions of P, N and inoculant. Formulation of guidelines for utilization of the resources needed in Mozambique.

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ACKNOWLEDGEMENT

We appreciate the tireless fieldwork efforts from IITA technicians in Mozambique and funding from United States Agency for International Development (USAID) to conduct this research.

Keywords: nodulation, storm, Zamboane

(Nr. 13)

REACTION OF SELECTED SOUTH AFRICAN DRY BEAN CULTIVARS AND GERMPLASM ACCESSIONS TO RUST IN THE GREENHOUSE

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INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is one of the most important legume crops world-wide on account of its nutritional value and health benefits. In South Africa, dry bean is consumed regularly by both the rich and the poor, however, production hampered by several diseases including rust. The aim of this study was to assess 22 selected South African commercial dry bean cultivars as well as 23 international germplasm accessions of the Agricultural Research Council Grain Crops Institute collection for reaction to rust in the greenhouse.

MATERIALS AND METHODS

Germplasm accession Pinto 114 was used as a positive control. Four seeds of each variety were planted per pot (8-cm-diameter), which was replicated three times. The study was conducted twice in order to confirm the first set of results. Where necessary, thinning was done to three plants per pot. Plants were inoculated when the primary leaves were more than 50% expanded using a mixture of rust races 3, 5, and 8 (2.4x104 conidia/mL) and inoculated plants were kept in the dew chamber (>95% humidity). After 48hrs, plants were transferred to the greenhouse and disease rating was done 15 days after inoculation using a 1-9 scale, where 1 is complete resistance (immunity) and 9 is complete susceptibility.

RESULTS AND DISCUSSION

The positive control, Pinto 114, was susceptible (7). Among the South African dry bean commercial cultivars, Mkuzi, Tygerberg and PAN 123 showed complete resistance (immunity) while Bonus (7), DBS 830 (6) and Kranskop (6). The majority of germplasm accessions showed resistance (8 showed immunity) while G 5686 (8), Golden Gate Wax (6) and CAL 143 (6) were susceptible.

CONCLUSION

The findings demonstrate that there is a need to continue breeding for rust resistance in South African dry bean commercial cultivars and that the international germplasm collection provides the necessary resistance in the greenhouse and can therefore be used as rust resistance donors.

Keywords: cultivars; dry bean; germplasm; resistance; rust

(Nr. 14)

SEED-BORNE FUNGAL PATHOGENS OCCURRING UNDER SMALL-HOLDER FARMING SYSTEM IN THE LIMPOPO PROVINCE

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INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) *Walp*) is an important leguminous plant cultivated by small-holder especially under dry land conditions in Africa and Asia. Seed-borne fungal pathogens have the potential to infect seeds under field conditions resulting serious crop losses especially under small-holder farming systems. The aim of this study was to evaluate the effect of different farming used by small-holder farmers in Limpopo on the occurrence of seed-borne fungal pathogens.

MATERIALS AND METHODS

Farmer saved cowpea seeds were collected from 3 areas in the Limpopo Province and evaluated for presence of seed-borne fungal pathogens using agar plating and Standard Blotter method (ISTA, 2007) under laboratory conditions. Collected seeds were further evaluated for seed germination ability. Fungi growing on diseased seeds were isolated and morphologically identified to species level in the University of Limpopo Plant Pathology laboratory. To identify farmer production and seed management and their effect on the occurrence of seed-borne fungal pathogens, a survey questionnaire was administered to a representative number of farmers.

RESULTS AND DISCUSSION

All farmers surveyed were small-holders and most of them used farm saved seeds with only 15% using certified seeds. All seed samples were infected with seed-borne fungal pathogens. However, the prevalence and levels of infection differed among seed samples and areas of collection. Most seed infections were caused by *Fusarium pallidoroseum* (69.4%) followed by *Colletotrichum lindemuthianum* (47.0%), *Macrophomina phaseolina* (29.6%), *Alternaria alternata* (12.9%), Fusarium oxysporum (10.4%) and *Cladosporum spp* (8.6%). There was no significant difference ($P>0.001$) in germination percentage of all tested seeds. Germination percentage was however significantly higher ($P<0.001$) in certified cowpea seeds which was used as control.

CONCLUSIONS

All tested seed samples had high prevalence of seed-borne fungal pathogens. Incidences of fungal infection were higher no seed treatment was carried out prior to storage, suggesting that farming practices played a significant role in seed infection by identified pathogens?

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Keywords: disease incidence, farming practices, fungal pathogens, germination percentage

(Nr 15)

EFFECTS OF LAND-USE CHANGES ON THE CAPE FLATS

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INTRODUCTION

GCS undertook the environmental regulatory processes and related specialist studies associated with the proposed development of a silica-sand mine (Cape Flats, Western Cape Province). The property is a 55ha horticultural area and the proposed mining operation will result in the creation of a large 'pond' on 64% of the property.

MATERIALS AND METHODS

Environmental, Water, Soils, Wetland and Ecology assessments on the current and proposed site land-uses were undertaken. Soil form classification, depth to groundwater, presence of wetlands, fauna and flora assessments and stakeholder engagement was undertaken. The likely effects of the proposed land-use changes on site and further afield were assessed.

RESULTS AND DISCUSSION

The proposed mining process will involve dredging. The water used for transportation of sand to the plant will be returned to the dredging pond post extraction. No chemicals will be added. Stakeholders: were predominantly concerned about impacts on the greater horticultural area and the downstream RAMSAR wetland site. Land Use: Horticultural production was being undertaken on 40.5% of the property, previously cultivated areas accounted for 46.8% and a disturbed wetland constituted the remaining 12.7% of the property. Soils: The Lamotte and Witfontein soil forms were identified underlying the property. These deep podzols are bleached, single-grained sandy soils (Fey, 2012). The soils exhibited very low phosphorus levels yet vegetable harvesting was noted on site. Water: The water table was measured at 1m below surface. Dredging is likely to result in lateral drainage of the water table into ponds that will remain full. The depression that remains will form a 'pond'. No overland flow is expected. Electrical conductivity measurements highlighted that no water from site enters the downstream wetlands. Wetlands and Ecology: The ecological sensitivities of the property were deemed to be low and the identified wetland was deemed to be degraded.

CONCLUSION

The proposed land-use change from horticulture to mining would not affect downstream wetlands and the resultant post-mining pond would be of agricultural benefit to the surroundings, but the immediate site's horticultural value would be permanently lost and the possibility of further mining in the area materialising could not be mitigated against.

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Normal 0 false false false EN-ZA X-NONE AR-SA

Keywords: ecology, land-use, soils, stakeholders, water

(Nr. 16)

THE EFFECT OF PLANTING DENSITY ON GROWTH OF FOUR CHICKPEA (*Cicer arietinum*) GENOTYPES WITH CONTRASTING GROWTH PATTERNS

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INTRODUCTION

Planting density is one of the most important cultural practices determining yield, as well as other agronomic attributes of the crop. Water availability is probably the most controllable factor affecting optimum planting density for grain under rain-fed production system. The use of different planting density and suitable genotypes which is adapted to semi-arid areas such as Limpopo Province may be beneficial. The study aimed at evaluating the effect of planting density on growth of chickpea genotypes having contrasting growth patterns.

MATERIALS AND METHODS

Field experiments were conducted in two locations, University of Venda and Limpopo research farms, Limpopo, South Africa during winter 2015. The treatments consisted of a factorial combination of 3 level of planting density (20, 25 and 33 plants/m2) and 4 chickpea genotypes (ACC# 1 ERECT, ACC #3 PROSTRATE, ACC#4 ERECT, and ACC#7 PROSTATE) arranged in RCBD with 3 replications. Data for number of primary, secondary branches and plant height was measured from three demarcated plants throughout the growing season. Data was analyzed using the randomized complete block design model of Genstat software version 17. Significant difference between the treatment means was compared using the least significant difference test at 5% probability.

RESULTS AND DISCUSSION

The results obtained from this study showed that effect of planting density had significance difference on number of primary branches ($P<0.001$). (ACC # 7) had higher number of primary branches at lower planting density of 20 plants per m2. The higher number of primary branches may be as a result of enough useful resources e.g. space, nutrients, sunlight and moisture and less completion among the plants. Furthermore genotype had no significant effect on number branches. The results showed that the interaction effect between genotype and planting density had significant difference in all levels of planting density.

CONCLUSIONS

The result showed that planting density had a considerable influence on number of primary branches produced by genotypes 7. This shows that the pattern of growth affect the number of primary branches at a given planting density.

Keywords: genotype, planting density, plant height, primary branches

(Nr. 17)

THE PERCEPTIONS OF WHEAT RESEARCHERS ON PROBLEMATIC PESTS AND DISEASES OF IRRIGATED WHEAT IN SOUTH AFRICA

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INTRODUCTION

Pests and diseases are some of the possible causes of reduced yields and profitability of irrigated wheat (T*riticumaestivum* L.) in South Africa. However, without virtuous knowledge of the specific problematic pests and diseases and damage they cause, it may not be possible to develop appropriate control measures and interventions for reducing their economic impact. The objective of this study was to determine the most problematic pests and diseases in the major irrigated wheat production areas of South Africa, based on the perceptions of wheat researchers.

MATERIAL AND METHODS

Questionnaire-based interviews were conducted on wheat researchers across South Africa. The questionnaires assessed the following key questions: (1) What are the most problematic pest and diseases of irrigated wheat in South Africa? (2) In which production areas are these problematic pests and diseases found? (3) What are the ideal control measures for used commercially to control them? The survey had 66 respondents, including postgraduate research students (15.2%), junior and senior researchers (42.2%), research team leaders(3%), research technicians (21.2%), university lectures and research directors (18.4%).Areas of specialization for the respondents were plant breeding (22.7%), biotechnology (7.6%),entomology (4.5%), weed science (7.6%), agronomy (33.3%), wheat quality (1.5%), plant pathology (15.2%), soil science (4.6%), weed science and crop protection (3%).

RESULTS AND DISCUSSION

The majority of respondents (65.2% and 52%, respectively) acknowledged that pests and diseases are a major problem in irrigated wheat, whereas the rest were not sure. Numerous pests and diseases of wheat were suggested as problematic. However, there was considerable variation in the perceptions, and they tended to be biased by area of specialization. For example, plant pathologists working on wheat rusts naturally suggested rusts as the major problem and most entomologists working suggested Russian wheat aphid as the most problematic pest. There was no consensus either, on the areas from which these pests and diseases are problematic.

CONCLUSIONS

There appears to be no consensus among researchers with regard to problematic pests and diseases of irrigated wheat in South Africa. Dedicated field studies may be required in order to provide scientific information which can be useful to researchers and policy makers.

ACKNOWLEDGEMENTS

Winter Cereal Trust and ARC PDP for funding.

Keywords: diseases, pests, wheat yields

(Nr. 18)

EFFECT OF DRYING METHODS ON NUTRIENT COMPOSITION OF Moringa oleifera LEAVES

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INTRODUCTION

Moringa oleifera Lam is a highly valued plant, distributed in many countries under tropical and subtropical regions. It has an impressive range of medicinal uses with high nutritional value from the leaves. The nutritional content is very high when compared with other food. The leaves and stem of Moringa are known to have large amount of oxalate crystals which are decreased by processing making them more available to the body (Mbah *et al*., 2012). This study was aimed at determining the effect of different drying methods on the proximate and other nutrient composition of *Moringa oleifera* leaves.

MATERIALS AND METHOD

Fresh samples of Moringa leaves were collected from one year old trees at NBef organics farm, Mopani district. The collected leaves were sorted and cleaned then dried using different drying methods as treatments, namely: (Sun dried, Room temperature, Oven dried at 20, 30, 40, 50, 60 and 70°C). A sample of Moringa leaves weighing 500g was used in each treatment. Duration of drying was recorded for each treatment. Dried leaves were analyzed for proximate composition (ash, fat and crude protein) and minerals (calcium, magnesium, potassium, sodium, phosphorus, zinc, manganese and iron). Leaf samples were sent to a registered Laboratory in Kaw-Zulu Natal for analysis.

RESULTS AND DISCUSSION

The drying duration ranged between 3h30 to 66 hours (2 days 18 hrs). The results revealed that protein content ranged 22.64 – 25.06 %. Drying methods reduced the fat content which ranged between 5.68 – 7.91%. Drying method of room temperature, sundry and oven dry at 20 and 30oC affected the nutritional content such as N, Ca, Mn, Na, K, P, Fe, and Zn of Moringa leaves. Similar results were reported by Mbah *et al*., 2012 and Satwase *et al*., 2012 where they revealed that shade drying indicated better retention of nutrients such as protein and other minerals.

CONCLUSIONS

Therefore, it can be concluded that, drying the leaves under low temperature condition could be an added advantage in terms of nutrients and protein retention. Therefore the study recommends shade drying method as an affordable method to communities who cannot afford to purchase oven for drying plant samples. Moringa is a cheap source of nutrient, the leaves can therefore be recommended to be used as food supplement when processed.

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Keywords: drying methods, *Moringa oleifera,* nutrients composition

(Nr. 19)

MONITORING *Fusarium verticillioides* INFECTION AND FUMONISIN PRODUCTION UNDER DIFFERENT CONSERVATION TILLAGE/ROTATION SYSTEMS

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INTRODUCTION

Fusarium verticillioides is the most common maize ear rot pathogen, posing a serious threat to maize production and grain safety for consumption, due to its ability to synthesise fumonisins. Fumonisins have been associated with oesophageal cancer in humans and mycotoxicoses in animals. Apart from the apparent health factors, ear rot infection and fumonisin contamination pose serious economic losses such as reduced exports and lower prices due to poor quality, which can be of enormous significance to developing countries (Degraeve *et al*., 2015). The increasing shift towards conservation agriculture (CA) in South Africa can have numerous effects on pests and pathogens. The use of CA ensures the efficiency of a cropping system by enhancing the quality of the soil, and provides cheaper, more productive and environmentally friendly crop production (Hossain, 2013). The biggest challenge in crop production is the need to sustainably produce high yielding crops, with minimal diseases and pests (Pittelkow *et al*, 2014), it is therefore important to establish an understanding on which cropping system is best suited for these goals. Therefore, the aim of the study was to determine the extent *of F. verticillioidesand fumonisin* contamination in maize grain produced under different tillage and crop rotation systems.

MATERIALS AND METHODS

CA field trials were conducted for six seasons (2009/10 - 2014/15) in two different localities in the North-West province (Buffelsvallei and Erfdeel). The experimental design was a split plot consisting of four treatments, replicated four times. Treatments included conventionally tilled maize monoculture (1), no till maize monoculture (2), no till maize seasonal rotation with sunflower/cowpea (3), no till maize two seasonal rotation with babala and sunflower/cowpea (4). Trials were naturally infected and real-time quantitative PCR (qPCR) was used to quantify fungal biomass while fumonisins were quantified using HPLC.

RESULTS AND DISCUSSION

Conventionally tilled monoculture maize, no-tilled monoculture maize and a two and three-season maize crop rotation, respectively, did not affect fumonisin producing *Fusarium* spp. biomass and fumonisins at both localities. These variables were, however, influenced by the seasonal variation observed and weather data will be incorporated to explain this variation.

CONCLUSIONS

The results of this study will demonstrate the potential effect of tillage and cropping systems on *F. verticillioides* and fumonisin contamination. This information will be of importance in improving grain quality and managing mycotoxin contamination.

Keywords: fumonisin, HPLC, maize, tillage, qPCR

(Nr. 20)

THE EFFECT OF BIOCHAR AND RHIZOBIUM INOCULATION ON NODULATION AND CHLOROPHYLL CONTENT OF CHICKPEA (*Cicer arietinum* L.)

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INTRODUCTION

Soil infertility, water supply, and availability of high yielding and drought tolerant crop genotypes remain major constraints for agricultural production in semi-arid regions. Management practices in such areas should be geared towards improving productivity at a low cost while sustaining soil fertility. The use of biochar, rhizobium inoculants and drought tolerant legumes like chickpea in cropping systems may be crucial for improving productivity of chickpea. Therefore this study aimed at assessing the effect of biochar and rhizobium inoculation on nodulation and chlorophyll content of 3 chickpea genotypes.

MATERIALS AND METHODS

A field experiment was conducted at the University of Venda's Experimental Farm in Thohoyandou (23°35'14.0" S and 30°15'50, 3" E and 595m asl), South Africa during winter 2015. The treatments consisted of a factorial combination of 3 chickpea genotypes (ACC# 4, 5, and 6), 2 rhizobium levels (inoculated and uninoculated) and 3 biochar levels (0, 10, and 20 t ha-1) arranged in randomised complete block design with 3 replications. Nodulation was determined at flowering and Chlorophyll content was measured at physiological maturity as described by Lichtenthaler (1987). Data was subjected to ANOVA using Genstat (version 17). Significant differences between treatments were determined at 5% level using Turkey's method.

RESULTS AND DISCUSSION

The effect of biochar, rhizobium inoculation and genotype was highly significant on chlorophyll content compared to other treatment combinations. Chlorophyll content was greater in Inoculated ACC# 5 at 10t ha-1 of biochar levels. The increase in chlorophyll content with biochar and rhizobium inoculation could be due to the effect of biochar and rhizobium on plant nutrient status. Biochar contain useful minerals such as carbon, potassium, magnesium, and calcium and improves soil properties and fertility. Rhizobium inoculation improves biological nitrogen fixation (BNF) hence improving the plant nutrient status. Biochar and rhizobium inoculation increased number of nodules per plant and the nodule dry weight ($P<0.001$). The highest number of nodules was observed on ACC# 6 at 20 t ha-1 biochar level which was inoculated. Inoculating legumes with suitable rhizobia increases effective rhizobium populations in soils with low or no native rhizobia and ensures root nodulation.

CONCLUSIONS

Biochar application and rhizobium inoculation affected chlorophyll content and nodulation of 3 chickpea genotypes and clearly could improve chickpea productivity in this area. ACC# 5 and 6 showed greater chlorophyll content and number of nodules respectively. However, we recommend further studies before definite conclusions can be drawn.

Keywords: chlorophyll content, nodulation, rhizobium, biochar

(Nr. 21)

EFFECT OF DIFFERENT CROPPING SYSTEMS AND PLANTING SPACING ON MAIZE-COWPEA PRODUCTIVITY

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INTRODUCTION

Intercropping is the growing of two or more crops simultaneously on the same field within a season. Addition of nitrogen fixing legume in the intercropping system is known to improve soil fertility and consequently productivity. Smallholder farmers' soils are continuously depleted due to mono-cropping and lack of fertilizer application thus leading to poor soil quality and reduced crop yield. Therefore the objective of the study was to determine the effect of different cropping systems and planting spacing on maize-cowpea productivity.

MATERIALS AND METHODS

The study was conducted during 2014/2015 growing season under dry-land conditions at Towoomba Research Station (Bela-Bela) in Limpopo Province. Maize (*Zea mays* L.) and cowpea (*Vigna unguiculata* L.) were crops used in a 3X3 factorial experiment laid in RCBD with three replications. Cropping systems were sole crop, mixed and row intercropping, and three planting spacing (50X50, 75X45, and 90X40 cm inter-intrarow). Grain yield and 100 seed mass were recorded for maize and cowpea at maturity stage. Data were analyzed using SPSS (11.5) and treatments means were separated using LSD at $P<0.05$.

RESULTS AND DISCUSSION

Results indicated that the highest maize grain yield was obtained under sole cropping plots at 90X40 cm spacing (7.45 tons ha-1) followed by 75X45 cm spacing (6.30 tons ha-1). Notably, the sole maize performed better when compared to intercropped maize and this was due to lower plant density and lack of competition for resources such as light, nutrients and water. Cowpea yield was significantly higher ($P<0.05$) under mixed cropping system at planting spacing of 50X50 cm and 90X40 cm with 2.15 and 2.07 tons ha-1 respectively, however both were not significantly different to the sole cowpea at 75X45 cm spacing which recorded 2.14 tons ha-1. Furthermore, no observed significant differences for 100 seed mass across all treatments for both maize and cowpea.

CONCLUSIONS

The observations from the study indicate that intercropping maize and cowpea in different patterns and mix-proportions may affect maize grain yield due to competition between the 2 crops compared to sole cropping. However, the yield of cowpea under mixed cropping system was improved compared to sole cropping system irrespective of planting density.

Keywords: cropping systems, planting spacing, maize, cowpea, yield

(Nr. 22)

EFFECT OF FERTILIZATION AND SPACING ON A YIELD OF CHINESE CABBAGE (*Brassica rapa* L, subsp. *chinensis*)

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INTRODUCTION

This study was initiated to address the lack of scientific agronomic knowledge in support of the production of non-heading Chinese cabbage (*Brassica rapa L. subsp. chinensis*) in the East of South Africa. The two objectives of the study were to explore current practices used by growers of Chinese cabbage and to determine the response of the crop to the availability of nitrogen. The study show that Chinese cabbage responded positively to Nitrogen availability. Chinese cabbage was particularly sensitive to the availability of nitrogen, but also depended on the adequate availability of P and K for optimum growth.

MATERIALS AND METHODS

Experiment was conducted at the university of Fort Hare Alice campus. Effect of three different fertilizer levels (Zero, 100kg and 200kg) and three different spacing levels (30 cm x 30 cm, 20 cm x 50 cm and 20 cm x 15 cm) were tested on Chinese cabbage. Experiment design that was used was Randomised Completely Block Design (RCBD). Experiment was replicated three times. Data collected were analysed using Mstat, release 12.1. Marketable yield was harvested every two weeks. Samples were sent to the oven for drying for 48 hours at about 700C.

RESULTS AND DISCUSSION

Study also provides both the importance of Chinese cabbage vegetable and its agronomic practises, which can benefit the rural communities. The findings of this paper reveal that utilization of Chinese cabbage as a leaf vegetable can benefit rural communities in providing the needed nutrition for undernourished people, improve the health status of people living with HIV and AIDS and contribute to reduce food insecurity. There are, however, challenges that need to be addressed if Chinese cabbage is to be produced commercially. More factors to do with importantly entry into the already flooded market need to be addressed in order to generate income for the poor.

CONCLUSIONS

The study showed that, nitrogen has effect on the fresh yield of Chinese cabbage.

Keywords: chinese cabbage, fertilizers, nutrition, planting population, poverty

(Nr. 23)

EFFECT OF LIQUID MAXIFLO AND TRYKOSIDE ON YIELD OF POTATO

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INTRODUCTION

Potato (*Solanum tuberosum*) is an herbaceous plant belonging to the *Solanaceae* family. Potato is also classified under the hemispherical type of root systems. Potatoes can grow in temperate climates or the mountains of tropical areas. Potato tubers give an exceptionally high yield per hectare, many times than any grain crop and are used as processed food and livestock feed. Therefore, this investigation attempts to assess the effect of liquid maxiflo and trykoside on growth of potatoes.

MATERIALS AND METHODS

Potato trail was conducted at the experimental farm of the Department of Soil, Crop and Climate Sciences, University of the Free State, near Kenilworth in the Bloemfontein district during the 2003 growing season. A randomized complete block design (RCBD) was used for potato trial. Three treatments (Control, Maxiflo, and Trykoside) were randomly applied and each treatment was replicated five times. The soil on which the experiment was conducted was a sandy loam soil. The trial was planted mechanically and the plot size was 96 m2. The number of stolons per plant was counted in separate plots treated in the same way as plots used for yield assessment. Over four week period, the total number of stolons per plant were counted weekly. Potato tubers were mechanically harvested and the total yield was determined by weighing using a commercial mass meter and expressed as ton ha-1.

RESULTS AND DISCUSSION

Although, no significant differences between treatments were observed in terms of either leaf canopy area, stem counts, stolon counts, tuber size and total yield of potato trial. Four weeks after emergence, both Maxiflo and Trykoside treatments tended to decrease the canopy area. During later growth stages, the canopy area measure was rather inconsistent, no clear pattern emerged and no statistically significant effect was observed. There was no significant differences in stem counts between three treatments. The results showed non-significant differences between the numbers of stolons per plant probably due to huge standard deviations calculated. Trykoside and Maxiflo had a slight enhancing effect on the number of stolons per plant. Compared to the untreated control, especially Trykoside had an increasing effect on the medium, medium/large and large size potato tubers

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CONCLUSIONS

In potatoes, compared to the untreated control, separated foliar spray treatments with neither Maxiflo nor Trykoside showed a significant effect on vegetative growth in terms of canopy development, stem count and stolon counts per plant.

Keywords: maxiflo, trykoside, potato growth

(Nr. 24)

SOIL ALLELOCHEMICAL RESIDUE EFFECTS OF PHYTONEMATICIDES ON LEGUMINOUS CROPS AND CARRYOVER NEMATODE NUMBERS

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INTRODUCTION

Nemarioc-AL phytonematicide, manufactured from ground fermented *Cucumis myriocarpus* fruit, consistently stimulated growth of tomato *(Solanum lycopersicum*) and suppressed nematode population densities of *Meloidogyne* spp. under diverse environments. However, soil allelochemical residue (SAR) effects of the product on growth of successor leguminous crops and post-treatment nematode population densities are undocumented. A field trial was, therefore, conducted to investigate nemarioc-AL SAR effects on growth of *Bradyrhizobium japonicum* seed-inoculated cowpea (*Vigna unguiculata*) as a successor crop and the related nematode population densities.

MATERIALS AND METHODS

Ground *C. myriocarpus* fruits were EM-fermented to prepare nemarioc-AL phytonematicide. SAR conditions in a tomato crop were created in a 5 × 5 factorial trial, with the first and second factors being concentrations and application intervals of nemarioc-AL phytonematicide, respectively, in a RCBD, with 10 replications. After harvest of tomato plants, the land was fallowed for 30 days and cowpea var. Eureka seeds were planted at previously marked stations, but withholding treatments and harvested at 120 days after planting.

RESULTS AND DISCUSSION

Concentration × application interval contributed 21% to total treatment variation (TTV) in nodule numbers, withpermutations consistently reducing nodule numbers (7-83%). The concentration factor contributed 12% and 8% to TTV in dry seed mass and number of nematodes, respectively, increasing (39-83%) and decreasing (88-94%) the two variables. The application interval contributed 7% to TTV in dry shoot mass and nematode numbers each, increasing (39-69%) and reducing (45-92%) the two variables. Stimulation and inhibition for plant and microbial growth, respectively, suggested existence of density-dependent growth patterns.

CONCLUSION

Nemarioc-AL phytonematicide SAR effects significantly inhibited nodulation of *B. japonicum* and carryover densities of *Meloidogyne* species, while stimulating the partitioning of dry shoot mass and seed yield in cowpea.

ACKNOWLEDGEMENTS

The authors acknowledge the Agricultural Research Council-Universities Collaboration Centre, the Land Bank Chair of Agriculture – UL and the Flemish Interuniversity Council (VLIR) for financial support.

Keywords: botanicals, dosage, environmental impact, successor crop

(Nr. 25)

GENETIC DIVERSITY OF BOTTLE GOURD (*Lagenaria siceraria* (Mol.) Standl.) LANDRACES REVEALED BY SIMPLE SEQUENCE REPEAT MARKERS

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INTRODUCTION

Bottle gourd *[Lagenaria siceraria* (Mol.) Standl.] landraces are widely grown in South Africa by small-scale farmers for food and valuable genotypes could be selected for breeding or systematic conservation. The objective of this study was to assess the genetic diversity present among bottle gourd landraces using 14 selected polymorphic simple sequence repeat markers.

MATERIALS AND METHODS

Seeds of 67 bottle gourd landraces were planted at the Controlled Research Facility (CEF), University of KwaZulu-Natal, Pietermaritzburg. DNA was extracted following the CTAB (mixed alkyltrimethyl-ammonium bromide) procedure as described by CIMMYT (2005). Polymerase Chain Reaction (PCR) products were fluorescently labelled and separated by capillary electrophoresis using ABI 3130 automatic sequencer. Genetic diversity parameters, such as number of alleles per locus (Na), number of effective alleles per locus (Ne), allelic richness (Ar), expected heterozygosity (He), polymorphic information content (PIC), gene flow (Nm) and genetic differentiation (FST) were estimated. Genetic relationships among the landraces was determined using neighbor-joining algorithm using the unweighted pair group method (UWPGM) in DARwin 6.0.

RESULTS AND DISCUSSION

The number of alleles detected per marker ranged from 4 to 11, with a total of 86 putative alleles being amplified. Allele sizes ranged from 145 to 330 bp. Number of effective alleles (Ne) ranged from 1.58 to 6.14 with a mean of 3.10. Allelic richness varied from 3.00 to 8.90 with a mean of 5.23. Expected heterozygosity (He) values ranged from 0.37 to 0.84 with a mean of 0.65. The mean polymorphic information content (PIC) was 0.65. The level of gene flow (Nm) ranged from 1.83 to 116.9 with a mean of 24.46. Genetic differentiation (FST) ranged from 0 to 0.05 with a mean of 0.04. Jaccard's coefficient of similarity values ranged from 0.00 to 1.00, with a mean of 0.63. Analysis of Molecular Variance revealed that 79, 17 and 4% of the variation in bottle gourd landraces was attributable to among landraces, within landraces and between populations, respectively. The UWPGM-derived dendogram classified the bottle gourd landraces into three major clusters.

The study established the existence of considerable genetic diversity among South African bottle gourd landraces. Unique landraces such as BG-4, BG-6, BG-8, BG-9, BG-15 from cluster I, BG-55, BG-42, BG-57 and BG-58 from cluster II, BG-28, BG-23, BG-29 and BG-34 from cluster III were selected based on their highest dissimilarity index. These are recommended for breeding and conservation.

ACKNOWLEDGEMENTS

The University of KwaZulu-Natal and the National Research Foundation (SA) are acknowledged for financial support.

Keywords: bottle gourd, genetic diversity, landrace, simple sequence repeats markers

(Nr. 26)

MAIZE GROWTH AND LODGING RESISTANCE AS AFFECTED BY DIFFERENT FERTILIZER RATES AND CHEMICAL REGULATION IN NORTH CHINA PLAIN

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INTRODUCTION

Increasing maize production in China is vital in order to feed its population. One way of increasing production is through the use of high levels of nitrogen fertilizers. However, high nitrogen levels are associated with weak root system and elongated weak stalks which are susceptible to lodging. Although the introduction of semi-dwarf cultivars had largely solved the problem of lodging, evidence was already accumulating that a timely application of a growth retardant could increase the grain yield. The study was aimed at the fertilizer rate and plant growth regulator effects on maize performance.

MATERIALS AND METHODS

A 4 x 2 factorial arrangement fitted in Randomized Complete Block Design with 4 replications was conducted at Wuqiao Experimental Station of China Agricultural University (37º 41' N; 116º 37' E) in 2015 growing season. Treatments consisted of four levels of nitrogen fertilizer (0, 75, 150 and 225 kg N/ha) broadcasted and incorporated into the soil, and two levels of ethylene (0 and 400ppm) applied as foliar at V8 growth stage. The fertilizer source was Urea (46%). The cultivar used was Zhengdan 958. The inter-row and intra-row spacing of 0.6 m and 0.27 m respectively, was used on a 6 m x 6 m plot size. Plant height at V8, V13, silking and grain filing stage, ear height at silking and grain filling stage, above ground biomass, internode length, internode thickness, and stalk breaking force resistance at 8, 9 and 10 internodes were collected and analysed using SAS 9.3.

RESULTS AND DISCUSSION

Results showed that maize performance differed significantly ($P<0.05$) following application of variable nitrogen fertilizer rates. It was observed that an increase in fertilizer rates increased plant height (129.89, 176.47, 227.72 and 255.08 cm) and above ground biomass (32.22, 64.46, 108.51 and 187.89 g/plot) across V8, V13, silking and grain filling stages, respectively whereas the mean ear height of 109.50 and 111.75 cm were recorded as the highest with the highest fertilizer rates (225 kg N/ha). The application of ethylene as growth retardant significantly reduced the plant height (119.78, 155.75, 204.24 and 240.25 cm) across V8, V13, silking and grain filling stages respectively whereas the ear height of 97.05 and 96.83 cm were recorded as the lowest during silking and grain filling stages respectively. Similar trend was observed where the internode length reduced significantly. In contrast, the internode thickness and the stalk breaking force resistance increased significantly across the 8, 9 and 10 internodes at different growth stages.

CONCLUSIONS

The preliminary finding underpins the importance of plant growth regulator and fertilizer application for reducing lodging without compromising maize performance that could ultimately affect yield.

Keywords: fertilizer, growth retardant, lodging, yield

(Nr. 27)

SUSTAINABLE PRODUCTION OF COWPEA IN AREAS WITH *Meloidogyne species*

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INTRODUCTION

Nemafric-BL phytonematicide and Biocult Mycorrhizae WS (*Glomus* spp. and *Trichoderma* spp.) are separately being developed in South Africa for sustainable crop production systems. However, the two products have not been simultaneously tested for managing the root-knot (*Meloidogyne* spp.) nematodes and absorption of phosphorus, respectively, in legume crops. Greenhouse study was therefore conducted to determine whether the collaborative use of Biocult Mycorrhizae (B), nemafric-BL phytonematicide 3% (P) and *Meloidogyne* species (N) would be beneficial on growth of cowpea (*Vigna unguiculata*).

MATERIALS AND METHODS

A 2 × 2 × 2 factorial experiment, with the first, second and third factors being BM, NP and nematode, respectively, was conducted in pot trial under controlled conditions in the greenhouse. The factors and their permutations, ($B_0P_0N_0$, $B_1P_0N_0$, $B_0P_1N_0$, $B_0P_0N_1$, $B_1P_1N_0$, $B_1P_0N_1$, $B_0P_1N_1$ and $B_1P_1N_1$), were arranged in a randomised complete block design, with 9 replications. Cowpea var. Eureka seeds were inoculated with *Rhizobium leguminosarium biovar phaseoli* spores and planted into 25-cm-diameter pots filled with pasteurised mixture of loam and sand at 1:1 ratio (v/v) and placed on greenhouse benches at 0.3 m inter-row and 0.2 m intra-row spacing. Two weeks after planting, appropriate permutations were inoculated with B and 6 000 eggs and second-stage juveniles of *M. javanica* and P was applied weekly using 300 ml diluted solution. At 56 days after inoculation, the following plant variables were collected dry shoot mass, plant height, stem diameter and chlorophyll content.

RESULTS AND DISCUSSION

The first order interaction, B × P, was significant (P = 0.05) on dry shoot mass, plant height and stem diameter, contributing 4%, 11% and 10% to total treatment variation (TTV) of the variables, respectively. Similarly, B × N interaction significantly affected chlorophyll content, contributing 35% to TTV of the variable. Relative to untreated control, phytonematicide alone alone increased dry root mass, plant height and stem diameter by 18%, 17% and 23%, respectively. Treatments had no effect on nematode numbers.

CONCLUSION

Relative to untreated control, phytonematicide alone, followed by combination with P × B, was the best product for use in cowpea production.

ACKNOWLEDGEMENTS

Authors are grateful to the Land Bank Chair of Agriculture – University of Limpopo, Flemish Interuniversity Council for funding the study.

Keywords: effective microorganisms, nematicide, fruit extracts, cucurbitacins, root galls

(Nr. 28)

CALIBRATION AND VALIDATION OF THE SWB MODEL FOR DRY BEAN *(Phaseolus vulgaris L.)*

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INTRODUCTION

Irrigation water management is necessary for structural, economic and environmental reasons. Many scheduling approaches have been developed funded by the Water Research Commission over the past 4 decades with varying levels of success (Annandale *et al*., 2011). The interest in scheduling irrigations with crop growth computer models is rapidly increasing (Annandale *et al*., 1996). The Soil Water Balance (SWB) computer model was identified by the Water Research Commission as a potential technology that could be adopted for real time irrigation scheduling country-wide (Annandale *et al*., 2002). The objectives of the study were to determine the crop specific parameters for dry bean and to successfully calibrate and validate the Soil Water Balance Model.

MATERIALS AND METHODS

A field experiment was conducted at the Hatfield Experimental Farm of the University of Pretoria, Pretoria, South Africa (latitude 25o45'S, longitude 28o16'E and an altitude of 1327 m.a.s.l. in 2013. The trial was replicated eight times. The plot size was 5x9m2 for each plot. The trial was irrigated every week depending on the requirement by the crop. Top dressing was done 28 DAP using lime ammonium nitrate (LAN-28%N) at the rate of 30kg/ha. Growth and Leaf Area Index data was collected at 30, 37, 43, 58, 72, 86 and 99 DAP. Fractional Interception of Photosynthetically Active Radiation was collected every two weeks. Soil moisture was monitored twice a week, at 0.2m increments to a depth of 1.0m. Specific weather data were sourced from the weather station on the farm. The model validation was done using data from drought stress experiment which was also conducted at the Hatfield Experimental Farm of the University of Pretoria.

RESULTS AND DISCUSSION

Model calibration simulations of Leaf Area Index, Total Dry Mass, Fractional interception and Harvestable Dry mass, and soil water deficits fitted reasonably well with the measured values. Statistical parameters for Leaf Area Index, Total Dry Mass and Fractional interception were within the acceptable limits as recommended by De Jager (1994). Irrigation to Field capacity was predicted with low accuracy. The model simulations for Leaf area index for treatment D1 fitted reasonably well with the field measured data. The model simulations for Total Dry Mass, Fractional interception and Harvestable Dry mass for treatment D2 fitted reasonably well with the field measured data.

CONCLUSION

Database of crop specific model parameters was generated. SWB model was calibrated and validated for the selected cultivar and from these parameters growth and water use of the crop can be simulated.

Keywords: crop specific parameters, irrigation scheduling, simulating growth

(Nr. 29)

AMARANTHUS YIELD AND RESOURCE USE EFFICIENCY

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INTRODUCTION

Indigenous leafy vegetables such as Amaranthus is widely used in arid and semi-arid areas of South Africa. Amaranthus usually grows as a volunteer plant in the wild (Jansen van Rensburg *et al*., 2007) and dominantly as a weed in the cultivated fields at the start of rain season (DAFF, 2010). Most exotic vegetables require large amount of water and production cost involved in their successful is higher than that of indigenous leafy vegetables. A number of climatic factors including radiation, evapotranspiration (ET) and wind have an effect on growth and yield. However, in semi-arid areas of South Africa water and radiation use efficiency limit the improvement of Amaranthus productivity. The purpose of this study therefore was to evaluate the water and radiation use efficiency (WUE and RUE) and their relationships for different water application treatments.

MATERIALS AND METHODS

Field experiment was conducted at experimental farm (29°02'S, 26°15'E and 1354 m), near Bloemfontein, Free State, South Africa. Five levels of water treatments were applied that varied from full irrigation to rainfed plots. The irrigated plots were closer to the sprinklers while the rainfed plots were the furthest from the sprinkler source. The treatments are W5: Full irrigation, W4: Adequate irrigation, W3: Moderate irrigation, W2: Least irrigation and W1: Rainfed. Irrigation was applied during windless conditions, mostly during the night when soil water fell below 70% of the Drain Upper Limit (DUL) in full irrigation (W5) plot. Soil water content, radiation interception and crop parameters measurements were carried out to compute the water use and radiation use efficiencies. Analysis of variance was employed using the statistical software SAS 9.1.3 for Windows.

RESULTS AND DISCUSSION

The fully irrigated W5 showed a significantly lower fresh mass (FM) yield compared to other less irrigated treatments. Grain yield and biomass, significantly highest harvests were obtained from W2 irrigation treatment at least P = 0.05 level, with LSD value of 172.5g and 46.77g, respectively. The WUE is higher for rainfed plots than fully irrigated conditions. As a result, amaranthus can be produced more effectively under rainfed conditions. The fraction of radiation intercepted for all the treatments show a similar trend, however, rainfed plot (W1), indicates the lowest fraction of intercepted radiation when compared to other water treatments. WUE and RUE are showed a positive correlation with optimum value on W3.

CONCLUSIONS

In harvesting fresh yield less amount of irrigation or rainfed is economically advantageous to minimize irrigation costs instead of supplying full irrigation. Grain yield and biomass of amaranthus is high at least water application but decreases with the increased rate of irrigation supplied. Absorbed radiation is positively correlated with transpired water until W3 treatments bur remain constant under least irrigation or ranfed conditions.

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Keywords: amaranthus, radiation interception, radiation use, water use, yield

(Nr. 30)

SOIL AND ORGAN PHOSPHATASE ACTIVITY BY INOCULATED AND INOCULATED PROMISCUOUS SOYBEAN GENOTYPES ESTABLISHED AT MBOMBELA, SOUTH AFRICA

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INTRODUCTION

Phosphorus (P) is one of the major nutrients essential to plant growth and is available to plants as phosphates (Pi), which are acquired by the roots from the soil solution. Plants and microbes located in low P soils develop numerous strategies such as acidification of the rhizosphere, exudation of organic acids and secretion of extracellular phosphatases to enhance P supply. Mineral P is catalyzed from organic phosphate esters, in acid and alkaline P low soils by enzymes, making P more available in these soils (Maseko and Dakora, 2013). The aim of the study was to assess P nutrition through the determination of plant organs and soil phosphatase activity of inoculated and uninoculated soybean varieties grown at Mbombela.

MATERIALS AND METHODS

Five (5) to 10 replicates of young inoculated and uninoculated test soybean varieties shoots, from which rhizosphere soils were also collected from, were sampled at flowering stage from Mbombela experimental site. Rhizosphere soils together with bulk soils were collected, assay for acid and alkaline phosphatase activity was conducted (Tabatabai, 1994).

RESULTS AND DISCUSSIONS

The data, showed a generally high APase activity on leaves followed by nodules and stems and the least on roots in most genotypes, especially the uninoculated genotypes with the exception of TGx 2001-19DM. Whereas nodules mostly showed a higher organ P content followed by shoots and then roots also on uninoculated genotypes. There was generally high acid and alkaline phosphatase activity on TGx varieties when uninoculated in tested site, with TGx 1440-1E and 1830-20E varieties in Mbombela showed much greater alkaline and acid phosphatases.

CONCLUSIONS

Uninoculated varieties on tested site have a much greater soil acid and alkaline phosphatase activity. Therefore the TGx varieties show a greater P solubilizing ability, hence increase P mineralization in the soil, and thereby increasing Pi concentration in soil. Uninoculated varieties showed greater phosphatase activity and P content and therefore showed increase P availability therefore improve its nutrient uptake.

ACKNOWLEDGEMENTS

National Research Foundation and Tshwane University of Technology are appreciated in this study.

Keywords: organ phosphatase, rhizosphere, soybean genotypes

(Nr. 31)

POTENTIAL USE OF *Spirostachys africana* POWDER EXTRACTS AS MAIZE GRAIN PROTECTANTS AGAINST *Sitophilus zeamais* (Motsch.)

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INTRODUCTION

Maize (*Zea mays*) is an important food security crop as it is a staple food for many sub-Saharan countries. However, storage of the grain is hampered by qualitative and quantitative grain loss caused by maize weevils, *Sitophilus zeamais*. Dried chips of an indigenous tree, *Spirostachys africana*, are traditionally used as an insect repellent to protect maize grain against storage pests in Vhembe District, Limpopo Province. This study was carried out to assess the insecticidal activity of various plant parts of *S. africana* extracts on *S. zeamais*.

MATERIALS AND METHODS

Fifty grams of maize grain in a 500 ml plastic jar were admixed with various amounts (0.05; 0.5; 2.5 and 5 g) of powder extracts from ground leaves, seeds, outer bark, inner bark and roots of *S. africana*, with a control jar without plant powder extracts. Ten female and ten male adult *S. zeamais* (7 d old) were added to each jar and each treatment replicated four times at each of three time periods post treatment (30 d, 60 d and 90 d). At each time interval, weevil mortality and grain weight loss were determined.

RESULTS AND DISCUSSION

The highest mortalities were recorded at 2.5 and 5 g of powders from roots and outer bark. Thirty days post treatment, weevil mortality was significantly higher in root and outer bark powders than the control (90%, 75% and 1%, respectively). Grain weight loss was also significantly lower for root and outer bark powders compared to the control (1%, 2% and 14% respectively). At 60 and 90 d post treatment, all treatments were not able to control new generations of weevils effectively. However, the grain loss was significantly lower for root and outer back compared to the control at all time points. Chikukura*et al*. (2011) also found botanicals were able to provide short term pest control against stored product weevils.

CONCLUSION

This study demonstrated the potential of S. africana powder extracts as short term grain protectants against *S. zeamais*.

REFERENCE

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ACKNOWLEDGEMENTS

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Keywords: botanical insecticides, grain weight loss, powder extracts, Spirostachys africana, Sitophilus zeamais, weevil mortality

(Nr. 32)

THE GROWTH AND YIELD OF POTATO POST-INOCULATION WITH *Pectobacterium carotovorum* subsp. brasilense

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INTRODUCTION

Bacterial diseases such as blackleg and soft rot caused by pectinolytic *Pectobacterium* spp. are the most harmful and damaging potato diseases worldwide. The first incidence of blackleg caused by *Pectobacterium carotovorum* subsp. *brasiliense* (*Pcb*) was detected during the 2006/7 growing season in South Africa. Among the pectinolytic bacteria associated with potato blackleg and soft rot diseases in South Africa, *Pcb* was found to be the most prevalent bacteria in potato-growing regions. The aim of this study was to assess the effect on growth and yield of potato post-inoculation with *Pcb* under glasshouse conditions.

MATERIALS AND METHODS

In this study, certified potato seed tubers cv. 'BP1 were planted in 4 L plastic potting bags filled with sterile potting soil. Ten 14-day old seedlings were inoculated at the base with a dab of *Pcb* bacterial colony as described by van der Merwe *et al*. (2010). Another set of 10 uninoculated potato seedlings (control) were also pierced with sterile toothpicks and the wound sealed with petroleum jelly and laboratory sealing film. Growth parameters were recorded at five-day intervals from day 29 through 69 days after planting (DAP). Half of the replications (five plants) were harvested and weighed at 69 DAP (to determine above-ground biomass) and the remaining five plants allowed to grow until tuber formation and maturity at 90 DAP. All data collected were statistically analyzed using one-way ANOVA.

RESULTS AND DISCUSSION

The plant height, basal stem diameter and biomass were significantly ($p<0.05$) affected post-inoculation with *Pcb* when compared with the control. Throughout the experimental period of 69 DAP, overall decrease in inoculated plant height was 27.38% relative to the control. At maturity, tuber yield was also affected when tuber number and weight of the *Pcb*-inoculated plants where compared with the control. The weight of the biggest tuber for the control was 0.3% greater than that of the inoculated plants post-inoculation with *Pcb*.

CONCLUSIONS

Pcb infection on the stem can significantly affect the growth of individual plants according to the findings of this study.

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Keywords: control, *Pectobacterium carotovorum* subsp. *brasiliense*, post-inoculation

(Nr. 33)

THE EFFECT OF BORIC ACID ON GROWTH AND YIELD OF POTATO POST-INOCULATION WITH *Pectobacterium carotovorum* subsp. *brasilense*

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INTRODUCTION

Pectobacterium carotovorum subsp. *brasiliense* (*Pcb*) was recently identified as the most virulent and damaging pectinolytic bacterial pathogen of potato in South Africa. This pathogen causes blackleg and tuber soft rot diseases on potatoes. There is a dire need to manage these diseases. Boric acid is identified as a safe biochemical to enhance growth and control diseases such as black scurf, common scab, dry rots and soft rots of potatoes. In this study, the effect of 3% boric acid was tested on growth and yield of potato cv. 'BP1' post-inoculation with *Pcb* under glasshouse conditions.

MATERIALS AND METHODS

Thirty 14 days old potato seedlings (cv. 'BP1'), growing in 4 L bags filled with potting soil, were grouped into three sets (10 ten seedlings each) as experimental treatments. One set was inoculated with *Pectobacterium carotovorum* subsp. *brasiliense* (isolate BD255 obtained from the Agricultural Research Council-Plant Protection Research Institute in Pretoria, South Africa). The other set was also inoculated with *Pcb* but subsequently received treatments of 3% boric acid and the third set which served as the control was un-inoculated. Seedlings were inoculated at the base with a dab of *Pcb* bacterial colony as described by van der Merwe *et al*. (2010). Growth parameters were recorded at five-day intervals from day 29 through 69 days after planting (DAP). Half of the replications were harvested and weighed at 69 DAP and the remaining five plants allowed to grow until tuber formation and maturity. All data collected were statistically analyzed using one-way ANOVA.

RESULTS AND DISCUSSION

The effect of 3% boric acid on growth of potato post-inoculation with *Pcb* was found to be significant relative to the control. At 69 DAP, *Pcb* inoculated plants sprayed with 3% boric acid were taller with greater stem diameter and biomass when compared with *Pcb*-inoculated plants not sprayed with 3% boric acid. At maturity, *Pcb*-inoculated plants sprayed with 3% boric acid exhibited higher tuber yield relative to inoculated plants not sprayed with boric acid.

CONCLUSIONS

This preliminary finding seems to suggest that boric acid can be used to manage *P. carotovorum* subsp. *brasiliense* on potato.

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ACKNOWLEDGEMENTS

Authors acknowledge University of South Africa for funds.

Keywords: boric acid, *Pectobacterium carotovorum* subsp. *brasiliense*, post-inoculation

(Nr. 34)

THE EFFECT OF PLANTS POPULATION DENSITY ON SOME PHYSIOLOGICAL TRAITS OF THREE CULTIVARS OF *Amaranthus spp*.

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INTRODUCTION

Amaranthus is one of the most important annual leafy vegetables in the tropical climates of South Africa where it has been collected from the wild for centuries (Bello *et al*., 2011). The leaves are rich in protein, vitamins, sugar, fibre and minerals (Rangarajan and Kelly 1994). Amaranthus growth and yield is affected by plant physiological processes such as stomatal conductance, chlorophyll content and intercepted photosynthetic active radiation (PAR). Crop management practices are likely to affect these physiological processes. Therefore this study assessed the effect of plant densities on stomatal conductance, chlorophyll content and intercepted photosynthetic active radiation of 3 cultivars of amaranthus.

MATERIAL AND METHODS

The study was conducted at University of Venda, Thohoyandou (23°35'.14.0" S & 30°15'50.3" E 595m asl) in Limpopo South Africa in summer 2015. The experiment consisted of a factorial combination of 3 cultivars (*Amaranthus palmeri*, *Amaranthus hypochondriacus* and *Amaranthus retroflexus*) and 3 plant densities (120, 66 and 44 plants m^2) laid out in a complete randomised block design and replicated 3 times. Stomatal conductance was measured using steady state porometer, Chlorophyll content was measured using cholophyll content meter during vegetative and reproductive crop growth stages and Intercepted radiation was measured using AccuParLP-80 ceptometer in 3 days interval. Data was subjected to ANOVA in Genstat (17th edition).

RESULTS AND DISCUSSION

Cultivars and plant density did not affect stomatal conductance at all crop growth stages probably due to inadequate soil moisture (Alireza *et al*, 2014). Chlorophyll content increased with an increase in plant density at all crop growth stages. The highest chlorophyll was observed in *Amaranthus retroflexus* and lowest in *Amaranthus palmeri*. PAR increased with increasing plant density at all crop growth stage probably due to increase in canopy cover as expected (Fandazo *et al*., 2010).

CONCLUSIONS

Physiological traits such as chlorophyll content and intercepted photosynthetic active radiation were affected by plant density and cultivars. Stomatal conductance was not affected by plant density and cultivar under low soil moisture.

Keywords: amaranthus, chlorophyll content, PAR, stomatal conductance

(Nr. 35)

RESPONSE OF KENAF (*Hibiscus cannabinus* L) CULTIVARS TO ROW SPACING AND PLANTING DENSITY ON FIBRE QUALITY AND QUANTITY

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INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is a fiber plant native to east central Africa where it has been grown for several thousand years for food and fiber. Plant density and row spacing have a more pronounced effect on growth and yield than on fibre percentage. Usually with more space available, the plants grow taller and develop thicker stems. Increased plant populations leads to higher yields, while increase in the row spacing leads to lower yields. With wider rows more detrimental to yield. Higher plant populations will not necessarily result in higher yields. The cost of planting extremely high plant populations is not always economically viable. Therefore, the objective of this study was to determine the optimum row spacing and plant density for optimum yield and quality of kenaf cultivars under both dryland and irrigation conditions.

MATERIAL AND METHODS

The study was conducted under varied climate and rainfall condition at Winterton (KZN) and Rustenburg (NW) during 2013/2014 growing season. The trial design was a split plot with main plot treatments as row spacing (30cm, 35 cm and 40 cm) and sub plots planting densities (600 000 plant ha-1, 500 000 plants ha-1and 400 000 plants ha-1) with two cultivars, Elal 1 and Raz 2 as treatments. A plot consisted of four rows with 3m length each. Plants were harvested manually at flowering stage (Duke and Ducellier, 1993). A sample dry stem yield (kg.ha-1) of one meter stalk was put into an oven to dry for 5 days at 60 oC. Then fibre yield(%)The weight of bast in the above ground dried stalk divided by dry stalk mass x 100 fibre quality was measure in terms of reed length, bundle breaking tenacity and elongation at break.

RESULTS AND DISCUSSION

There were significant differences (P=0.05) observed in fresh biomass, green stem, dry stem yield and fibre yield of cultivars as influenced by row spacing and row spacing x cultivars x planting density interactions. Kenaf yield tended to increase at lower row spacing of 30 and 35 cm with combination of high planting densities for both cultivars and localities. At Winterton, Elal1 dry stem yield was the highest at 30cm and 627 778 plants ha-1, with 46 379 kg ha-1. This was 68% higher than the lowest dry stem yield at 40 cm and 404 167 plants ha-1. Plant height and diameter did not differ significantly between cultivar, row spacing and plant densities. Fibre qualities were better at the lowest row spacing and high planting densities.

CONCLUSION

Minimum row spacing and plant densities for optimum yield will be 30 to 35 cm and 500 000 to 600 000 plants ha-1respectively, for both localities and cultivars.

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Keywords: kenaf, planting density. Elal 1, Raz 2

(Nr. 36)

IMPROVING DRYLAND COWPEA PRODUCTION THROUGH MOISTURE CONSERVATION AND PHOSPHORUS FERTILIZATION

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INTRODUCTION

The impact of rainfall variability in recent years has resulted in frequent drought and dry spells especially in low rainfall areas. This challenging drought conditions require innovative and alternative methods for sustainable dryland crop production. Cowpea (*Vigna unguiculata*) is one of the most important food legume grown for its leaves and grain harvesting. Although cowpea is drought-tolerant, its yield potential has been declining over the years due to lack of sufficient soil moisture availability and fertilizer use by smallholder farmers. The objectives of this study were to determine the effectiveness of the rainwater conservation technique (mechanized basins (MB)) to increase soil moisture content (SMC) and cowpea grain yield as compared to conventional tillage (CON), and to determine the importance of phosphorus (P) application on cowpea yield.

MATERIALS AND METHODS

A field trial was conducted at the Towoomba ADC during the 2014/15 growing season as a 2X2X3 factorial experiment laid as RCBD with three replicates. The treatment consisted of two farming systems (MB and CON), two cowpea varieties (Glenda (C1), Bechuana white (C2)) and three phosphorus levels (P1 = 0 kg, P2 = 15 kg and P3 = 30 kg P ha-1). The soil samples were collected before planting and after harvesting to determine the total required and total P used. The plant parameters recorded were biomass, number of vines plant-1, number of pods plant-1 and grain yield. The gravimetric method was used to determine the soil moisture content (SMC) at 0-15cm and 15-30cm soil depth. Data were analysed using Genstat 14.0 and treatment means were separated at $P<0.05$.

RESULTS AND DISCUSSION

The results indicated that MB with high P application (P3) had significantly higher cowpea biomass and grain yield compared to CON system at all P levels. The number of vines plant-1, number of pods plant-1 and yield plant-1 were highly influenced by the interactive effects between P levels and cowpea varieties. The highest grain yield of 1750 kg ha-1 was observed withC2 when under MB and P3. The average SMC of MB was 18% higher than CON at both soil depths. The MB and P3 for C1 and C2 had 12 and 17% significantly higher biomass than of CON, respectively. The MB farming system had 10 and 11% higher water use efficiency for C1 and C2 respectively, irrespective of the P application level when compare to CON.

CONCLUSIONS

The results revealed that farming system MB of rainwater conservation significantly increased SMC, cowpea biomass and grain yield when compared to CON treatment. The prospects of the study are interesting and validation of these preliminary findings will continue for two more seasons.

Keywords: cowpea, mechanized basins, phosphorus, soil moisture, yield

(Nr. 37)

GRAMINEOUS CROP PREFERENCE OF TWO LEPIDOPTERAN STEM BORERS: *Eldana saccharina* AND *Sesamia calamistis*

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INTRODUCTION

Gramineae crops are grown by subsistence farmers throughout Sub-Saharan Africa of which maize is the most important staple food. However, grain sorghum is also important because of its drought resistant properties. Lepidopteran borers are among the economically important pests of these crops in Africa. Maize yield losses caused by stem borers in Africa vary greatly depending on ecological zone, region and cropping season. In order to effectively prevent or reduce stem-borer damage to gramineae crops, a detailed knowledge and proper understanding of the preferred host plants of stem borers are essential. The objective of this study was to determine *Eldana saccharina* and *Sesamia calamistis* preference between maize, grain- and sweet stem sorghum by using larval development as a parameter.

MATERIALS AND METHODS

Maize (DKC8010), grain sorghum (M153) and sweet stem sorghum (SSP007) were planted in the field and the whorls collected to conduct a laboratory experiment. Whorls of each crop were cut separately and placed in 100 ml plastic containers. Each whorl was inoculated with five neonate larvae of *E. saccharina* or *S. calamistis*, respectively. Five replicates (5 reps X 10 containers) for each species were evaluated a week after inoculation and then bi-weekly over a period of 20 days to determine larval survival and mass.

RESULTS AND DISCUSSION

No significant differences existed between the treatments in terms of larval survival for both *E. saccharina* and *S. calamistis*. However, larval mass of *S. calamistis* and *E. saccharina* were significantly greater when feeding on maize compared to those that fed on sweet stem sorghum. There was, however, no significant difference in mass when larvae were feeding on grain sorghum.

CONCLUSIONS

Both *E. saccharina* and *S. calamistis* developed and survived better on maize than on grain sorghum and sweet stem sorghum and therefore preferred maize over the other two crops.

Keywords: grain sorghum, maize, stem borers, sweet stem sorghum

(Nr. 38)

MYCELIAL COMPATIBILTY AND AGGRESSIVENESS OF *Sclerotinia sclerotiorumin* KWAZULU-NATAL

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INTRODUCTION

A pernicious pathogen, *Sclerotinia sclerotiorum* (Lib.) de Bary has a wide host range and a wide geographic distribution. *Sclerotinia sclerotiorum* was first confirmed in South Africa in 1979 and has become increasingly more common and severe over the years. Crop losses due to Sclerotinia diseases range from 0-100%.

MATERIALS AND METHODS

Sclerotinia sclerotiorum isolation: Plants infected with *Sclerotinia* were collected from: Kokstad, Merrivale, Cedara and Pietermaritzburg. A single sclerotia from infected plants was surface sterilized with 10% sodium hypochlorite for three minutes, washed three times in sterile distilled water for two minutes and placed onto potato dextrose agar (PDA). The plates were incubated for five days at 26ºC. Cultural variation and mycelial compatibility groupings (MCG's): Mycelial plugs (10 mm-diameter mycelial disc) of each isolate were sub cultured from the plates onto PDA and incubated at 26ºC. Mycelial expansion was measured daily for 10 days. After 21 days sclerotial production (total number and dry weight (g)) were evaluated. This was repeated twice. Isolates were paired on modified PDA amended with 50mg/l Bromophenol blue which was added to enhance the visibility of the incompatible reaction lines (MCG's). A 10 mm diameter plug of five day old cultures from each of the isolates were placed in a rectangular position. The plates were incubated at 26ºC for seven days and the reaction between each isolate pair, was evaluated, if two isolates grew without obvious line between them, they were considered compatible with each other. Each isolate was paired with itself as a control for compatibility.

RESULTS AND DISCUSSION

Cultural Variation and mycelial compatibility groupings (MCG's): All isolates were morphologically characterized on solid medium. The Kokstad and Cedara isolates were grouped as fast growing with the Merrivale isolate as intermediate and the Pietermaritzburg isolate deemed as a slow growing isolate. This grouping was due to the average daily expansion within 48hrs which varied from 0.68 mm (Pietermaritzburg) to 1.18 mm (Kokstad). The Kokstad isolate had a significantly faster colony expansion as compared to the rest of the isolates. Significant differences was observed in the sclerotial weight and number on of sclerotia on PDA ($p<0.001$). The Kokstad isolate produced a significantly lower number of sclerotia as compared to the other isolates. Mycelial pairings of all the isolates on the amended PDA medium produced an incompatible reaction, indicating a high level of genetic variability amongst these isolates.

CONCLUSIONS

Results indicate that the faster mycelial expansion suggest a lower number of sclerotia production. The MCG shows that the isolates are incompatible indicating a high level of genetic variability.

Keywords: cultural variation, mycelial compatibilty groupings, S*clerotinia sclerotiorum*

(Nr. 39)

EFFECTS OF PEG INDUCED DROUGHT STRESS ON GERMINATION OF WHEAT SEED

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INTRODUCTION

Seed germination is the most crucial stage of wheat growth as it determines the planting density in the field. Water stress at this stage is an important factor affecting wheat production by causing morpho-physiological alterations. Water stress lead to low germination and longer roots and shorter coleoptiles (Dhanda *et al*. 2004). The purpose of this study was to investigate the effect of drought stress on germination of different South African commercial bread wheat cultivars.

MATERIAL AND METHODS

Seeds of South African commercial bread wheat cultivars were tested for their germination response to four levels of PEG 6000 with osmotic potentials of 0, -1.48, -4.91 and -10.27 Mpa. Seeds were allowed to germinate in the growth chamber at 20oC. The experimental design was randomised complete block design with four replications. Total seed germination, coleoptile length and root length data was collected. GenStat® Version 16 was used to analyse data and LSD was used to separate means at a significant level difference of P = 0.05.

RESULTS AND DISCUSSIONS

PEG 6000 significantly influenced the total seed germination, coleoptile length and root length ($P < 0.001$). A significant decline in total seed germination was observed with increase in PEG concentration from osmotic potential of -1.48 Mpa and -4.91 Mpa. Coleoptile length and root length showed significant decline when PEG concentration was increased from 0 to -1.48, -1.48 to -4.91 and -4.91 to -10.27 Mpa osmotic potential. There was no germination and coleoptiles observed at -10.27 Mpa, only roots developed at -10.27 Mpa. The seed germination percentage decreased with decreasing levels of osmotic potential of PEG and this result correlated with the findings of Yamur and Kaydan (2008).

CONCLUSIONS

PEG 6000 induced stress results in low seed germination, coleoptile length and root length. And different cultivars are differently affected by water stress.

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ACKNOWLEDGEMENTS

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Keywords: cultivars, drought stress, germination, PEG, wheat

(Nr. 40)

EVALUATION OF GREENHOUSE CUCUMBER CULTIVARS AT TWO PLANT DENSITIES

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INTRODUCTION

Cucumber (*Cucumis sativus* L.) yield and fruit length are known to be affected by plant density (Schultheis *et al*., 1997). The objective of the study was to screen and select the best cultivars and planting density to maximize production efficiency and quality of long English fresh market cucumbers under hydroponic greenhouse production practices in Limpopo Province of South Africa.

MATERIALS AND METHODS

A trial was conducted at the Ukulima Research Farm near Modimolle under a 10 m x 30 m greenhouse single span structure. Seeds were directly sown utilizing the open sawdust bag technique in a hydroponic system. Twelve treatment combinations were used, namely six cucumber cultivars ('N12 51-46', 'Rubens', 'Teleons', 'Boreal', 'Auzon' and, '24-192') and two plant densities (30 cm or 15 cm spaced 1 m apart in double staggered rows) arranged in a randomised complete block design with four replications. At harvest, fresh mass, fruit diameter and fruit length were recorded.

RESULTS AND DISCUSSION

There were no significant interactions between plant density and cultivar for all parameters measured. The main effect of plant density also did not influence the performance of the cucumber cultivars. However, cultivars performed significantly different for fruit mass, fruit diameter and fruit length. The best cultivar in terms of the three parameters was Rubens and the worst was N12 51-56. Auzon was the second best cultivar based on fruit mass and fruit diameter, and cultivars 24-192 and Teleons were the best in terms of average fruit length.

CONCLUSIONS

This one year study demonstrated that there is no need to increase plant density beyond the 30 cm x 1 m double row spacing since it did not improve yield traits of cucumber cultivars in the hydroponic system under high tunnel production. Depending on the market demand, farmers have the option to select cucumber cultivars based on a single (fruit length) or combined fruit traits.

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ACKNOWLEDGEMENTS

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Keywords: Cucumis sativus L., fruit diameter, fruit length, fresh mass, plant density

(Nr. 41)

THE EFFECT OF NITROGEN ON *Fusarium verticillioides* INFECTION AND FUMONISIN SYNTHESIS IN MAIZE.

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INTRODUCTION

Fusarium verticillioides is the most common fungal pathogen isolated from maize worldwide. This fungus has the ability to produce fumonisin B1, B2, and B3, which are associated with various animal diseases and human oesophageal cancer. Fusarium infection and fumonisin synthesis are correlated with mean maximum temperature and minimum relative humidity during post-flowering and dough stage of grain development (Janse van Rensburg *et al*., 2015). These favourable conditions could be prolonged as a consequence of rich nitrogen (N) fertilizer applications, which would lead to longer vegetative growth (Blandino *et al*., 2007). On the other hand, maize plants exposed to drought or fertility stress are also more susceptible to infection by microorganisms than plants not under stress (Lisker & Lillehoj, 1991). The aim of this study was to determine the effect of nitrogen type and rate on Fusarium infection and fumonisin synthesis.

MATERIALS AND METHODS

A nitrogen glasshouse trial was planted in 80 L pots (2 plants per pot), in a factorial design, replicated three times, using cultivars CRN3505 and PAN6P-110. According to soil analyses, the starting concentration N in the soil was 3 kg Ha-1 and this was the first rate (zero application) followed by application rates of 30-, 60-, 90- and 120 kg ha-1 calculated for LAN (26%) and Urea (46%) individually. LAN and Urea combinations were applied in burrows (12 cm from plants) at the six leaf stage of plant growth. Burrows were then closed to prevent evaporation of Urea. Plant silks were inoculated with a high fumonisin producing *F. verticillioides* isolate MRC826. Ears were hand harvested, threshed and milled grain was subjected to qPCR (quantification of fumonisin producing fungal biomass) and HPLC analysis (quantification of fumonisins).

RESULTS AND DISCUSSION

ANOVA indicated significant cultivar x Urea x LAN interaction effects regarding target DNA (P=<.001) and fumonisins (P=0.01). Cultivar CRN3505 had the highest grain colonization at LAN and Urea combinations ranging from 6 - 90 kg Ha-1. Cultivar PAN6P-110 had higher grain colonization at LAN and Urea combinations ranging from 90-240 kg Ha-1. Cultivar CRN3505 had the highest fumonisin levels at LAN and Urea combinations ranging from 33 - 240 kg Ha-1. Cultivar PAN6P-110 had higher fumonisin levels at LAN and Urea combinations ranging from 60 - 150 kg Ha-1.

CONCLUSIONS

This study suggests that the rate of LAN and Urea combinations together with cultivar influence the amount of fungal infection and fumonisin synthesis. An integrated management plan including cultivar, nitrogen source and rate of application will directly benefit producers enabling them to make management decisions to reduce fungal infection and fumonisin contamination of grain.

Keywords: F. verticillioides, fumonisin, LAN, maize, nitrogen rates, urea

(Nr. 42)

SUNFLOWER DISEASE SURVEY CONDUCTED DURING 2012/13, 2013/14 AND 2014/15 SEASONS IN SOUTH AFRICA

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INTRODUCTION

Sunflower (*Helianthus annuus* L.) is the most important cultivated oilseed crop in South Africa and annual production ranges from 500 000 to 700 000 tons. Sunflower is host to many pathogens which possess potential risks to production, may reduce yields, depending on seasonal conditions and geographic locality. Increased enquiries from producers prompted the necessity for seasonal surveys to determine which diseases predominate in which areas and on which cultivars.

MATERIALS AND METHODS

Seventy three sunflower production sites including ARC-GCI national cultivar trials and producers fields were screened and diseases quantified over a period of three seasons. The ARC-GCI replicated national cultivar trials, cultivars SY4045, PHB65A25, SY4200 and PAN7049 were surveyed as well as producers' fields, where 30 plants were randomly selected at three points within the field and surveyed for disease incidence and severity. A questionnaire regarding sunflower farming practices was completed with farmers during the surveys.

RESULTS & DISCUSSION

The 2012/13 disease survey results of the cultivar trials indicated that percentage average diseases caused by Alternaria on all four cultivars was 65 %, whereas in all producers fields surveyed it was 60 %. Other prominent diseases in producers' fields such as brown rust (84 %) in Arlington, Sclerotinia head rot (31 %) in Delmas and Phoma stalk rot (96%) in Naboomspruit were observed. In 2013/14 season, the average severity of Alternaria leaf spot was 26.44 % and Sclerotinia head rot was 16.8 %. In producers' fields, average disease severity by Bacterial head rot was 32.22 % in Dwaalboom and brown rust 47.33 % in Arlington, Alternaria leaf spot 45.67 % and Sclerotinia head rot 38.90 % in all areas surveyed. During the 2014/15 season the average Alternaria leaf spot ranged between 42 % in producers' fields and 47 % in cultivar trials. Although powdery mildew was detected in several fields during the 2014/15 survey, severity was low. The questionnaire results showed that diseases, poor emergence and drought were the major sunflower production constraints. The severity of diseases caused by Alternaria obtained from both cultivar trials and producers fields was higher in 2012/13 and 2014/15 seasons when compared to the 2013/14 season. However, in contrast, the severity of Sclerotinia head rot was lower in 2012/13 and 2014/15 seasons relative to the 2013/14 season.

CONCLUSIONS

Disease incidence and severity are seasonal in nature which highlights the significance of multi-season surveys which identify and prioritise sunflower diseases.

Keywords: diseases, sunflower, survey

(Nr. 43)

OPTIMIZING AVOCADO IRRIGATION SCHEDULING NORMS USING MIDDAY STEM XYLEM WATER POTENTIAL

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INTRODUCTION

Currently, avocado growers schedule irrigation based on soil water content measurements. The major pitfall with soil-based scheduling methods is that they do not measure plant water status directly and may therefore not be optimal (Jones, 2004). In order to optimize irrigation, water application should be applied according to the water status of the plant. Midday stem xylem water potential (MSXWP) was found to be a reliable indicator of plant water status in a number of crops and used to optimize irrigation scheduling (Naor, 2000). The aim of the current study was to use MSXWP as a plant water status indicator to optimize irrigation scheduling for avocado.

MATERIALS AND METHODS

The current study was carried out in the Tzaneen and Levubu areas on bearing 'Hass' avocado trees. To determine the onset of stress for avocado trees, MSXWP, stomatal conductance, transpiration and photosynthesis rates were measured. All the measured parameters were correlated with MSXW. In addition, soil volumetric water content and soil water potential were measured and correlated with MSXWP. The effect of irrigation on yield and fruit size was further determined in a trial with four irrigation treatments, namely -10 to -25, -25 to -35, -35 to -45 kPa and the farm's irrigation programme as control. Data was statistically analysed using GENSTAT.

RESULTS AND DISCUSSION

Correlating midday stem xylem water potential with the other physiological parameters, showed a plant response at approximately -0.5 MPa. In this instance stomatal conductance and transpiration suddenly decreased implying stomatal closure at MSXWP values of -0.5 MPa and lower. Corresponding to stomatal closure, a decrease in the rate of photosynthesis occurred. It was further found that MSXWP dropped below -0.5 MPa when 60% or more depletion of easily available water occurred (below -35 kPa for a sandy-clay soil). Yield was not significantly affected for any of the irrigation treatments but fruit size was negatively affected for the -35 to -45 kPa treatment. More than 60% depletion of easily available water from the soil therefore had a negative effect on fruit size as well.

CONCLUSIONS

From the results obtained, it is recommended that no more than 60% depletion of easily available water should be permitted in order to prevent plant stress.

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Keywords: transpiration, photosynthesis, stomatal conductance, yield, fruit size

(Nr. 44)

RELEASE OF THE GROUNDNUT CULTIVARS ARC-AKWAPLUS AND ARC-SELLIEPLUS

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INTRODUCTION

The South African groundnut industry relies on a constant supply of new cultivars to ensure competitiveness with the international market. This highlights the need for new cultivars but also for cultivars with the characteristics that is needed to maintain a high quality, high yielding product. To the producer, on the other hand, the most important considerations with cultivar choice are the expected yield and monetary value of the crop. Monetary value is largely influenced by the grading quality obtained. An introduction of two new cultivars will enhance the cultivar basket from which the producer can make his selection.

MATERIALS AND METHODS

Breeding lines were tested within the Phase One groundnut trials and compared with standard cultivars under a variety of climatic conditions. Standard cultivation practices were used. Grading procedures according to PPECB standards were used to obtain yield and grading data. The selected breeding lines were submitted to the Department of Agriculture, Forestry and Fisheries: Plant Improvement for testing and registering of lines as cultivars and for registering of plant breeder's rights.

RESULTS AND DISCUSSION

Resigtration for ARC-AkwaPlus and ARC-SelliePlus was obtained in August 2015 from the Registrar of Plant Improvement. ARC-AwkaPlus and ARC-SelliePlus both showed an increase in yield and disease resistance thus providing greater income for the producer. The first major seed multiplication of breeder seed for the two newly registered cultivars have commenced in November 2015 and will be available for sale to the industry in the 2016-17 summer growing season.

CONCUSIONS

Providing the groundnut industry of South Africa with high quality groundnut cultivars has been the mission of the ARC since its inception in 1994. The release of ARC-AkwaPlus and ARC-SelliePlus will greatly contribute to the sustainability of groundnut production in South Africa.

Keywords: groundnut, cultivar, new

(Nr. 45)

TILLAGE AND CROP RESIDUE MANAGEMENT EFFECTS ON SOIL MOISTURE AFTER 30 YEARS OF WHEAT-FALLOW ROTATIONS IN THE FREE STATE

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INTRODUCTION

The Free State (FS) Province is major dryland wheat (*Triticum aestivum* L.) production area in South Africa. Wheat is dry-planted on high water table soils during dry winter months and vegetative growth stages of the crop depend on stored soil moisture accumulated during the preceding fallow period. Conservation of summer rainfall occurring in this area is therefore important for successful dry land wheat production. The objective of this study was to determine the effect of tillage and residue management on soil moisture storage after 30 years of continuous wheat-fallow rotations on a deep Avalon in the Eastern Free State.

MATERIALS AND METHODS

A wheat-fallow rotation trial that has been running in Bethlehem, Eastern FS for 30 years was used for this study. Three tillage methods are being tested, namely; no-till, ripped and ploughed. The experiment was designed as 3 x 2 x 2 factorial treatment structure and laid out using a randomised complete block design with 3 replications. The factors were as follows: Tillage methods – 3 levels (no-till, ripped and ploughed); Residue management strategies – 2 levels (burnt/removed or not burnt.) and depth – 2 levels (0-20 and 20-40). Soil samples were collected at depths of 0- 20 cm and 20- 40 cm from the trial in June 2015 prior to wheat planting. The moisture content of these samples was determined using the gravimetric method. Moisture data was subjected to analysis of variance.

RESULTS AND DISCUSSION

A significant interaction between depth and tillage method was observed with respect to soil moisture content. Soils sampled at the deeper depth (depth 2) for the tillage method 2 showed higher moisture content than tillage method 1 and 3 at both depth 1 and 2. Soil moisture content was significantly ($P<0.01$) influenced by tillage method, with no-till (15.3% soil moisture) having more water than either the ripped (14.4%) or the ploughed (13.7%) soil. Residue management effects were however not significant ($P>0.05$), including their interactions with tillage methods. The interaction between tillage system and soil sampling depth was significant ($P<0.01$) and it showed that no-till increases moisture storage at the lower depths (16.4%), whereas ploughing dries the lower soil depths (13.9%).

CONCLUSIONS

No-till conserves more moisture for dryland wheat planting, especially at the lower soil depths. Removal of wheat residues from the field may not significantly affect the water storage.

ACKNOWLEDGEMENTS

ARC- PDP program and the Winter Cereal trust for the financial aid.

Keywords: crop residues, dryland wheat, soil moisture, tillage system

(Nr. 46)

INTERACTIVE EFFECTS OF NEMACUR, BIOCULT MYCORRHIZAE AND NEMARIOC-AL PHYTONEMATICIDE ON *Meloidogyne javanica* POPULATION DENSITIES AND GROWTH OF POTATO CV. 'MONDIAL G3'

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INTRODUCTION

Nemarioc-AL phytonematicide (a.i.: cucurbitacin A) and Biocult Mycorrhizae (a.i.s: Glomus spp. + Trichoderma spp.) are separately researched and developed for managing the root-knot (*Meloidogyne* species) nematodes and enhancing crop productivity through improved absorption of P. Therefore, the objective of this study was to determine the interactive effects of Nemacur, Mycorrhizae and Nemarioc-AL on *M. javanica* population densities in potato production.

MATERIAL AND METHODS

Potato cv. 'Mondial G3' seeds were sown in 25-cm-diameter pots containing 5 000 ml steam-pasteurised clay soils, sand and Hygromix at 2:1:1 (v/v). Each pot was inoculated with 5 000 eggs and second-stage juveniles (J2s) of *M. javanica* at 50% seedling emergence. Eight treatments, namely, untreated control (N0B0P0), Nemacur alone (N1B0P0), Biocult alone (N0B1P0), phytonematicide alone (N0B0P1), Nemacur + Biocult (N1B1P0), Nemacur + phytonematicide (N1B0P1), Biocult + phytonematicide (N0B1P1) and Nemacur + Biocult + phytonematicide (N1B1P1), were arranged in a randomised complete block design (RCBD), with 8 replications.

RESULTS AND DISCUSSION

Fifty-six days after inoculation, second order interaction, N1B1P1, was highly significant (P = 0.05) on eggs in root, eggs and J2s in root and total nematodes, contributing 13, 12 and 12% to total treatment variation (TTV), respectively . Two first order interactions, N1B1P0 and N1B0P1, had highly significant effects on all nematode variables. A three-way table was drawn for total nematode. Relative to the untreated control all the permutations reduced nematode numbers. The second order interactions did not have effects on any plant variable. In contrast, the first order interaction N0B1P1 had highly significant effects on gall rating and chlorophyll content, contributing 18 and 41% to TTV of the respective plant variables. A two-way table for chlorophyll content was drawn and relative to the untreated control Biocult alone reduced chlorophyll content by 6%, whereas when in combination with phytonematicide reduced by 2%.

CONCLUSION

The three materials would complement each other in the management of *Meloidogyne* species in potato production.

ACKNOWLEDGEMENTS

The authors are grateful to the Agricultural Research Council (ARC), Land Bank Chair of Agriculture-University of Limpopo and the Flemish Interuniversity Council (VLIR) for financial support.

Keywords: complementary management strategies, cucumis myriocarpus, medicinal plants, organic amendments, potato

(Nr. 47)

OPTIMISING STORAGE PERIOD OF NEMAFRIC-BL PHYTONEMATICIDE AFTER PROCESSING

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INTRODUCTION

Fresh fruit of *Cucumis africanus* deteriorate rapidly after maturity and therefore, should be dried at 52°C for 72 h prior to use in manufacturing of nemafric-BL phytonematicide. Due to large quantities of ground material, extended storage is necessary prior to manufacturing process (Mashela *et al*. 2011). Quality of plant-based products is largely depended upon the active ingredients, which among many factors, may deteriorate due to storage time prior to use. Optimisation of the quality of nemafric-BL phytonematicide made from fermented dried crude extracts of *C. africanus* fruit is not documented. The objective of the study, therefore, was to determine the effect of post-storage of nemafric-BL phytonematicide on concentration of cucurbitacin B at room temperature.

MATERIALS AND METHODS

Fruit of *C. africanus* were harvested at maturity, dried at 52 °C for 72 h, ground and fermented as described by Pelinganga *et al*. (2012). Fermented crude extracts of *C. africanus* fruit were stored in a dark room at room temperature for six months, with samples analysed monthly using Shimadzu Prominence HPLC to quantify the concentration of cucurbitacin B.

RESULTS AND DISCUSSION

The concentrations of cucurbitacin B in nemafric-BL phytonematicide were optimised at 2.74 months (approximately 71 days), with the quadratic relationship model explaining 93% of total treatment variation in cucurbitacin B concentration. Generally, most fermented plant extracts can be stored for up to three months.

CONCLUSIONS

Processed nemafric-BL phytonematicide should not be stored for over 71 days. However, trials should be conducted to assess the effects of synchronising this period with the industry standard.

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Pelinganga OM, Mashela PW, Nzanza B, Mphosi MS. (2012). Baseline information on using fermented crude extracts from *Cucumis africanus* fruit for suppression of *Meloidogyne incognita* and improving growth of tomato plant. African Journal of Biotechnology 11: 11407-11413.

ACKNOWLEDGEMENT

University of Limpopo and Flemish Inter University Council are acknowledged for financial support.

Keywords: agro-processing, cucurbitacin A, effective microorganisms, nemarioc-AL phytonematicide, phytotoxicity

(Nr. 48)

RESPONSES OF CUCURBITACINS TO DRYING TEMPERATURES FROM TWO *Cucumis* spesies

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INTRODUCTION

Dried fruits of *Cucumis myriocarpus* and Cucumis africanus are used to develop nemarioc-AL and nemafric-BL phytonematicides. Potent active ingredients in *C. myriocarpus and C. africanus* are cucurbitacin A and cucurbitacin B, respectively. Generally, in order to enhance consistent performance of phytonematicides, the active ingredients need to be monitored throughout the value-chain (Shadung *et al*. 2015). Therefore, the objective of this study was to determine the effect of different oven-drying temperatures on cucurbitacin A and cucurbitacin B from dried fruits of *C. myriocarpus* and *C. africanus*, respectively.

MATERIAL AND METHODS

Fruits of *C. myriocarpus* and *C. africanus* were harvested at maturity, chopped and dried at six different oven-drying temperatures, viz; 52, 60, 70, 80, 90 and 100°C. Extracted samples were quantified for cucurbitacin A and cucurbitacin B using reverse phase Shimadzu HPLC.

RESULTS AND DISCUSSION

Oven-drying temperatures contributed 65% and 71% to total treatment variation in cucurbitacin A and cucurbitacin B concentration, respectively, with the depended (y-axis) and independent (x-axis) variables having significant (P = 0.05) quadratic relationships. The quadratic curves explained 94% and 95% of the observed variation in cucurbitacin A and cucurbitacin B. Oven-drying temperature at 52°C resulted in high concentrations of cucurbitacin A (2.724 µg/ml) and B (6.706 µg/ml). Also, increasing temperatures drastically decreased concentrations of cucurbitacins.

CONCLUSION

This study showed that *C. myriocarpus* and **C. africanus** fruits dried at 52°C retained high concentration of cucurbitacins, which would therefore improve the efficacy of the two phytonematicides.

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ACKNOWLEDGEMENT

Authors are grateful to the Land Bank Chair of Agriculture, University of Limpopo, Flemish Interuniversity Council of Belgium and Technology Innovation Agency (TIA) for funding the study.

Keywords: Cucurbitaceae, drying methods, nematodes

(Nr. 49)

CLASSIFICATION OF ARC MAIZE (*Zea mays* L.) INBRED LINES INTO HETEROTIC GROUPS

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INTRODUCTION

Maize (*Zea mays* L.) plays a major role in global nutrition and household food security primarily in Sub-Saharan Africa. Knowledge of heterotic groups and heterotic patterns is essential in maize breeding programs in order to maximize heterosis in hybrid combinations, maintain diversity of breeding lines and aid in improvement of elite inbred lines. Defining the smallest number of heterotic groups as possible improves breeding efficiency. The objective of the study was to re-classify ARC maize inbred lines into two heterotic groups.

MATERIALS AND METHODS

Thirty eight maize inbred lines from seven known heterotic groups of the ARC maize breeding program were crossed to four testers in a line by tester mating design. Testers representing two heterotic groups were A (B73 and CML312) and B (MO17 and CML444). The hybrids were evaluated at two sites (Potchefstroom and Cedara). The trials were laid out in a (0, 1) alpha lattice design with two replicates. The inbred lines were classified based on the specific combining ability (SCA) value of a line and a tester for grain yield (tons/ha); where positive SCA effects with one tester indicate that lines belong to the opposite heterotic group and negative SCA effects indicate that lines belong to the same heterotic group. The Analysis of Genetic Designs (AGD) software was used for data analyses.

RESULTS AND DISCUSSION

The ARC maize inbred lines were divided into three heterotic groups. Some inbred lines were allocated to heterotic group A, some to group B, and others were allocated to both A and B. Lines allocated to both A and B showed negative SCA with both testers. Heterotic group A was comprised by the lines that showed positive combining ability with group B testers, and the heterotic group B comprised those that combined positively with heterotic group A testers. Classification of most inbred lines corresponded with their known pedigrees. None of the lines were not classified into defined groups. However, because the lines used were from known heterotic groups, there was a distortion in the classification of some lines where different inbred lines from the same group were classified differently. This could be due to the interaction between a specific tester and a specific inbred and therefore differences in the allocation into one group. Interestingly, regardless of the differences in the origin of the testers (CIMMYT and USA) used, classification by either heterotic group A or B was consistent, confirming that CML312 (CIMMYT) and B73 (USA) belong to heterotic group A and also CML444 (CIMMYT) and MO17 (USA) both belong to heterotic group B.

CONCLUSIONS

Classification of most inbred lines based on the SCA effects corresponded with the pedigree information. However, a few lines were classified into both A and B heterotic groups suggesting that yield data alone might not be sufficient for full classification. Molecular data may also be crucial.

Keywords: heterotic group, inbred lines, specific combining ability, testers

(Nr. 50)

PLANT SPACING AND CULTIVAR EFFECTS ON GROWTH, YIELD AND QUALITY OF TUNNEL-GROWN TOMATOES

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INTRODUCTION

Tomato (*Solanum lycopersicum*) is the second most important vegetable crop after potato in South Africa. Tomato marketable yield and fruit size are known to be affected by plant spacing. The objective of the study was to investigate the influence of plant spacing and cultivar effects on growth, yield and quality of tunnel-grown tomatoes.

MATERIALS AND METHODS

Five indeterminate tomato cultivars ('Vinchy', 'Dyvine', 'Leon', 'Dominique' and 'Amestita') were planted in a tunnel at two planting densities to determine their growth, yield and quality. Temperature and relative humidity were monitored and recorded throughout the growing period. Fruit mass, fruit size, fruit marketable yield, fruit firmness, % Brix, and marketable yield were recorded at harvest maturity. For postharvest evaluation, a sub-sample of fruits was stored in either a cool room at 10oC or at room temperature. Fruit moisture loss, firmness and sugar content were assessed at seven and at fourteen days of storage.

RESULTS AND DISCUSSION

Plant height was greatest under high density planting resulting in higher total number of fruits per plant. Furthermore, fruit size, fruit mass and marketable yield were lower with high density planting. A higher total number of cull fruits was obtained in the high density planting. However, cultivars; namely: Vinchy, Dyvine and Dominique performed equally well in both plant densities. Temperature and storage period has no effect on % Brix however, have effect on fruit firmness.

Fruit moisture loss was higher at room temperature in contrast with cool room temperature (10°C).

CONCLUSIONS

Plant spacing has an effect on growth, quality and yield of tunnel-grown tomatoes. High yields were obtained in both plant densities, but low density resulted in high marketable fruit yield. Postharvest storage and temperature has effect on quality. Furthermore, fruit firmness and moisture decreases as increasing the storage period.

ACKNOWLEGDEMENTS

This research was funded by the Belgian Development Agency.

Keywords: indeterminate cultivars, plant density, post-harvest storage, *Solanum lycopersicum*

(Nr. 51)

INTEGRATION OF NEXT-GENERATION SEQUENCING TECHNOLOGIES WITH COMPARATIVE GENOMICS IN CEREALS

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INTRODUCTION

Significant limitations to cereal crop production and productivity pose a threat to global food security since these crops are the main sources of calories that support the ever-growing human population. Despite the significant progress that has been made in the improvement of edible yield through classical breeding techniques, the current rates of increase in grain yield in several major cereal crops are still too slow to catch up with the increasing demand of growing populations (Ray *et al*. 2013; Lobell and Field 2007). This is likely to get worse according to the projected climate change scenarios (Rosenzweig *et al*. 2001), as it also affects biotic stresses such as pests, diseases and weeds, and abiotic stresses including drought, extreme temperatures, salinity and nutrient deficiencies (Chakraborty and Newton 2011; Duveiller *et al*. 2007). Although there are various strategies to cope with these constraints, the use of genomics-assisted breeding has been an effective and economic strategy.

MATERIALS AND METHODS

Despite the sustainability of breeding resilient crops, there are still several genomic constraints to genome-based selection and stress resistance improvement, particularly for multigenic traits. A poor understanding of the genetic basis and the regulatory mechanisms of various stresses is among the major challenges for successful genetic manipulation through gene introgression, gene pyramiding, gene stacking or gene silencing. Additionally, more diagnostic genetic markers are necessary to improve the current limited success in marker application in both foreground and background selection. These challenges are related to the fact that genomes of some cereal crops are not yet fully sequenced and annotated, either because the crops have been under-researched or the genomes are huge and structurally complex.

RESULTS AND DISCUSSIONS

Comparative genomics is expected to provide invaluable information on the control of gene function in complex cereal genomes, and also in designing molecular markers across related species.

CONCLUSION

This chapter discusses advances in sequencing technologies, their application in cereal genomics and their potential contribution to the understanding of the relationships between the different cereal genomes and their phenotypes.

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The National Research Foundation of South Africa and the Agricultural Research Council are thanked for funding.

Keywords: bioinformatics, cereals, comparative genomics, next-generation sequencing, synteny

(Nr. 52)

PROJECTED CLIMATE CHANGE SCENARIOS ON MAIZE PRODUCTION: CASE STUDY ON SELECTED SEMI-ARID REGIONS OF SOUTHERN AFRICA

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INTRODUCTION

Climate change impact projections in Southern Africa reveal increased occurrences and severity of drought (Lobell *et al*., 2008). Changing in climate adds pressure in smallholders across the region and is likely to increase risk of crop failure of stable crops like maize (*Zea mays* L.) and food insecurity in the region. The Agricultural Model Intercomparison and Improvement Project (AgMIP) engaged in climate change impact assessment research to improve the characterization of global food security as affected by variability and changing of climate (Cynthia *et al*., 2013). During Phase-I AgMIP scientific tracks (Fast-track and Post-track) laydown a robust framework to understand climate impact on stable crop production system. The aim of the study therefore is to assess and compare historical and future maize production simulations using Agricultural Production Simulator Model (APSIM) with baseline (1980-2010) and mid-century future (2040-2070) climate scenarios on selected semi-arid regions of Southern Africa.

METHODS AND MATERIALS

In the study the Southern Africa region (SADC) was represented by including maize growing areas of 14 semi-arid locations in South Africa, Lesotho, Namibia, Botswana and Swaziland. Methodologies, tools and protocols developed for crop modelling in AgMIP were adopted to address improved projections of climate impacts on smallholder maize production with and without adaptation strategies.

RESULTS AND DISCUSSION

Model performance showed reasonable R2 (0.46 – 0.59) and RMSE (355 – 681 kg ha-1) values, when only district yields were used for testing, in spite of climate related year-to-year variations in yield. Climate change causes variability in maize yields, which is expected to make maize production more risky without improved adaptation strategies. More importantly, diversified potential management in agricultural practices due to climate change would improve rural livelihoods and the whole Southern African regional economy. This implies that all vulnerable groups are threatened by climate change through insecure food production.

CONCLUSIONS

Current maize production systems are sensitive to climate change, resulting in negative impacts of climate change on future maize production in the SADC region. A crop modelling approach helps to understand the coping mechanisms for improved on-farm decisions to benefit from adaptation strategies by the smallholder farming community.

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Keywords: adaptation strategy, apsim, climate change, maize, semi-arid

(Nr. 53)

EFFECT OF CONSERVATION TILLAGE PRACTICES FOR POTATO PRODUCTION ON SOIL COMPACTION, YIELD AND TUBER CHARACTERISTICS IN THE SANDVELD REGION OF SOUTH AFRICA

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INTRODUCTION

Tillage plays a major role in the modification of soil structure as it influences the distribution of energy rich organic matter within the soil profile and thus impacts on the energy flow and the dynamics of soil geo-chemical functions. Alternative tillage methods are favoured due to the negative effects of excessive tillage in conventional tillage practices. The project has the objective to evaluate the effect of conservation tillage practices on soil compaction, yield and tuber characteristics in the Sandveld.

MATERIALS AND METHODS

The trial was conducted on a sandy soil at Aurora in the Sandveld. Three tillage treatments were performed and consisted of a conventional tillage treatment which included a mouldboard plough to a depth of 350 mm combined with a rip treatment 600 mm deep between planting rows, a conservation rip treatment to a depth of 600 mm between planting rows and a paraplough treatment over two planting rows to a depth of 600 mm. The soil penetrometer readings were determined with a recording Geotron P5 penetrometer before any tillage operations were conducted and then one week post planting to determine soil compaction. The effect of the tillage treatments was determined on yield, size distribution and specific gravity of tubers.

RESULTS AND DISCUSSION

The general compaction pre-planting was 3073 kPa at a depth of 300 mm, 3543 kPa at 400 mm and above 5000 kPa in 90% of the sample points at a depth of 500 mm. After tillage and planting, the paraplough treatment had a significant higher compaction up to a depth of 300 mm when compared to the other two tillage treatments. The data at 400 and 500 mm depth showed no significant differences between all the tillage treatments and from a depth of 600 to 800 mm the paraplough treatment showed significantly less compaction when compared to the other two tillage treatments. The paraplough treatment showed significantly the highest yield of 61.2 tha-1 and the conservation rip treatment the lowest of 53.75 tha-1. The specific gravity of 1.056 recorded with the paraplough treatment differed significantly from the conventional tillage treatment.

CONCLUSIONS

The results show that alternative tillage regimes can result in higher yields and enhanced tuber characteristics without the negative effects of conventional tillage regimes.

Keywords: conservation tillage, potato, specific gravity, soil compaction, yield

ABSTRACTS
POSTER PRESENTATIONS

HORTICULTURAL SCIENCE

LISTED ALPHABETICALLY

(Nr. 54)

DESIGNING VENTILATED PACKAGING FOR OPTIMAL COOLING PERFORMANCE AND ENERGY EFFICIENCY

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INTRODUCTION

Inadequate cooling of produce after it has been packaged can result in a higher incidence of postharvest losses and therefore wastage of horticultural fresh produce. Packaging plays a critical role in preventing physical damage during transport as well as presenting an aesthetically pleasing product to the consumer. However, the use of multiple scales of packaging, such as internal packaging, boxes and pallets negatively influences the cooling efficiency of forced air cooling systems. Ventilation holes are added to the cartons so as to enhance cooling airflow penetration into the stacked cartons. Due to the complex needs and considerable variations in produce packaging designs, little success has been achieved in optimizing total vent area and stacking arrangements of cartons. The specific objectives are to characterize the effects of vent design on cooling performance and energy efficiency of individual and stacked fruit packaging.

MATERIALS AND METHODS

A multi-parameter analysis technique was used to incorporate the effect of the various packaging scales. The effect of each cold chain component is therefore incorporated into all evaluations. Furthermore, a novel multi-parameter evaluation process was used to investigate cooling performance and energy efficiency. Performance parameters included: cooling rate and cooling uniformity, airflow resistance and energy efficiency. Additionally, both experimental and numerical methods were used as evaluation techniques.

RESULTS AND DISCUSSION

Results showed that numerical methods provided the convenience of high resolution data collection, whereas experimental setups are often hindered by the limitations of placing sufficient monitoring devices. However, experimental results are still essential for the validation of numerical findings. Results showed that circular-shaped vent holes are preferable to other shapes for cartons packed loose (bulk). In addition, vent hole sizes should not be increased beyond 7% of carton area as cooling efficiency does not increase significantly at larger sizes. The Influence of internal packaging was also significant; addition of trays increased cooling energy consumption by 31%, whereas the addition of liner bags reduced cooling rate by 78%. Carton vent hole designs should therefore be configured to incorporate the presence of internal packaging. Finally, results also showed that vent alignment of stacked cartons is of a higher importance than optimising vent hole design on individual cartons.

ACKNOWLEDGEMENTS

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Keywords: cooling, CFD, packaging, energy efficiency, multi-scale approach, internal packaging

(Nr. 55)

THE PERFORMANCE OF FUKOMOTO NAVEL ON VARIOUS ROOTSTOCKS AND ROOTSTOCK-INTERSTOCK COMBINATIONS

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INTRODUCTION

Fukumoto is an early maturing navel orange, with a good internal quality, an attractive round shape and a deep orange rind colour. Fukomoto was released into the South African Citrus Industry in 2000 and has become a popular navel cultivar. However, Fukomoto navel is reported to suffer from die-back, due to incompatibility, on some rootstocks. Therefore a trial with Fukomoto navel on various rootstocks and rootstock-interstock combinations was established at the Addo Research Station, Addo, Eastern Cape in August 2005. Troyer citrange, C35 citrange and Swingle citrumelo were used as rootstocks and Troyer citrange was used in combination with Cara-Cara and Washington navel interstocks. Inspections were carried out for incompatibility, while data was collected to compare the performance of Fukomoto navel on various rootstocks and rootstock-interstock combinations.

MATERIALS AND METHODS

The trees were inspected on a yearly basis for any signs of die-back or incompatibility. Data was collected for 2012, 2013 and 2014, for Juice %, Brix %, Acid %, Brix:Acid ratio and yield. This data was visualised by means of GGE Comparison biplots.

RESULTS AND DISCUSSION

No signs of incompatibility were noted on Fukomoto navel on Troyer citrange and Swingle citrumelo rootstocks and Troyer citrange with Cara-Cara and Washington interstocks. Fukomoto trees on C35 citrange were dwarfed and die-back was noted on some trees. C35 citrange rootstock gave the highest Juice % and Brix %. However, while the Juice % was stable over the years the Brix % was not. Swingle citrange rootstock gave the highest Acid % and was stable for this characteristic over the years measured. Troyer citrange rootstock with a Washington navel interstock gave the highest Brix:acid ratio and the highest yield and was stable for both these characteristics over the years measured.

CONCLUSION

Fukomoto navel on C35 rootstock showed signs of incompatibility, while Fukomoto on the other rootstocks and rootstock-interstock combinations did not. None of the rootstocks or rootstock-interstock combinations were superior in all the characteristics measured. However, from this data Fukomoto navel on Troyer citrange rootstock with a Washington navel interstock appeared to be the best combination.

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Keywords: citrus, incompatibility, interstock, Troyer citrange, comparison biplot

(Nr. 56)

ETERMINATION OF FEMALE FERTILITY IN MANDARIN ORANGE BY MEANS OF CONTROLLED MANUAL CROSS POLLINATIONS

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INTRODUCTION

Seediness in supposedly seedless varieties, caused by cross pollination, remains an undesirable trait in mandarin varieties. In order to sufficiently describe female fertility of seedless mandarins, the suitability of controlled manual cross pollination as methodology for distinguishing fertility differences between cultivars was assessed as part of a collaborative study between Spain, Morocco and South Africa. The aim of the project was to use pollinators with highly fertile pollen and supposedly seedless female parents to evaluate if controlled manual cross-pollination can be used to describe female fertility.

MATERIALS AND METHODS

The study was conducted in the Eastern Cape Province during September/October of the 2012-13 and 2013-14 citrus flowering seasons. Controlled manual cross-pollinations were made at anthesis and six days after anthesis on four female parents (‘Nules’, ‘Nadorcott’, ‘Nova’, ‘Marisol’) using two male parents (‘Nova’, ‘Nadorcott’). Open-pollinated fruit were included as control. Pollen viability and pollen germination were tested during flowering and the number of seed per fruit was determined at harvest.

RESULTS AND DISCUSSION

Pollen germination was higher in ‘Nadorcott’ compared to ‘Nova’. The number of seed per fruit was higher in controlled manual cross pollinated flowers compared to open pollinated flowers. The number of seed decreased with later pollination dates, most likely due to reduced stigma receptivity. ‘Nadorcott’ as pollinator resulted in higher number of seed in female parents in comparison with ‘Nova’ as pollinator except when pollinated with itself. Fruit set potential increased with controlled manual cross-pollination.

CONCLUSIONS

Results of controlled manual cross pollinations on ‘Nova’, ‘Nules’, ‘Marisol’ and ‘Nadorcott’ with the pollinators ‘Nadorcott’ and ‘Nova’ have shown that seed formation is affected by genetic and environmental factors and variations between years can occur.

Although the reasons for seedlessness may be many, controlled manual cross pollinations with highly fertile pollinators resulting in seediness show a clear indication of female fertility. We therefore conclude that female fertility is directly related to seediness and that the degree of female fertility can be determined with high accuracy by controlled manual cross pollination. This methodology provides a simple means to describe cultivar specific differences in female fertility.

Keyowrds: pollen germination capacity, seedless varieties, seed formation

(Nr. 57)

DESIGNING VENTILATED PACKAGING FOR OPTIMAL MECHANICAL PERFORMANCE

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INTRODUCTION

Postharvest losses and waste of fruit due to mechanical damage during handling are major problems in the fresh produce industry. Ventilated corrugated paperboard (VCP) packages are used extensively in the fruit industry to minimize damage and facilitate airflow around the produce to maintain the cold chain. In the postharvest journey of fruit, these packages are subjected to a multitude of dynamic and static forces such as impacts, compression and vibration which results in damage and reduces the quality of the packed fruit. Proper packaging and good design of ventilated packages is therefore crucial to reduce susceptibility of packed fruit to mechanical damage. This research aims to assess fruit and package interactions when subjected to various mechanical loadings to obtain a package design with an optimal mechanical performance.

MATERIALS AND METHODS

Fruit packed inside ventilated packages were subjected to impact, compression and vibration load to study the package and fruit interactions. Incidence and susceptibility to bruise damage were determined. Numerical investigation on the resistance of the packages to buckling was done using finite element analysis (FEA). Validated FEA models were used to study different design configuration of the package.

RESULTS AND DISCUSSION

Findings showed that the incidence and susceptibility of fruit to bruise damage was affected by package design, as more than 50% higher incidence of damage occurred on fruit packed in bulk than fruit packed in layered package designs. Bruise susceptibility also varied spatially inside the package. About 16% reduction in compression strength of the package occurred when environmental conditions were changed from (23 C and 50%) to (0 C and 90%). Under vibration load, the highest bruise damage was observed at a frequency of 12 Hz, where the greatest packaging transmissibility of 243% occurred. The incipient buckling load of the package obtained from the FEA model could accurately predict the experimental value obtained during the compression test. Rectangular vent holes better retained the strength of the packages compared to circular vent holes. Results obtained from this research provided practical guidelines for improving future design of packages for the fresh produce industry.

ACKNOWLEDGEMENTS

This work is based upon research supported by the DST-South African Research Chairs Initiative of the Department of Science and Technology and National Research Foundation.

Keywords: ventilated packaging, bruise damage, finite element analysis (FEA), mechanical damage

(Nr. 58)

RELATIONSHIP BETWEEN MORPHOLOGICAL AND MOLECULAR CHARACTERISATION OF MACADAMIA CULTIVARS IN SOUTH AFRICA

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INTRODUCTION

Macadamia (Proteaceae) is an economically important crop valued for its edible kernel. At present, South Africa is one of the largest producers of macadamia worldwide. Currently, cultivars grown locally are evaluated on morphological characteristics. However, there are some disadvantages with this method including that such characteristics might be influenced by environmental conditions, which can hamper cultivar identification and potentially lead to misidentifications. Molecular markers can provide a supplementary tool and have the advantage of discriminating amongst cultivars quickly and efficiently without environmental influence. To date, a range of molecular markers have been developed for macadamias, with microsatellite markers being the most popular.

METHODS AND MATERIALS

At the Agricultural Research Council's Institute for Tropical and Subtropical Crops in Nelspruit, the application of Simple Sequence Repeat (SSR) and Sequence-Related Amplified Polymorphism (SRAP) markers have been investigated to determine the genetic relatedness of macadamia cultivars in South Africa. However, while there has been much discussion on the advantages and limitations of morphological versus molecular markers, there appears to be limited information on direct comparisons (with appropriate data sets) between the two methods, particularly in the case of macadamia. Therefore, this was considered in the present study in the context of cultivars of interest in South Africa.

RESULTS AND DISCUSSION

The results revealed a lack of suitable morphological descriptors for many of the tested cultivars. There were no relationships of note between the SSR molecular analysis and morphological characters, despite the high co-phenetic correlation coefficient values (CCC) obtained. In contrast, a few similar trends were observed when the molecular analysis for SRAP markers were compared with that of morphological characters. However, this latter relationship was characterised by low CCC values.

CONCLUSIONS

The results indicate the need for further work to improve the CCC values obtained (either by optimisation of the SRAP markers or the application of more suitable molecular markers) and to compile a more complete list of morphological descriptors.

Keywords: Macadamia, molecular markers, SSRs

(Nr. 59)

EFFECT OF VERTE GUANO ON GROWTH OF CABBAGE (*Brassica oleracia* L. var. STAR 3301) GROWN UNDER DRIP IRRIGATION SYSTEM

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INTRODUCTION

Verte Guano is an organic liquid seabird guano fertilizer high in phosphorus and various other macro and micro nutrients. Phosphorus is used by plants for healthy root, flower and fruit development. Verte Guano can be used when plants are flowering and fruiting to promote larger and more radiant flowers and fruits. It can also be used to promote root growth after transplanting. It is mixed at a rate of 25 mL Verte Guano to 1 L of water and it can be applied as a foliar feed, or straight to the soil. However, little is known about the effects of Verte Guano on leafy vegetables. As such it was ideal to evaluate its effect on growth (plant height and number of leafs prior to head formation) and yield parameters (head length, fresh head mass, head girth and diameter) of cabbage under open field conditions.

MATERIALS AND METHODS

The study was conducted as RCBD, with three dilution levels of Verte Guano: 0ml/20L, 500ml/20L and 750ml/20L of water replicated four times at Ga-Mothiba village in Limpopo Province. Drip pipes of 60cm inter-hole spacing were used and seedlings were planted using the in-row spacing of 60 cm as guided by the drip pipe line. Verte Guano was applied manually on a weekly basis with a Knapsack sprayer from two weeks after transplanting. The eight middle rows were used for data collection from four weeks after transplanting. Data on growth parameters (plant height and number of leafs) were recorded continuously on biweekly basis.

RESULTS AND DISCUSSION

Plant height and number of leaves were not significantly different for the different treatments from second and fourth weeks of application. There was a significant increase in plant height at the 6th week of application at the higher concentrations. The dilution level of 750ml/20L was significantly different from the control but non-significant from the dilution level of 500ml/20L on the 6th week of application. There were no significant a differences for number of leaves across all dilution levels.

CONCLUSION

Preliminary findings of the study demonstrate that foliar application of Verte Guano increased plant height from the 6th week after application, however the number of leafs were not affected. Data on yield parameters were not included since the crop is still at the growing stage. The study is still in progress for further evaluation on growth and yield parameters.

Keywords: dilution levels, growth parameters, verte guano, cabbage

(Nr. 60)

MUTATION AND DISTANT HYBRIDISATION AS BREEDING TECHNIQUES TO IMPROVE PAPAYA

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INTRODUCTION

Caricaceae has a relatively small genome of 372 Mbp which is about the same as Citrus (382 Mbp). For comparison, the genome of maize is eight times larger, pine 56 times larger and the Lily family 322 times larger. The family consists of six genera and papaya is the only specie in the genus *Carica*. Although numerous cultivars are available they tend to have similar limitations which include poor tolerance to low temperatures, susceptibility to diseases, vigorous tall growing plants, wind sensitivity and poor or no tolerance to waterlogging. Mutation breeding is of great use to a plant breeder with limited genetic variation in a crop. Distant hybridization is another alternative method to introduce unique characteristics into a crop with limited variation from another crop that is not closely related. Little success has been achieved with this method as the probability of a successful cross and useful, fertile progeny are very low. It is however an innovative technique and worth investigating. The objective of the study was to evaluate the effectiveness of the two methods to induce variation in the progeny of the selected papaya cultivars.

MATERIALS AND METHODS

Mutation breeding involved six papaya cultivars and selections, of which the seed from self-pollinated fruit was washed and air dried. The seed was irradiated with a Cobalt 60 source at 7 dosages ranging from 20gy to 120gy with 0gy as control. Distant hybridization involved the cross pollination of six papaya genotypes with three granadilla genotypes.

RESULTS AND DISCUSSION

It was found that plant growth is negatively correlated to irradiation dosage. Mildew tolerance was induced by radiation and two selections with cold tolerance were identified. Preliminary investigations showed that the difference between the genetic content of papaya and the granadilla could be detected through flow cytometry which might be useful to identify interspecies crosses. Only one pollination combination rendered fruit with seed that could be germinated. The pollinations will be repeated.

CONCLUSIONS

Cultivars had a definite response to irradiation dosage. Gamma irradiation proved to be a useful alternative breeding tool. The investigation into distant hybridisation needs refinement.

ACKNOWLEDGEMENTS

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Keywords: mutation, distant hybridisation, interspecies, breeding techniques, papaya

(Nr. 61)

MORPHOLOGY OF SEED TESTA IN WILD CUCUMIS SPECIES: POTENTIAL CONTRIBUTION TO PHYSICAL SEED DORMANCY

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INTRODUCTION

Seed dormancy within the Cucurbitaceae family, has been attributed to allelochemicals, referred to as cucurbitacins (Jeffrey 1980). However, poor germination in leached seeds of wild watermelon (*Cucumis africanus*), as well as complete failure in germination of leached wild cucumber (*C. myriocarpus*) seeds could be attributed to the existence of impermeable layers in the seed testa to water (Maila and Mashela 2013). The objective of this study was two-fold: to determine whether the testa in seeds of the two *Cucumis* species possess structures, which have generally been known to interfere with imbibition and movement of water to the endosperm and the existence of "water gap" structures, which can amplify imbibition.

MATERIALS AND METHODS

Seeds were cut into longitudinal, middle and chalaza regions using a microtome blade. Cut sections were mounted on aluminium stubs using sticky tabs and coated with carbon, then examined, measured and photographed using a field emission scanning electron microscope.

RESULTS AND DISCUSSION

In *C. myriocarpus*, five distinct layers were observed: epidermis, hypodermis, sclerenchyma, aerenchyma and collenchyma. In contrast, only four layers occurred in *C. africanus* as the hypodermis was missing. Most of the layers were heavily lignified and therefore, served as candidates for impermeability to water. In both the *Cucumis* species, a "canal" was observed at the micropyle and chalaza regions, with scarification at either region unblocking the "canal" and thereby, enhancing germination.

CONCLUSIONS

In addition to chemical dormancy, seeds of both *Cucumis* species also have physical dormancy. Therefore, to enhance seed germination, both dormancies must be ameliorated.

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ACKNOWLEDGEMENTS

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Keywords: cucurbitacins, ethnomedicinal plant, microbial degradation, secondary metabolite

(Nr. 62)

THE EFFECT OF COW MANURE AND PLANT POPULATION DENSITY ON GROWTH AND YIELD OF THREE *Amaranthus spp*.

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INTRODUCTION

Amaranthus is one of the oldest wild harvested food crops in the world. It is currently grown as green, leafy vegetable in many temperate and tropical regions of South Africa. Some of the reason for cultivating this crop is for household food security and replenishment of the seed bank (DAFF 2010). Therefore, this study was conducted to investigate the effect of cow manure on different planting densities of *Amaranthus spp*.

MATERIALS AND METHODS

The study was carried out at the University of Venda experimental Farm, Thohoyandou (23°35'.14.0" S & 30°15'50.3" E 595 masl) in Limpopo South Africa from January to March 2015. Two plots were prepared with different planting densities, 30 × 30cm and 40 × 40 cm spacing between the plants respectively. Both plots consisted of a factorial combination of 3 × 3 treatments laid out in a complete randomized block design and replicated 3 times. *Amaranthus* cultivars investigated were *Amaranthus palmeri*, *Amaranthus hypochondriacus* and *Amaranthus retroflexus* with the cow manure application rate of 1 kg/ha, 3.5 kg/ha and 7kg/ha. Parameters measured were Plant height, number of leaves and stem diameter. Data was subjected to ANOVA in Genstat (17th edition).

RESULTS AND DISCUSSION

There was no significant (<0.05) difference in number of leaves, stem diameter and plant height under different doses of cow manure and varied plant densities which was probably due to low soil moisture content. However, number of leaves increased with decreasing plant density and increasing manure dose probably due to low competition for nutrients and space.

CONCLUSIONS

The amount of cow manure in the soil does not affect the plant growth under different plant densities with low soil moisture content although number of leaves tend to increase under low plant density.

Keywords: Amaranthus spp, plant height, number of leaves, stem diameter

(Nr. 63)

PHENOLOGICAL STUDIES OF QUEEN PINEAPPLE VARIETIES, CLONES AND SELECTIONS IN HLUHLUWE, SOUTH AFRICA

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INTRODUCTION

The Natal Queen pineapple variety is mainly produced in Hluhluwe, Northern KwaZulu-Natal, for the fresh market in South Africa. The industry is small and has little genetic variety. This limits the opportunity for effective breeding and the expansion of the varieties against pest and disease resistance. A project was launched in 2005 where several clones and Queen-like clones of the Queen variety from a field gene bank of CIRAD-PHLOR in Martinique are evaluated for adaptability under South African conditions. Outstanding qualities can then be introduced to the industry to increase the gene pool or it can be used in a breeding program.

MATERIALS AND METHODS

The study is conducted at the ARC-ITSC Research Station in Hluhluwe. Four Queen Pineapple varieties TA 039, GU 044, GU 076 and SI 087 and 2 Queen like clones, BR338 and BR 316c, were bulked through tissue culture and planted in the field in 2008. One local selection JOKKIE and the VC Queen clone were also included in the study. The Natal Queen was introduced in the third season of the study (2013) for comparison purposes. Plant growth, nematode infestation, pests and disease occurrence, time and duration of flowering, fruit yield as well as external and internal fruit quality were evaluated. The study is ongoing and in each new season more variables such as the effect of age of planting material and sucker size on plant growth and yield will be added. The effect of different cultivation practices on yield and fruit quality was also determined.

RESULTS AND DISCUSSION

All new varieties and clones are more vigorous and yield more planting material than the local selection and varieties. On average the SI 087 variety has the lowest plant parasitic nematode infestation in the last four planting seasons. There was no general trend observed in mealybug and red mite infestation. The new varieties and clones are more susceptible to natural flowering than the local selection which, can be ascribed to a larger plant size. Fruit size has increased over the years, while yield and fruit quality are significantly influenced by the cultivation practices applied. Fruit of most of the new varieties is highly susceptible to water logging (translucency).

CONCLUSION

The varieties seem to adapt well to the Hluhluwe growing conditions therefore a full comparison study against the Natal Queen will be conducted to identify and select desirable characteristics as well as a possible alternative variety for the industry. Trials will also be done to find the best cultivation practices for optimum production for the new varieties/clones.

Keywords: cultivation practice, gene pool, fruit quality, fruit yield, natural flowering

(Nr. 64)

INFLUENCE OF DIFFERENT OYSTER MUSHROOM *(Pleurotus ostreatus)* SUBSTRATES ON THE ESTABLISHMENT AND GROWTH OF THREE SELECTED VEGETABLES

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INTRODUCTION

Spent mushroom substrate is the by-product of a growth media leftover after a mushroom crop has been harvested. It has the potential to improve the soil structure and nutrient content when used as compost (Guo, 2004). A pot experiment was carried out with an objective to investigate growth response of each of the three selected vegetable types to four types of oyster mushroom spent substrates.

METHODS AND MATERIALS

The experiment was laid out in a 4×1 single factor experiment for each vegetable namely: Carrot (V1), Spinach (V2) and Beetroot (V3), using a Complete Randomized Design with four replicates. The four treatments were as follows: (i) Liverseed grass (S1), (ii) Maize straw (S2), (iii) Maize cob (S3) and (iv) 100% soil (S0). Soil amendment was carried out in the proportion of 70% substrate : 30% soil for each of the respective substrates. Seedling growth response was evaluated with respect to emergence, number of leaves per plant, plant height and chlorophyll content index.

RESULTS AND DISCUSSION

First emergence for Spinach (V2) and Beetroot (V3) was observed on the 4th day after planting in all four growth media. Maize straw (S2) gave the highest emergence rate at 90% for the two vegetables and the lowest was observed in soil at 50% on day 14 after planting. Emergence of carrots was observed at the 2nd week after planting at a rate of 20% on all four growth media. Full emergence of 98% was recorded on the 4th week for only three substrates, namely: S1, S2 and S3, but the control (S0) rated low at 75%. As for plant height, 30cm was recorded as the highest plant height for carrots growing in S2 and the lowest was recorded in soil at 6cm long after 134 days. Furthermore, the highest plant height was observed on spinach planted in S2 at 19cm in length and the lowest was 7.4cm in soil after 155 days of growth. A similar trend was observed on beetroot grown in S2 with the highest height being 21cm and the lowest was recorded in soil at 6cm after 148 days of maturing. The highest number of leaves recorded per plant on spinach was 10 for S2 and S3. On beetroot, 11 leaves per plant was recorded as the highest for S1, S2 and S3. The chlorophyll content of leaves is dependent on a number of factors; such as light intensity, availability of N, Fe, Zn, Mn, Ca and Mg. An increase in chlorophyll content index means there is higher release of the trace elements by the respective growth media and these nutrients released are then taken up the plant. Deficiency in either one or more of the above mentioned micro elements often cause a drastic decline in chlorophyll index. Maximum chlorophyll content index for carrots was recorded at 4.3µmol per m^{2}of leaf in S2 and the lowest was 2.6µmol per m^{2}in soil. 16µmol per m^{2}was the highest chlorophyll content recorded on spinach planted in S3 and 11.6 µmol per m^2 was recorded as lowest on S0. Furthermore, for beetroot, the highest chlorophyll content recorded was at 27 µmol per m^2 and lowest was 22.6 µmol per m^2 on liverseed grass (S1).

CONCLUSIONS

Foliar analysis for these trace elements needs to be carried out to determine nutrient release efficiency by the respective growth media.

Keywords: spent mushroom substrate, liverseed grass, maize straw, maize cob, seedling emergence, plant height, chlorophyll content index and trace elements

(Nr. 65)

EVALUATION OF A PORTABLE DEVICE FOR THE EFFICIENT MEASUREMENT OF ACIDITY IN CITRUS

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INTRODUCTION

Acidity is an important factor in determining maturity in citrus, with the °Brix (sugar): acid ratio used as a main export criteria as well as contributing to the flavour of the fruit. Whilst the °Brix can be measured quickly and easily using a portable refractometer, the acid must be measured via titration in a process of wet chemistry. There are currently two common methods of titration. The first method monitors pH change using a pH meter and can be done by hand, but is often automated by using a bench-top instrument. In the second method, the operator monitors pH change visually by the use of phenolphthalein, a compound that results in colour change. Both methods are time-consuming if done by hand and difficult to perform under field conditions. Whilst a bench-top instrument greatly increases the ease of doing the measurements, units are costly and not portable. There is no practical and inexpensive method available for acidity testing other than titration. Recently a new hand-held digital meter, capable of measuring both °Brix and acidity was developed by Atago Co., Ltd in Japan and measures acidity using electric conductivity (EC) of the juice. This could greatly improve the ease at which acidity is measured in the industry today. However, the use of EC to determine acidity in citrus is a new concept that requires validation.

MATERIALS AND METHODS

To evaluate the instrument over a range of acidities, 'Orri' mandarins from seven size counts were used (1X,1,2,3,4,5,<5). The juice was extracted, sieved and then measured using both the new PAL-BX|ACID1 and an automatic system (Metrohm 888 Titrando) that served to determine actual acidity. The 1:50 dilution required for measurement with the PAL-BX|ACID1 was prepared using two methods; a pipette and dilution line on the attachment (provided with the device) and secondly, a scale (up to 0.01g accuracy) to weigh the juice and distilled water. As an additional test, juice was sieved a second time using a finer sieve to determine whether solid components released into the juice would interfere with measurements.

RESULTS

Dilution with the supplied pipette and dilution line on the attachment was not sufficiently accurate. Thus, accurate pipettes (Eppendorf Research 1000µ and 10ml) were used to dispense the exact volumes. Even so, results indicated that the use of pipettes for dilution varied from the actual acidity by 42%. However, this difference was reduced at higher acidity levels. With the method of weighing, actual acidity and PAL-BX|ACID1 readings were closer, with the greatest difference of 16%. Again it was observed that accuracy improved at higher acidity levels, reducing to a 0.6% difference.

CONCLUSION

It was found that the weighing of sample components was a more accurate method of dilution compared to pipettes. Accuracy increased at higher acidity levels and solid components may also interfere with measurements of conductivity.

ACKNOWLEDGEMENTS

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Keywords: titration, acidity, electric conductivity, citrus

(Nr. 66)

TACKLING HIDDEN HUNGER WITH ORANGE FLESHED SWEET POTATO LEAVES

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INTRODUCTION

Orange fleshed sweet potato (OFSP) *var. Bophelo* is a major crop in South Africa and widely used for alleviating hidden hunger (Vitamin A deficiency) because of high ß-carotene content of storage roots (Laurie *et al*. 2012), however, OFSP leaves have been underutilized and can be consumed as a dark green leafy vegetable, which could significantly increase food availability. The objective was to assess the effects of water and fertiliser management on the ß-carotene, Fe and Zn content of OFSP leaves.

MATERIALS AND METHODS

A field experiment was conducted at ARC-VOPI in 2013/14 season. The experiment was laid as 2 x 2 x 2 randomized complete block design: 2 water levels (W1= irrigating to field capacity and W2= supplemental irrigation), 2 fertilisation levels (F1= full fertilizer application (NPK) and F2= zero fertilizer application (N0P0K0), and 2 leaf harvesting methods (H1= no leaf harvesting and H2= leaf harvesting at 4, 6, 8, 12, 14, and 16 weeks after transplanting) which were replicated three times. Leaves were sampled from the field at 4 and 12 weeks after transplanting and were analyzed for Fe, Zn and ß-carotene.

RESULTS AND DISCUSSIONS

There was a significant effect ($p = 0.05$) for Fe and Zn between water and fertilisation levels, but there was no significant effect for ß-carotene content ($p = 0.05$). ß-carotene content ranged from 4 – 24 mg 100 g-1, Fe from 41 – 74 mg 100 g-1, and Zn from 2.6 – 3.6 mg 100 g-1. The highest contents were observed from the F1W2H2 for ß-carotene, F2W1H1 for Fe, and F2W2H1 for Zn. This suggest that water and fertiliser management have an effect on micro-nutrient content of OFSP leaves.

CONCLUSIONS

Resource poor households are encouraged to utilize OFSP leaves as a dark green leafy vegetable to meet their daily dietary nutrient requirements.

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Keywords: micro-nutrient deficiency, food security, resource poor households, underutilized crops

(Nr. 67)

EFFECTS OF DIFFERENT PLANT SUBSTRATES AND GROWTH HORMONES ON THE GROWTH CHARACTERISTICS AND NUTRIENT CONTENT OF OYSTER MUSHROOM SPECIES (*Pleurotus ostreatus*) IN A SEMI-ARID REGION

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INTRODUCTION

The objective of this study was to investigate the effects of different plant substrates and plant growth hormones on the growth characteristics and nutrient content of oyster mushrooms species in a semi-arid region.

METHODS AND MATERIALS

Effects of various substrates and plant growth regulators on mycelial development, pinning/fruiting and total biomass were analyzed. A study was conducted during 2014/15 summer cropping season at Molelwane farm.The experiment was laid out in a 3 X 4 factorial experimental combinations: 3 substrates X 4 hormones. The three growth substrates were: Liverseed grass (S1), Maize straws (S2) (leaf and stalk) and Maize cob (S3) and the hormone treatments were: 2,4-D- an Auxin (H1); 6-Benzyladenine - a cytokinin (H2); Gibberellic acid - a Gibberellin (H3) and a Control (without hormone treatment (H0). These treatment combinations were replicated three times making a total of 36 experimental units. All the experimental units were inoculated with *Pleurotus ostreatus*. These treatment combinations were laid out in a Complete Randomized Block Design (CRBD).

RESULTS AND DISCUSSION

After a period of 21 days, all Liverseed grass domes had 100% surface mycelial cover followed by Maize straw at 80% and Maize cob at 50%. After 26 days, a similar trend was also observed for mushroom pinning/fruiting: Liverseed grass had the highest pinning/fruiting at 52%, followed by Maize straw at 35% and maize cob at 16%. Mushrooms which were treated with Auxins resulted in large fruit caps with an average diameter of 13.42cm, followed by the Cytokinin-treated mushrooms with 9.9cm diameter and Gibberellin-treated had the lowest diameter of 7.13cm. Gibberellin-treated substrates produced mushrooms with the longest styles with an average length of 11.03cm, followed by the Cytokinin-treated substrates with 8.83cm and mushrooms from Auxin-treated substrates had the shortest styles with an average length of 6.93cm.

CONCLUSION

Liverseed grass had the highest % (7019.62g) of biomass production and bigger fruiting caps (13.42cm). This could probably be due to several factors such as biochemical composition, nutrient content and textural characteristics. The poor performance of maize cob could be due to its high water holding capacity, nutrient composition and lower pH levels (5.19 acidic) that might have prohibited mycelial growth and therefore delay in the fruiting which resulted in poor biomass production (2855.74g).

Keywords: growth hormone, inoculation, nutrient content, pinning, spawn, substrates

(Nr. 68)

INFLUENCE OF NEMAFRIC-BL PHYTONEMATICIDE ON *Meloidogyne javanica* AND GROWTH OF *Pelargonium sidoides*

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INTRODUCTION

Withdrawal of methyl bromide and related synthetic nematicides has led to the use of Nemafric-BL phytonematicide as an alternative in managing root-knot (*Meloidogyne* species) nematode in various fruit crops. Phytonematicides are generally environment-friendly and therefore have distinct advantages over synthetic nematicides. Nemafric-BL has substantial and well-documented merits and demerits, with phytotoxicity being among the top listed demerit. Nemafric-BL solely relies on allelochemicals as active ingredient, which are used by plants as defence. Phytotoxicity trials of nemafric-BL are conducted for each crop prior to use, but have not been conducted for crops with harvestable underground parts. Therefore, this study was initiated to investigate whether a series of nemafric-BL concentrations would have an effect on nematode numbers and growth of *Pelargonium sidoides*.

MATERIALS AND METHODS

A micro-plot experiment was carried out in two seasons, autumn (March-May) and spring (August-October). Cuttings were raised in 30-cm-diameter pots containing 10 l steam-pasteurised sand and Hygromix at 3:1 (v/v), each inoculated with 5 000 eggs and second-stage juveniles (J2s) of *M. javanica*. Six treatments, namely, 0, 2, 4, 6, 8 and 10% concentrations of Nemafric-BL were arranged in a randomised complete block design, with seven replicates.

RESULTS AND DISCUSSION

During the first season, the phytonematicide levels significantly (P = 0.05) reduced J2s, eggs, total J2s and eggs in roots and gall rating, contributing 72%, 78%, 90% and 67% to total treatment variation (TTV), respectively. Relative to untreated control, phytonematicide levels reduced plant height without affecting other plant variables, while during the second season nematode numbers were reduced, but all plant variables were increased. The product has suppressive effects on nematode numbers and stimulative effects of growth of *P. sidoides*.

CONCLUSION

Nemafric-BL phytonematicide would apparently be suitable to serve as an alternative to methyl bromide in the reduction of population densities of M. javanica in the cultivation of *P. sidoides*.

ACKNOWLEDGEMENTS

The authors are grateful to the Land Bank Chair of Agriculture - University of Limpopo, the Agricultural Research Council and the Flemish Interuniversity Council for financial support.

Keywords: botanicals, *Cucumis africanus*, future crops, medicinal plants, organic amendments

(Nr. 69)

PROPAGATION OF *Aloe ferox* Mill: RESULTS OF SEED GERMINATION STUDIES

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INTRODUCTION

Aloe ferox (Cape Aloe) is a tall single stemmed aloe with thick fleshy leaves arranged in rosettes and either orange, yellow or red flowers in multi-branched inflorescences. It is indigenous to South Africa, occurring from southern KwaZulu-Natal, Eastern Cape and as far west in Swellendam and has medicinal and cosmetic properties used by the indigenous people for centuries. The increasing demand for *A. ferox* products has motivated the government and private sector to promote the industry for the benefit of rural communities. As wild harvesting is unsustainable in the long-term, successful commercialisation will depend on effective cultivation and harvesting practices. The ARC Infruitec-Nietvoorbij, in conjunction with the Department of Science and Technology, are evaluating methods to promote small scale commercial production. Results from the sexual propagation studies of this multifaceted project is reported on here.

MATERIALS AND METHODS

One-year-old seed, collected from two vigorous plants (Plant – factor 1) at the ARC *A. ferox* trial at Addo, Eastern Cape, were treated with either a liquid or dried formulation of Smoke Water, or with distilled water (Smoke Water – factor 2). After 24 hours, the seeds were placed in covered petri-dishes on moist filter paper at different temperatures (Temperature – factor 3) either a constant 25°C, 24°C/20°C for 12/12 hours or at room temperature (18.5°C/10.8°C Max./Min.) Temperature treatments were either in the light or dark (Light – factor 4). Seed germination was recorded after five and eight days. The trial was a randomised complete block design with three blocks and the treatment design was a factorial with four factors.

RESULTS AND DISCUSSION

In the first recording (after 5 days), the main effects of Plant, Smoke Water, Temperature and Light were highly significant. Seed germination of Plant 1 (19%) was significantly better than Plant 2 (14%). The highest germination (24%) occurred in seeds from Plant 1 treated with the dried formulation of Smoke Water, kept at room temperature in the dark. In the second recording (after 8 days), the main effects of Temperature and Light were highly significant with a significant interaction between Plant and Temperature, Smoke Water and Light and between Light and Temperature. The best germination (43%) occurred after treatment with the dried formulation of Smoke Water at room temperature in the dark, irrespective of the source of the seed.

CONCLUSIONS

The highest germination occurred in seeds from Plant 1 treated with the dried formulation of Smoke Water and kept at room temperature in the dark.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support of the Agricultural Research Council and Department of Science and Technology.

Keywords: indigenous knowledge, medicinal plants, rural communities

(Nr. 70)

IMPACT OF EMS ON EARLY JUVENILE TEPARY BEAN (*Phaseolus acutifolius*) GENOTYPES

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INTRODUCTION

Tepary bean (*Phaseolus acutifolius*) is a self-pollinating short season summer legume which is highly tolerant to drought. It is used mainly for human consumption and livestock feeds (Bhardwaj *et al*., 2013). However, the genetic improvement of the crop is limited by the narrow genetic base. The objective of the study was to evaluate the sensitivity of tepary bean to chemical mutagenesis using ethyl methane sulphonate.

MATERIALS AND METHODS

The seed of each genotype was transferred separately to aqueous solutions of varying doses (0.0, 0.5, 1.0, 1.5, 2.0 v/v) of EMS and incubated at room temperature for 1 hour prior to germination in the laboratory at room temperature. The experiment was laid out as a split plot design (SPD) arranged in a randomized complete block, replicated three times. Eight days after germination, several seedling vigor traits including percent seed germination (%G), the number of secondary roots (NSR), primary root length (mm) (PRL), shoot height (mm) (SHT) and root dry weight (g) (RDW) were measured.

RESULTS AND DISCUSSION

In comparison with the seedlings from M0 seed, the SHT in both 'Genotype 1' and 'Genotype 2' increased by more than 30% at the 0.5% EMS but decreased steadily thereafter. In contrast, the SHT in the 'Genotype 3' was reduced consistently between 0.5 – 1.5% EMS v/v. In contrast, the SDW showed an upward trend for all the genotypes over the whole range of EMS dose. The RDW showed an initial increase (at 0.5 % EMS v/v) but diminished steadily thereafter. The evaluation of %G in this study provided an insight into the variation in genotypic sensitivity to the EMS consistent with observations from other studies (Conger *et al*., 1976). The results from this study also showed that EMS induced some dominant mutations that were detectable in the M1 generation of tepary bean.

CONCLUSIONS

Mutation breeding using EMS can induce dominant mutations. A selection for mutants that partition optimum dry matter to the shoots could potentially contribute to yield improvement in tepary bean.

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Keywords: dose; generation, mutagenesis, tepary bean

(Nr. 71)

EVALUATION OF FIELD PERFOMANCE OF LOCAL AND EXOTIC AMARANTHUS GERMPLASM IN A SEMI-ARID LOCATION IN LIMPOPO PROVINCE

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INTRODUCTION

Amaranthus is a vegetable used mostly in African countries as a source of food and nutrition. Rural communities in South Africa utilize unimproved genotypes while in east African countries such as in Tanzania, communities use improved cultivars. However, the difference in the field performance in Limpopo among unimproved landraces and improved cultivars is unknown. Therefore this study aimed at evaluating the field performance of local unimproved and exotic improved genotypes.

MATERIALS AND METHODS

A field experiment was conducted at the University of Venda Experimental Farm, (23°35'14.0'' S and 30°15'50.3'' E and 595m above sea level), Limpopo Province, South Africa from February to April. Ten genotypes five local (ACC# 304,305, 306, 307, 308) and five exotic (Maadira1, Maadira2, AC-NL, AM 25, AH-TL) were planted in field plots laid out in a randomized complete block design with three replications. Each plot consisted of two rows spaced 3.0m x 0.9m and 0.2m intra-row spacing. Standard management practices for *Amaranthus* were applied throughout the season. Parameters measured included the number of leaves, plant height, head length, canopy width, stem girth and the number of branches per flower head. Data sets were subjected to ANOVA (SAS, vers.12.1).

RESULTS AND DISCUSSION

'Madira 1', Acc # 307 and Acc # 308 produced the highest number of leaves respectively. The study showed that three of the local genotypes (Acc # 304, Acc # 306 and Acc # 305) were significantly inferior to that of the exotic 'Madira 1' which also had the highest number of primary branches.

CONCLUSIONS

The variation observed among the genotypes for the various attributes indicated the potential for selecting improved types of the leafy vegetable. Further studies should be carried out at different locations to determine the field performance under different climatic conditions.

Keywords: genotype, leafy vegetable, growth parameters

ABSTRACTS
POSTER PRESENTATIONS

SOIL SCIENCE

LISTED ALPHABETICALLY

(Nr. 72)

EVALUATION OF SUNFLOWER, SOYBEANS AND MAIZE CROP ROTATION WITH MONO-CROPPING

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INTRODUCTION

Research on the in-field rainwater harvesting (IRWH) technique with respect to crop rotation has not been conducted previously and can help in providing answers to resource-poor farmers who can rotate oilseed crops to get maximum results in terms of crop yields. The main objective of the study was to conduct a crop rotation experiment with sunflower, soybean and maize within the IRWH technique and also compare yields with mono-cropping using conventional tillage (CON).

MATERIALS AND METHODS

An on-station field experiment was conducted at the Glen Agricultural Institute, on the Glen/Bonheim ecotope (28º57` S, 26º20` E). The experiment was conducted over a period of five growing seasons (2006/07 – 2010/11). Maize (cultivar PHB33A1B; 22000 plants ha-1), sunflower (cultivar PAN7351; 33333 plants ha-1) and soybeans (cultivar PAN 421R; 133333 plants ha-1) were planted as indicator crops in mono-cropping and rotation within the IRWH system and CON. Soil water content (SWC) was monitor at depths of 150, 450, 750 and 1050 mm during the fallow and growing seasons with a neutron water meter. Standard agronomic practices were followed. Biomass, grain yield and rainwater productivity (RWP), were measured and calculated following standard procedures.

RESULTS AND DISCUSSION

IRWH treatments produced significantly higher biomass yields at flowering, seed and biomass yields at harvest and RWP values compared to CON. When comparing mono-cropping (CON vs. IRWH) results indicated that IRWH mono-cropping increased biomass at flowering on average by 65%, 144% and 140% compared to CON mono-cropping for maize, sunflower and soybeans, respectively, during the experimental period. The IRWH mono-cropping also increased maize, sunflower and soybean yields on average with 114%, 149% and 194%, respectively, compared to CON mono-cropping. IRWH mono-cropping produced on average with maize, sunflower and soybean for every mm of rain that occurred 2.79, 1.2 and 2.01 kg more grain yield per hectare, respectively compared to CON mono-cropping. Reasons for this phenomenon were due to the ability of IRWH to stop ex-field runoff completely, to minimize evaporation from the soil surface and to harvest additional rainwater from the untilled 2 m runoff area and therefore maintain higher SWC compared to CON.

CONCLUSIONS

Soybean is a suitable crop to plant in rotation with maize and sunflower to increase maize and sunflower yields. However, soybeans planted in mono-cropping (1267 kg ha-1) outperformed the soybeans that were planted in rotation with maize (1238 kg ha-1) or sunflower (1014 kg ha-1). Maize is the most productive crop on the Glen/Bonheim ecotope. Average RWP values for maize, soybean and sunflower were 3.86, 2.05 and 2.01 kg ha-1 mm-1, respectively.

ACKNOWLEDGEMENTS

Agricultural Research Council for funding and Free State Department of Agriculture and Rural Development for supplying agricultural land.

Keywords: conventional tillage, crop rotation, in-field rainwater harvesting, mono-cropping

(Nr. 73)

IN-FIELD RAINWATER HARVESTING: KEY TO SMALLHOLDER PRODUCTIVITY

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INTRODUCTION

Subsistence farmers occupy large areas in the semi-arid region of Southern Africa. Rural households have access to arable land which is not utilized and homestead gardens with low production. The problem is that these areas are marginal for crop production due to: (a) low and erratic rainfall; (b) high evaporative demand; and (c) dominantly duplex and clay soils which result in low crop yields. To improve smallholder productivity, crop production needs to be increased through the application of appropriate rainwater harvesting and conservation (RWH&C) techniques. The objective of this study was to identify the most appropriate RWH&C crop production techniques to increase production in homestead gardens and croplands.

MATERIALS AND METHODS

Field experiments (statistical and demonstration) in homestead gardens and croplands were conducted over 16 growing seasons (1996/97 – 2011/12) on 20 different ecotopes in South Africa (Free State, Eastern Cape and Limpopo), Botswana and Zimbabwe. In-field rainwater harvesting (*IRWH*) was compared to conventional tillage/farmer's practice (CON) in homestead gardens while CON, *IRWH*, Daling plough, mechanized basins and minimum/no-till were compared in the croplands. Maize and sunflower were used as the test crops. Grain yield and rainwater productivity (RWP) were measured and calculated by making use of standard procedures (Botha, 2006).

RESULTS AND DISCUSSION

Average seed yields varied between 519 and 2749 kg ha-1. RWP varied between 1.3 and 5.6 kg ha-1 mm-1. Results indicated that manual and mechanically constructed *IRWH* structures induced significantly higher yields and RWP values than the other RWH&C treatments and CON in homestead gardens and croplands.

CONCLUSIONS

Manual and mechanical *IRWH* was identified as the most appropriate RWH&C crop production technique to increase crop yields and RWP in homestead gardens and croplands in order to improve smallholder productivity in semi-arid areas.

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ACKNOWLEDGEMENTS

Water Research Commission and Agricultural Research Council for funding. Provincial Departments of Agriculture and Rural Development for supplying agricultural land.

Keywords: conservation tillage, maize, rainwater harvesting, rainwater productivity

(Nr. 74)

RESPONSE OF MAIZE TO RAINWATER HARVESTING AND CONSERVATION TECHNIQUES ON THE GLEN/OAKLEAF ECOTOPE

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INTRODUCTION

Rainfall in South Africa is considered as one of the major constraints in agricultural production. It tend to beinsufficient, erratic and unreliable or occurs as high intensity events, resulting in unproductive water losses through runoff, evaporation from the soil surface and deep drainage which have a huge a negative impact on farmers that depend on rainfed agriculture. To prevent low production many agricultural scientists agrees that with the application of applicable rainwater harvesting and conservation (RWH&C) techniques, these unproductive water losses can be minimized. The study aimed at evaluating the impact of various RWH&C techniques on maize production compared to conventional tillage (CON) on the Glen/Oakleaf ecotope.

MATERIALS AND METHODS

The experiment was conducted under dryland conditions at the Glen experimental station in the Free State Province of South Africa during the 2008/09 and 2009/10 seasons. The first season was regarded as dry and second season was wetter with rainfall of 260 and 494 mm. A short growing maize cultivar (PAN 6Q-521R) was planted with estimated Plant population of 18 000. The experiment consisted of six treatments [Conventional tillage (CON); In-field rainwater harvesting (IRWH-2.0m); (IRWH-2.4m), Mechanized basins (MB); Minimal tillage (MIN); Darling plough (DAL)]. Each replication consisted of an area of 20 X 30 m. All the treatments were implemented with a tractor and specialized implements. Two aluminium neutron water meter (NWM) access tubes were installed in each plot. A NWM was used to monitor soil water content (SWC) at depths of 150, 450, 750 and 1050 mm during both seasons. Standard agronomic practices were followed. Indicators of cropland productivity, maize grain yield and rainwater productivity (RWP), were measured and calculated following standard procedures. Data was analysed using the general linear model procedure of SAS (Ver. 9.3) for personal computers (SAS0.05).

RESULTS AND DISCUSSION

The results showed that maize growth, yield, SWC and RWP were significantly influenced by RWH&C techniques compared to CON tillage. The results of RWP over the two seasons showed RWH&C techniques having a potential to increase yield compared to CON tillage most often on dryland.

CONCLUSIONS

Application of appropriate RWH&C techniques in communal croplands can be used to improve food security and cropland productivity through increased RWP and higher maize yields.

ACKNOWLEGEMENT

Water Research Commission and Agricultural Research Council to funding. Free State Department of Agriculture and Rural Development.

Keywords: rainwater harvesting, rainwater productivity, soil water content, maize yield

(Nr. 75)

EFFECTS OF CULTIVATION INTENSITY ON SELECTED VARIABLES OF SOIL HEALTH

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INTRODUCTION

Quality of South African soils is poor with preservation being less attended to since the main focus is on getting sufficient crop yield. The significance of understanding soil health is that nutrient cycling, water retention and other soil functions depend on the quality of the soil. The objective of the study was to assess and compare the soil health status of continuously cultivated, moderately cultivated and fallow cultivation.

MATERIALS AND METHODS

The study was conducted at the University of Limpopo Experimental Farm, which is located in the semi-arid region of Limpopo Province, South Africa. Three land uses on Clovelly soils were identified from the study area of which are: Continuously cultivated (CC), moderately cultivated (MC) and fallow cultivation (FC). Soil samples were collected in four replicates within a 1 m radius from the sampling point in all three treatment plots, and analysed for aggregate stability, texture, surface compaction, organic C, microbial biomass, EC, pH, P and N.

RESULTS AND DISCUSSION

Aggregate stability, surface compaction, organic C, organic matter content, P and N were significantly different ($P = 0.05$) among the three treatments. EC, pH and microbial biomass of MC and FC were found not be significantly different ($P > 0.05$). However, MC and FC effects were significantly different from CC effects. It was further observed that the microbial biomass of continuously cultivated soils are very low as compared to that of moderate and fallow cultivation. Amount of microorganisms in moderate and fallow cultivation abundant to the point that they were reported as too numerous to count.

CONCLUSIONS

In conclusion the results proved that continuous cultivation has a negative effect on soil variables including microbial biomass, and as such, has a negative effect on soil health. Thus fallowing is the best approach to a sustainable management of soil health.

ACKNOWLEDGEMENTS

Mr. ZM Kganyago is acknowledged for his assistance with data collection.

Keywords: over cultivation, fallowing, soil health

(Nr. 76)

EFFECTS OF ORGANIC MANURES ON SOIL FERTILITY, GROWTH AND YIELD OF SWISS CHARD ON SANDY LOAM SOIL

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INTRODUCTION

A pot experiment was conducted to investigate the effects of organic manures on soil chemical properties, growth and yield of Swiss chard as a test crop on sandy loam soil.

MATERIALS AND METHODS

Soil samples were randomly collected from a moderately cultivated research plot of the University of Limpopo (UL) Experimental Farm, mixed and air dried in the UL Soil Laboratory. A sub-sample was collected from the main sample and sieved to pass through a 2 mm sieve for physical and chemical characterization of the soil. The soil and different manure were analyzed for chemical and physical properties before planting and analyzed again after. Two 2 kg air dried soil from the field experimental site was weighed and filled into pots and mixed with animal manure. The treatments included cattle, goat, chicken manures, NPK fertilizer and a control at recommended rates of 260 g, 364 g, 624 g, 6.2 g and 0 g, respectively. Irrigation comprised 250 ml water every two days. Number of leaves, chlorophyll content, leaf area, leaf width and maximum height, were collected after every four weeks.

RESULTS AND DISCUSSION

The highest leaf number, maximum height, chlorophyll content and overall soil fertility were in goat manure and NPK, whereas the lowest was in chicken manure. Among the amendments, chicken manure produced the least crop yield and chlorophyll content. There was no significant difference ($P > 0.05$) in chlorophyll content in all.

CONCLUSIONS

Results suggested that goat manure could be recommended for use in production of Swiss chards.

Keywords: organic manure, soil fertility, Swiss chard

(Nr. 77)

PRELIMINARY RESULTS FROM SOIL CO_2 FLUX MEASUREMENTS ON A CONSERVATION AGRICULTURE TRIAL

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INTRODUCTION

The largest sink of global carbon (C) is the soil mantle at 3150 Pg C (Luo and Zhou 2006). As such, soil plays a critical role in regulating the C cycle on a regional and global scale. The plants and micro-organisms in the soil mostly use organic C as an energy source. Soil respiration is the release of carbon as CO_2 from plant roots as well as from respiration by soil fauna and flora. Any products of organic matter decomposition in the soil can be used, stored in a recalcitrant form or lost as CO_2, which manifests in the C balance. Ploughing upsets this balance, causing oxidation of organic material and C loss, as opposed to perceived benefits in that nutrients are made available to plants. The measurement of soil respiration gives an indication of the rate of decomposition and helps quantify the C balance equation. By reducing the soil respiration, a greater amount of C is available to be sequestrated.

MATERIALS AND METHODS

A medium-term conservation agriculture (CA) vs. conventional tillage (CT) trial was conducted at Zeekoegat, north of Pretoria (Swanepoel *et al*. 2014). Soil CO_2 flux measurements were made as a preliminary study to determine the differences, if any, between the two treatments. Metal rings were installed in the soil for the duration of the experiment, onto which a chamber was placed to make in-field measurements using an infrared gas analyser (Kidson *et al*. 2011).

RESULTS AND DISCUSSION

Measurements were made weekly during the growing season. The daily soil respiration cycle started with the lowest rate measured at 06:00 in the morning, peaking at 14:00 and dropping off at night. The respiration rate followed a similar cycle through the growing season starting in December (just after planting) and peaking in January with the maize plants flowering, then dropping off towards the end of the season. The soil C loss in the form of CO_2 between the two treatments during the growing season was 27% lower for the CA soils compared to the CT soils. Despite the reduced CO_2 flux in the CA soils, the increase in net soil organic C was low (not statistically significant) (Swanepoel *et al*. 2014). Furthermore, when the infrared gas analyser probes were placed in the soil profile, the soil CO_2 concentration was far higher in the CA soils compared to the CT soil.

CONCLUSIONS

These results confirm that soil carbon under conservation agriculture practices is more stable than under conventional tillage. The results stimulate further investigation where a tracer will be used to track the movement of C in the soil system, giving a clearer understanding of the C cycle in soils and enabling the optimisation of sound organic matter management.

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Keywords: conservation agriculture, conventional tillage, soil respiration, soil CO_2 flux

(Nr. 78)

MICROBIAL DIVERSITY AS INFLUENCED BY SOIL TILLAGE AND CROPPING SEQUENCE IN SHALE-DERIVED SOILS OF THE WESTERN CAPE

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INTRODUCTION

Knowledge about the influence of management practices on microbes is important to ensure sustainable crop production. It is expected that tillage and crop rotation will influence the microbial community in the root zone of crops. The aim of this study was to develop a better understanding of the effects of tillage practice and cropping sequence on microbial diversity.

MATERIALS AND METHODS

This long-term tillage/crop rotation trial was started in 2007 on Langgewens farm near Moorreesburg and Tygerhoek farm near Riviersonderend. Three cropping systems namely, wheat monoculture (WWWW), wheat-canola-wheat-lupin (WCWL) and wheat-medic-wheat-medic (WMcWMc) systems were included.1) Tillage treatments included were; zero tillage (ZT) - *soil left undisturbed and planted*, no-till (NT) - *soil left undisturbed and then planted with a no-till planter*, *minimum–till* (MT), *soil scarified to a depth of 100mm to 150mm in March/April and then planted with no-till planter* and conventional-till (CT) - *soil scarified in March/April, then ploughed before planting, and planted with the no-till planter*. Five sub-samples to a depth of 150mm per treatment combination were aseptically collected at the end of August 2014, pooled, and stored at ±8 ºC until analysis. Carbon source utilisation profiles were determined by inoculating the soil suspension into Biolog EcoPlates™. Soil microbial diversity was determined using the amount and equitability of 31 carbon sources metabolised as indicators of richness and evenness, respectively.

RESULTS AND DISCUSSION

Tygerhoek demonstrated a higher overall microbial diversity compared to Langgewens in 2014. The highest soil microbial diversity was observed in the WMcWMc sequence (Langgewens) and the WCWL sequence (Tygerhoek), whereas the lowest diversity was observed in CWLW (Langgewens) and LWCW (Tygerhoek). The lowest microbial diversity was observed under CT (Langgewens and Tygerhoek), while the highest was observed under ZT (Langgewens) and MT (Tygerhoek).

CONCLUSIONS

Soil microbial diversity showed higher sensitivity to cropping sequences than to tillage treatments during 2014. Preliminary results showed that the composition of soil microbial populations was the lowest in the LWCW cropping sequence and the highest in WMcWMc. Variation in microbial diversity between different cropping sequences demonstrates the ability of different crops to attract specific microbial communities with the ability to utilise different root exudates most effectively.

Keywords: carbon source utilisation profiles, crop rotation, soil tillage, microbial diversity, soil quality

(Nr. 79)

THE EFFECTS OF SOIL TILLAGE AND CROPPING SEQUENCE ON ENZYME ACTIVITY IN SHALE-DERIVED SOILS OF THE WESTERN CAPE

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INTRODUCTION

Soil enzymes play an important role in organic matter decomposition and nutrient mineralisation in soils. The aim of this study was to develop a better understanding of the effects of tillage practice and cropping sequence on the potential of the soil microbial population to decompose or convert substrates.

MATERIALS AND METHODS

This trial is conducted as a component study within a long-term tillage/crop rotation trial that started in 2007 on Langgewens farm near Moorreesburg and Tygerhoek farm near Riviersonderend. Three cropping systems namely, wheat monoculture (WWWW), wheat-canola-wheat-lupin (WCWL) and wheat-medic-wheat-medic (WMcWMc) systems were included. Tillage treatments were; zero tillage (ZT) - soil left undisturbed and planted with a star-wheel planter, no-till (NT) - soil left undisturbed until planting and then planted with a tined planter, minimum–till (MT) -soil scarified to a depth of 100mm to 150mm in March/April and then planted with the no-till planter and conventional-till (CT) - soil scarified to a depth of 100mm to 150mm in March/ April, then ploughed before planting, and planted with the no-till planter. Five sub-samples to a depth of 150mm per treatment combination were aseptically collected at the end of August 2014, pooled, air-dried at 40 ºC, sieved (2mm), stored at ±5 ºC and soil microbial enzyme activity determined. ß-glucosidase, acid- and alkaline phosphatase and urease activities were calculated with reference to the applicable calibration curves.

RESULTS AND DISCUSSION

Soil microbial communities in the WMcWMc cropping sequence demonstrated the highest overall microbial activity at Langgewens, whereas the LWCW sequence demonstrated the highest activity at Tygerhoek. The WWWW cropping sequence at Langgewens demonstrated the lowest overall microbial activity, while the CWLW sequence demonstrated the lowest activity at Tygerhoek. At both localities, soil microbial activity was higher under ZT, but the lowest under CT (Langgewens) and MT (Tygerhoek).
The absence of similarities regarding microbial activities between extreme tillage systems amongst the two localities could be attributed to differences in soil physical-chemical characteristics.

CONCLUSIONS

Due to the sensitivity of soil microbial communities as biological indicators of a soil's health status, cropping sequences and tillage systems affect soil microbial activity with relation to nutrient cycling.

Keywords: crop rotation, soil tillage, soil quality, microbial activity, soil enzyme activities

(Nr. 80)

ORGANIC CARBON AS INFLUENCED BY TILLAGE AND CROP ROTATION ON THE SHALE DERIVED SOILS OF THE OF THE WESTERN CAPE

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INTRODUCTION

Minimum soil disturbance, crop rotation with diverse crops and stubble retention are important management strategies that will ensure the success of conservation agriculture (CA). Adoption of CA practices will normally increase soil productivity and crop performance, however not instantaneously. The aim of this study was to quantify the effect of soil disturbance and crop rotation on soil organic carbon, active carbon and C:N relations in the soil.

MATERIALS AND METHODS

Three crop rotations namely: continuous wheat (WWWW), medic-clover/wheat/medic-clover/wheat (McWMcW) and lupin/wheat/canola/wheat (LWCW) were allocated to main plots and replicated four times at the Langgewens (Moorreesburg) Research Farm (-33.276822 18.703171) near Moorreesburg and Tygerhoek (-34.148100 19.902800) near Riviersonderend. Each main plot was subdivided into four sub-plots allocated to four tillage treatments, namely: zero-till (CT) – soil left undisturbed then planted with star-wheel planter, no-till (NT) – soil left undisturbed until planting and then planted with a tined, no-till planter, minimum till (MT) – soil scarified March/April and then planted with a no-till planter and conventional tillage (CT) – soil scarified late March/early April, then ploughed and planted with a no-till planter. Soil organic carbon, active carbon and C:N as influenced by the treatment combinations were recorded. Depth distribution of organic carbon was determined at 0-5, 5-10, 10-15 and 15-20 cm soil depth.

RESULTS AND DISCUSSION

No significant differences between parameters tested were recorded at Tygerhoek. At Langgewens however, organic carbon content in the no-till in the WMcWMc system decreased from 2.14 % in the 0-5cm soil layer to 0.54% in the 15-20cm layer. The mixing effect of the tine- and plough treatments in the conventional tillage treatment is clear as mean soil organic carbon content in the conventional-till treatment decreased from 1.38 % (0-5cm) to 0.67 % (15-20 cm). Active C was higher in McWMcW and WWWW compared to WCWL. Significantly lower active C was recorded for CT with no differences between other tillage treatments tested. McWMcW (13.1) and CWLW (14.1) resulted in lower (P=0.05) C:N than WWWW (23.7). Tillage did not influence soil C:N at Langgewens.

CONCLUSIONS

Study showed that soil carbon dynamics differs between sites. At the Langgewens site the detrimental effects of soil disturbance manifested itself in lower organic and active carbon content, an observation not recorded for Tygerhoek.

Keywords: active C, C:N

(Nr. 81)

EFFECT OF ONCE-OFF TILLAGE ON SELECTED SOIL PROPERTIES UNDER NO-TILL IN THE SWARTLAND SUB-REGION OF THE WESTERN CAPE

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INTRODUCTION

Minimum soil disturbance is an important aspect of conservation agriculture (CA). No disturbance of soil may result in nutrient stratification, increased bulk density and increased crop residue cover that might create a habitat for pests and diseases or interfere with the planting proses. These effects may be addressed through, amongst others, the cultivation of soil. The objective of this study was to determine the effect once-off tillage of no-till land has on selected soil physical and chemical properties.

MATERIALS AND METHODS

The study was conducted during 2014 to 2015 at the Langgewens Research Farm, managed by the Western Cape Department of Agriculture near Moorreesburg. The experimental design was a randomised complete block with a split-plot treatment design. Five cropping sequences, namely: medic-clover/wheat/medic-clover/wheat (McWMcW), wheat/lupin/wheat/canola (WLWC) and lupin/wheat/canola/wheat (LWCW), canola/wheat/lupin/wheat (CWLW) and wheat/medic-clover/wheat/medic-clover (WMcWMc) were allocated to main plots and replicated four times. The last letter in the sequence represents the crop on the field at the time of data collection. Main plots were sub-divided into three sub-plots and allocated to tillage treatments, namely: continuous no-till (NT), soil left undisturbed until planting and then planted with a tined no-till planter, non-inversion tillage (DT), deep tine to a depth of ~400 mm and inversion tillage (MP), soil inverted using mouldboard plough to a depth of ~250 mm. Coarse fragment %, bulk density, aggregate stability, conductivity (EC), pH and soil organic carbon (SOC) content were determined for the 0 - 100, 100 - 200, 200 - 300 and 300 - 400 mm soil layers during May 2015. Infiltration rates were measured before and after tillage using a Mini Disk Infiltrometer. Active carbon content was determined for the 0 - 100 and 100 - 200 mm soil depths before-, after- and 1 year after tillage.

RESULTS AND DISCUSSION

Tillage had no significant effect on coarse fragment %, aggregate stability, pH, SOC and active C content ($P = 0.05$). A significant higher EC under DT compared to NT was recorded in the 100 - 200 mm layer in McWMcW. Although not significant ($P > 0.05$) bulk density tended to be higher for DT in the 200 - 300 mm depth (LWCW) compared to NT. Significant lower infiltration rates were measured for NT compared to MP and DT in the WLWC sequence. In McWMcW significantly higher infiltration rates for DT compared to NT and MP were recorded. Significantly lower infiltration rates for MP compared to NT and DT were recorded for LWCW.

CONCLUSION

Preliminary results shows that potential negative effects of soil disturbance as single strategic tillage action on the soil properties tested are negligible.

Keywords: aggregate stability, EC, infiltration rate, pH, strategic tillage

(Nr. 82)

THE SUITABILITY OF LAND TYPE INFORMATION FOR HYDROLOGICAL MODELLING OF THE MOUNTAINOUS REGION OF HESSEQUA, SOUTH AFRICA

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INTRODUCTION

Land Type soils information was primarily developed for agriculture use, with the mountainous regions mostly neglected. With most dams and catchments located in mountain regions, and most of these regions increasingly being used for agroforestry, the question around the suitability of the Land Type data for use in hydrology arise. The quality of the information ultimately impact on predictions and management of water resources. Furthermore the land type approach was found to be generally too course for the upper parts of catchments with a largely undulated character.

MATERIALS AND METHODS

The soils of the catchment were investigated at road cuttings and profile pits, sampled and classified. Soil physical properties were determined. The soil occurrence was compared with land type information and local agroforestry soil maps. Terrain analysis was done using elevation models. A segmentation map indicating terrain classes was prepared. The map was firstly populated with Land type data. It was then compared with the soils database developed for this project and other soils maps found for this region. All the data was subjected to statistical analysis to reflect on the best options for soil mapping of the region.

RESULTS AND DISCUSSION

The Land Type information was found to be a good source to acquaint oneself with the soils of the region, but the main problem related to the actual distribution of soil types in this undulating landscape. The solution was found in a better understanding and approach in morphological modelling.

CONCLUSIONS

Mapping of the morphology of the region, using higher resolution radar derived elevation data, holds the key to enhance our ability in predictive soil mapping that leads to better hydrological modelling of the flows in the region.

Keywords: digital oil mapping, hydropedology, soil water modelling

(Nr. 83)

ASSESSMENT OF COWPEA LANDRACE YIELD UNDER THREE PHOSPHORUS FERTILIZATION LEVELS: FARMER-LED DEMONSTRATION

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INTRODUCTION

Occurrences of prolonged dry spells and below normal rainfall poses a challenge to rainfed farming community. Small-scale farmers are shifting towards drought tolerant crops as an adaptation measure. Cowpea (*Vigna unguiculata* (L.)) is increasing interest to Diphagane farmers due to its amongst other, high drought tolerance characteristics. During innovation platforms with farmers in Diphagane, they identified low crop yield and soil fertility as a problem limiting crop production. The farmers proposed a demonstration trial aimed at assessment of cowpea landrace yield under three phosphorus levels.

MATERIALS AND METHODS

The demonstration trial is part of the aim towards development of innovative technologies to enhance food security and income through efficient nutrient and water use by farming communities. Farmers initiated rainfed demonstration trial at Diphagane in the Sekhukhune district of Limpopo Province. Three levels of phosphorus were assessed, that is, 0; 30 and 60 kg P/ha on cowpea landrace. The trial was laid out in a randomized complete block design, replicated four times during 2014 cropping season.

RESULTS AND DISCUSSION

Cowpea landrace significantly responded to the phosphorus fertilization. Application of 30 kg P/ha was observed to have the higher (P=0.03) grain yield of 894 kg/ha than 404 kg/ha when no P was applied, i.e., 0 kg P/ha. Application level of 60 kg P with grain yield of 706 kg /ha was not significantly different when half of the level (30 kg P/ha) was applied to the soil.

CONCLUSIONS

Fertilizer application of 30 kg P/ha shows potential towards improving cowpea landrace yield under rainfed condition at Diphagane.

Keywords: cowpea yield, drought, phosphorus fertilization

(Nr. 84)

A SOCIOLOGICAL APPROACH TO UNDERSTAND CROP YIELD TRENDS AND CONSTRAINTS IN NTABELANGA, EASTERN CAPE, SOUTH AFRICA

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INTRODUCTION

The world population is predicted to increase by 35% in 2050and this needs the doubling of crop yields and maximization of land available for agriculture. However, in the Eastern Cape Province water is the key restrictive factor for crop production. High atmospheric evaporative demand and unreliable rainfall makes farming a risky industry and especially smallholder farmers are vulnerable to these climatic constraints. The aim of this study was to identify and understand yield trends and constraints in Ntabelanga area. This area is where the Department of Water Affairs has announced plans to build two large dams; Ntabelanga and Laleni which will be referred to as the Mzimvubu Water Project (MWP). The government hopes that this project will rejuvenate the agricultural sector in this area and surroundings.

MATERIALS AND METHODS

Five communities that may be impacted by the dam as appearing on the satellite map of the dam were selected. These areas are Ngxotho, Ngqongweni, Lower Sinxaku, Ntzebe and kuGubengxa. Four main data collection techniques were used in obtaining information for this study, namely: conventional focus groups, town hall focus groups, individual in-depth interviews and observations. A town hall focus group discussion (FGD) was conducted in Ngxoto, complemented by in-depth interview of a key authority figure in the community. In Lower Sinxaku, both conventional and town hall FGDs were conducted in Lower Sinxaku. In Ngqongweni, a conventional FGD was complemented by in-depth interviews. In Ndzebe, eight in-depth interviews were conducted, while in KuGubengxa, a town hall FGD was complemented by in-depth interview of an established spiritual figure (a Sangoma).Throughout the communities a series of the same questionnaire was used.

RESULTS AND DISCUSSION

Across all the communities the common message that was conveyed is the change in the farming (livestock and crop yields) produce. In the FDG'S older participants understood the yield and livestock declines better. They indicated that 20 to 30 years ago agricultural practices were much better than now. The decrease in yields was associated with the variation in rainfall patterns: it is either the summer rains are too much or less. The youth accredited causes of change in production to global warming and soil erosion. They highlighted that the weather conditions are warmer than before, also their soils are more susceptible to erosion therefore the heavy rainfalls wash away their soils and they are getting poorer with time. In terms of what they are producing they indicated that they were mainly growing maize and depending on adequacy of rainfall in that year a few vegetables such as cabbage, spinach, potatoes carrots, etc. They stated that over the past 10 years the rainfall patterns have changed from bad to worse. The unusual supply of rain makes it difficult for them to get reliable yields or plant at all. Amongst the long list of causes of their low yields lack of irrigation to supplement rainfall and lack of access to fertilizers were the main constraints.

CONCLUSIONS

A physical approach using a Soil Management Frame Work will be used in this study to determine the health status of the soils in the area. This will help to predict the potential yields and compare them to the estimated yields that will be measured during the next harvest season. The gap between the estimated and the potential yields will enable this study to state reasonable conclusions and recommendations.

ACKNOWLEDGEMENTS

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Keywords: smallholder farmers, crop yield trends and constraints

(Nr. 85)

SOIL MICROBIAL ACTIVITY RESPONSES IN LOCAL CONSERVATION AGRICULTURAL MAIZE PRODUCTION SYSTEMS

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INTRODUCTION

The disruption of soil structure, composition and natural biodiversity due to conventional cultivation practices can be minimized through Conservation Agriculture (CA). CA is governed by principles that include minimum disturbance of the soil, multiple cropping systems and a soil cover of crop residues (Montgomery, 2007). These practices may induce major shifts in the population and composition of soil microbial fauna and flora, which may impact on soil structure, organic matter decomposition and nutrient cycling (Andersen, 1999). Although CA has been widely studied, inadequate research has been done on the impact that local CA maize based systems have on soil microbiology. The study aimed to investigate the effect of CA systems on soil microbial activity in local maize production.

MATERIALS AND METHODS

Rhizosphere soil samples were taken 70 days after planting from a maize field trial, comprising of a loam sandy soil in the North-West Province. Treatments consisted of (1) conventionally cultivated, mono-cropped maize, (2) mono-cropped maize with minimal soil disturbance, (3) a two-year system with maize in rotation with cowpea or sunflower with minimal soil disturbance and (4) a three-year system with maize in rotation with cowpea or sunflower and pearl millet with minimal soil disturbance with systems 2-4 as variants of CA. Microbial activities were determined using ß-glucosidase and urease assays. Samples were subjected to 16S and 18S rRNA gene PCR-denaturing gradient gel electrophoresis (DGGE) for microbial community profiling in soil. Data were statistically analysed using Statgraphics software.

RESULTS AND DISCUSSION

ß-glucosidase activity levels were significantly higher in the mono-cropped maize with minimal soil disturbance compared to the other treatments. Urease activity levels were not significantly different between the various treatments. DGGE analysis showed changes in bacterial and fungal DNA banding profiles between various treatments. DGGE fingerprints displayed higher fungal to bacterial ratios in the CA than conventional monoculture system.

CONCLUSIONS

Results suggest that switching from conventional agricultural to CA cropping systems encourages higher soil microbial activity and fungal diversity.

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Keywords: CA, soil microbial enzymes, PCR-DGGE, maize production

(Nr. 86)

REGIONAL AND TILLAGE EFFECTS ON SOIL ORGANIC MATTER STATUS OF IRRIGATED WHEAT LANDS IN SOUTH AFRICA

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INTRODUCTION

Soil organic matter (SOM) acts as a nutrient store-house, increases the cation exchange capacity, supports biological activity and improves the water storage capacity of soils. If the soil organic carbon (SOC) content is below 1%, it may not be possible to obtain potential yields irrespective of soil type (Kay & Angers, 1999). Biophysical factors and soil management, including tillage with or without retention of crop residues, have important effects on soil organic matter levels. The objective of this study was to determine regional and tillage effects on the SOM status of irrigated wheat (*Triticum aestivum* L.) lands in South Africa.

MATERIALS AND METHODS

Soils were sampled from in the top soil (0 - 20 cm) of representative wheat farmers' fields from the major irrigated wheat production regions of South Africa, namely KwaZulu-Natal (KZN), Eastern Highveld (EH), Cooler Central (CC) and Warmer Northern (WN) regions. The sampling was done from fields under no-till, minimum and conventional tillage. A total of 130 fields were sampled across the country. The soil samples were analysed for soil organic carbon (SOC) using the Walkley Black method. Soil organic matter (%) was determined from organic C using the universal conversion factor of 1.724.

RESULTS AND DISCUSSION

Overall, SOM levels varied considerably, ranging from 0.22 to 10.38%, with 65.60% coefficient of variation. The SOM was highest in KZN (3.97 ± 1.55 %), followed by WN (2.80 ± 1.82%), with the CC (1.66 ± 1.04%) and EH (1.36 ± 0.74%) having lower levels. Soil organic matter content was also significantly ($P<0.001$) different across tillage systems, with no-till (4.40 ± 2.05%) and minimum till (4.09 ± 1.60%) having more SOM than conventional till (1.83 ± 1.14%) systems.

CONCLUSION

There are regional differences in SOM content in wheat production areas of South Africa Conventional tillage results in reduction in SOM contents on wheat farms. No-till and minimum till may need to be promoted to maintain or increase SOM, hence sustainable improvement of yields on irrigated wheat farmer's fields.

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Keywords: soil organic matter; irrigated wheat, tillage

(Nr. 87)

CALIBRATION OF A NEUTRON PROBE IN A CLAY SOIL IN THOHOYANDOU

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INTRODUCTION

The productivity of rainfed cropping systems in dry environments may be improved through management practices that increase crop water use efficiency, WUE (Ogola and Thangwana, 2013). Periodic and accurate measurement of soil moisture is important in determining crop water use and WUE. Neutron probe is one technique that is widely used for periodic measurements because it is non-destructive. This study aimed at calibrating a neutron probe in a clay soil in Thohoyandou, South Africa.

MATERIALS AND METHODS

This study was conducted at the University of Venda's Farm, Thohoyandou (22°58.08´S and 30°26.4´E, 595m asl) which is characterized by deep, well-drained clay soils (Soil Classification Working Group 1991). Two spots, each 6 m², were selected and three (1.2 m) PVC access tubes installed, 1 metre apart, in both spots. One spot was irrigated to saturation and the other one was not. The irrigated spot was allowed to settle for 24 hours before taking any readings. A neutron probe (530 DR hydroprobe, Campbell Pacific Nuclear International Inc.) was lowered in each access tube and counts were taken at 30, 60 and 90 cm depth.

These depths were chosen because the texture and organic matter content of soil from these layers are different. Five soil samples at each spot were collected at the selected depths for gravimetric moisture content (GMC) determination. Volumetric moisture content (VMC) was computed from the GMC and dry soil bulk density. Simple linear regression analysis of the five VMC against the corresponding measured count ratios for each depth was conducted to generate the calibration equations.

RESULTS AND DISCUSSION

The results of the linear regression of VMC against the neutron count ratios for the three soil layers are shown in equations 1-3.

$$\text{0.30 m depth: } Qv = 0.0268 + 0.0818x \ (R^2 = 0.95) \quad (1)$$

$$\text{0.60 m depth: } Qv = -0.2733 + 0.3227x \ (R^2 = 0.91) \quad (2)$$

$$\text{0.90 m depth: } Qv = -0.3297 + 0.3736x \ (R^2 = 0.91) \quad (3)$$

Where x is the count ratio.

The regression coefficient (R^2) for all the depths was high indicating that there was a strong relationship between the gravimetrically determined VMC and the neutron counts for this soil ecotope.

CONCLUSIONS

The calibration equations developed may be used to accurately estimate VMC from neutron probe readings for this site.

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Keywords: count ratios, crop water use, linear regression, soil depths, volumetric water content

ABSTRACTS
POSTER PRESENTATIONS

WEED SCIENCES

LISTED ALPHABETICALLY

(Nr. 88)

EFFICACY OF GLYPHOSATE ON UROCHLOA PANICOIDES AT DIFFERENT GROWTH STAGES

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INTRODUCTION

Urochloa panicoides (liverseed grass) is an annual grass native to eastern and southern Africa, the Arabian Peninsula and the Indian sub-continent. Liverseed grass produces a large number of seeds and increased infestation levels can reduce maize yield especially if plants re under drought stress. Application of the herbicide, glyphosate, expanded significantly with the trend to minimise tillage in crop production and the introduction of transgenic Roundup Ready® (RR) crops. The aim of this study was to determine the efficacy of different glyphosate formulations on the control of *U. panicoides* at different growth stages of this grass weed.

MATERIALS AND METHODS

A field trial with natural infestation of *U. panicoides* was used to lay out a completely randomized design trial where each growth stage of the grass and glyphosate treatment were replicated three times, respectively. Glyphosate was applied post-emergence at four different growth stages. These growth stages were tufts with a diameter of 5, 10, 20 and 30 cm. Six different glyphosate (g a.e.ha-1) formulations were applied viz. glyphosate 360 g (Monsanto = M), glyphosate 360 g (Villa Crop Protection = V), glyphosate 480 g (DOW AgroSciences = D), glyphosate 500 g (Syngenta = S), glyphosate 500 g (Arysta LifeSciences = A), and glyphosate 540 g (Monsanto). Dosage rates were calculated to ensure that 1000 g acid equivalent (a.e.) per hectare was constant over treatments. Ammonium sulphate and /or other adjuvants were added as indicated on the respective labels of each product. Visual observation to determine efficacy (% of control) were done on 7 and 14 days after application. Regrowth of the grass weed in all treatments was recorded at 28 days after application.

RESULTS

Glyphosate 360 g (M), glyphosate 360 g (V), glyphosate 480 g (D) and glyphosate 540 g (M) gave effective control (>90%) 7 DAA where *U. panicoides* was 5 cm in diameter. However, only glyphosate 480 g (D) gave effective control (>90%) in all four growth stages of U. panicoides 7 DAA. The same tendency was observed at 14 DAA where both glyphosate 360 g (V) and glyphosate 480 g (D) gave effective control at all four growth stages of *U. panicoides*. Regrowth of *U. panicoides* was the highest where glyphosate 360 g (M) (88%) and glyphosate 500 g (S) (87%) was applied.

CONCLUSIONS

Growth stage of *U. panicoides* has an effect on the efficacy of glyphosate formulations and glyphosate should be applied when grass tufts are still small (5 cm in diameter). Most glyphosate formulations did not gave effective control (>90%) and only reduced or suppressed growth of *U. panicoides* (50 – 89%) when grass tufts were larger than 20 cm diameter.

ACKNOWLEDGEMENT

Financial support from Syngenta South Africa is gratefully acknowledged.

Keywords: control, efficacy, glyphosate, formulations, regrowth

(Nr. 89)

INFLUENCE OF SMOTHER CROPS AS HEDGEROWS ON THE BIODIVERSITY OF INSECT SPECIES: PRELIMINARY RESULTS

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INTRODUCTION

A combination of pressures, namely insecticide- and herbicide-resistance and environmental concerns, has prompted interest in new measures to improve agroecosystems. Addressing these issues, points to the utility of smother crops, which are normally used for weed suppression, to support sustainability in a non-chemical way and emphasizes the importance of wider ecosystem services currently limited by the over-usage of chemical crop protection products. Therefore, the aim of this research was to study the effect of smother crops on the improvement of biodiversity in a normal grain production system.

MATERIALS AND METHODS

Smother crop plots were arranged in a randomized block design with four replicates in a field trial conducted at Langgewens. Smother crop combinations consisted of serradella and rye, white mustard and lupine and black oats and vetch. Four yellow water traps were placed in each plot and these traps were emptied on a weekly basis. Identification and counts were made of the different insect species.

RESULTS AND DISCUSSION

Results showed that more dung flies (Scathophagidae), a predator of aphids, were caught outside than inside the smother crop plots, while Parasitoids were more active inside plots than outside. Where white mustard occurred more diamond back moths were encountered. However hover fly (Syrphidae) numbers, another predator of aphids and indicators of diversity, were low in all cases and may indicate the influence of monoculture within the current production area.

CONCLUSIONS

Integrating smother crops as hedgerows within a current grain production system as a safe haven for natural enemies may assist in the reduction of problem insect species in a sustainable way.

Keywords: crop protection, predators, smother crops, weed suppression

(Nr. 90)

EFFICACY OF PRE- AND POST-EMERGENCE HERBICIDES ON CONTROL OF BENGHAL WANDERING JEW (*Commelina bengalensis*)

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INTRODUCTION

Commelina benghalensis, (Benghal Wandering Jew) is one of the world's most problematic weeds and compete with crops for water and nutrients. This weed produces aerial and subterranean flowers and has the ability to root at nodes and propagate vegetatively from cuttings. Due to its high tolerance to commonly used herbicides, particularly glyphosate, infestation of *C. benghalensis* are increasing, especially under conservation agricultural systems. The aim of this study was to evaluate different herbicides applied at different growth stages to determine the efficacy of various products for control of this problem weed.

MATERIALS AND METHODS

Aerial seeds were harvested by hand from mature plants and separated from the capsule and left to dry. Seeds were also treated in a dry-oven at 90°C for 2 hours to uplift inherent dormancy and to facilitate moisture uptake. Glasshouse trials were conducted where seeds were planted in rectangular containers to evaluate the efficacy of six pre-emergence and eight post-emergence herbicides. The trial layout was a complete randomized design where treatments were repeated three times. Post-emergence herbicides were applied at two growth stages of the weed (V4 and flowering stage). Herbicides evaluated included the following active ingredients: acetochlor, atrazine, terbuthylazine, s-metolachlor, dimethenamid-P, 2,4-D, flumetsulam, mesotrione, bromoxonil, bendioxide, tembotrione, topramezone and glyphosate. Visual ratings were done at fortnightly intervals to determine efficacy of all herbicide treatments. Re-growth of *C. benghalensis* was recorded 30 days after herbicide applications.

RESULTS AND DISCUSSION

The most effective pre-emergence herbicides were acetochlor/atrazine/terbuthylazine, mesotrione/s-metolachlor, S-metolachlor, dimethenamid-P and acetochlor 840 which gave greater than 90% control at 76 days after application (DAA).The post-emergence application of tembotrione at V4 stage resulted in 80% control, with glyphosate + 2,4-D at 100% effective control 36 DAA. Bromoxynil and glyphosate + 2,4-D applied post-emergence at the flowering stage gave 100% control 31 DAA.

CONCLUSION

The pre-emergence application of herbicides containing acetochlor, atrazine, terbuthylazine, s-metolachlor and dimethenamid-P controlled *C. benghalensis* effectively. Although this weed is difficult to control after emergence, early identification and timely post-emergence application of glyphosate + 2,4-D or bromoxynil will result in effective control when applied at the seedling stage.

ACKNOWLEDGEMENT

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Keywords: acetochlor, control, efficacy, glyphosate, re-growth

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RESPONSE OF RYEGRASS (*Lolium multiflorum*) TO ONCE-OFF STRATEGIC TILLAGE IN THE SWARTLAND SUB-REGION OF THE WESTERN CAPE

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INTRODUCTION

The benefits of conservation agriculture (CA) are well known. As a result of zero soil disturbance, it might be more difficult to control weeds in certain cropping systems. Ryegrass (*Lolium multiflorum*) is a typical example of a weed specie that might become problematic under zero-till conditions. Although soil tillage is not recommended under CA, the question however arises whether strategic use of once-off tillage under CA could be feasible to manipulate *Lolium multiflorum* survival and weather it is possible to reduce viable *Lolium multiflorum* seed in the seedbank through tillage.

MATERIALS AND METHODS

The study was conducted during 2014 and 2015 at the Langgewens Research Farm of the Western Cape Department of Agriculture near Moorreesburg (33016'42.33" S; 18042'11.62" E; 191 m). The experimental design was a randomised complete block with a split-plot treatment design. Three cropping sequences: medic-clover/wheat/medic-clover/wheat (McWMcW), wheat/lupine/wheat/canola (WLWC) and lupine/wheat/canola/wheat (LWCW) were allocated to main plots and replicated four times. The last letter in the sequence represents the crop on the field at the time of data collection. Tillage treatments were allocated to sub-plots namely: continuous no-till (NT), soil left undisturbed until planting and then planted with a tined no-till planter, non-inversion tillage (DT), deep tine to a depth of ~400 mm and inversion tillage (MP), soil inverted using mouldboard plough to a depth of ~250 mm. Soil samples were collected to a depth of 50 mm one day before tillage (2014) and one day before planting (2015), placed in pots under shade-netting and irrigated. Weeds were count and removed continuously until all weeds in the pots germinated. Weed study in field was recorded 4 weeks after planting (2014 and 2015) before herbicide application.

RESULTS AND DISCUSSION

Preliminary in-field results in (2014) showed a general decrease in the amount of *Lolium multiflorum* with tillage. MP tended to result in the lowest amount of *Lolium multiflorum* seedlings (212 m^{-2}) compared to DT (433 m^{-2}) and NT (555 m^{-2}) for the wheat sequences during 2014. Similar results were obtained during the 2015 season with MP (19 m^{-2}), DT (24 m^{-2}) and NT (45 m^{-2}). In the trail under shade-netting *Lolium multiflorum* also decreased with increased soil disturbance.

CONCLUSIONS

Preliminary results showed a definite trend, a decrease in *Lolium multiflorum* populations as degree of soil disturbance intensifies.

Keywords: canola, no-till, plough, rip, weed seed bank, wheat