

ASSESSMENT OF VARIABLE APPLICATION RATES OF BIOLOGICAL AMENDMENT SUBSTANCES ON SEEDLING ESTABLISHMENT AND GROWTH CHARACTERISTICS OF MAIZE GROWN UNDER GLASSHOUSE CONDITIONS

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INTRODUCTION

The desire of every grain producer is to obtain higher yields at minimal costs and thus optimize net returns on investments. Crop establishment and plant vigour represent key factors influencing the success of grain crops (Hammermeister *et al.*, 2008). Ensuring optimal crop establishment is not only a cost-saving measure, but could also contribute to increased productivity and reduced seeding rates. The various inputs utilized by farmers on their fields exert variable effects on not only the crops but also seedling establishment (Baloyi *et al.*, 2009). This study was therefore carried out to evaluate the effects of variable rates of different industrially manufactured biological amendment substances (IMBAs) on seedling establishment and selected phenological traits of maize.

MATERIALS AND METHODS

A greenhouse pot experiment was carried out at Grain Crops Research Station, Potchefstroom during 2008-summer planting season. The IMBAs assessed as treatments comprised of Biozone, Advanced crop care, Gromor accelerator, Growmax, K-humate, Lanbac, Molcast, Montys organics and Promis at 50, 75 and 100% of the recommended rates along with NPK and the unamended control as standard checks. Blanket rates of 80 kg N ha⁻¹ and 43.5 kg P ha⁻¹ were applied using Limestone Ammonium Nitrate (LAN) and superphosphate respectively. Application of K was excluded in the fertilization programme based on the test results of the soil used. Soil-filled pots (4 kg) were arranged on the floor of the glasshouse in a completely randomised design with four replications. Two uniform sized maize seeds (cv. PAN 6479) were sown in each pot at a depth of 5cm. Plants were supplied with 400ml of deionised water after every three days during the six weeks trial period. Weeds were manually removed when necessary. Percent seedling emergence was determined at 2 weeks after emergence while phenological data such as plant height, maize biomass yield, leaf area, root biomass were recorded at different sampling intervals. Data was subjected to analysis of variance using Statistix 8.1 and differences in treatment means were separated using Tukey HSD test with significance level set at 5% probability level.

RESULT AND DISCUSSIONS

The effects of the different IMBAs as well as the IMBAs x application rates interaction on plant height, maize biomass yield and leaf area were significant ($P < 0.05$). The percent seedlings emergence in Molcast and Promis treated pots was significantly reduced. Generally, percent seedling emergence and growth phenological characteristics of maize plants obtained at 50 and 75% of the recommended rate were comparable and significantly higher than values obtained at the optimum recommended rate for the different IMBAs.

CONCLUSION

Application of IMBAs at 50 and 75% of the recommended rates promoted greater percent seedling emergence and better phenological characteristics in maize. The results justify the importance of agronomic assessment of these materials prior to recommendation for use by farmers.

LITERATURE CITED

BALOYI, T.C., KUTU, F.R. & DU PREEZ, C.C., 2009. Evaluation of biological amendment substances on maize (*Zea mays* L.) performance under variable field conditions. Paper presented at the 2009 Combined Congress of SASSS, SASCP, SAWSS and SASHS held at the University of Stellenbosch, Stellenbosch on 19 - 22 January 2009.
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http://www.agbio.ca/Docs/TechnicalBulletins08/TechnicalBulletin41web_grain.pdf

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Keywords: Industrial manufactured biological amendment substances, maize phenology, seedling emergence, soil amendments

COMPARING METHODS FOR MEASURING THE PATHOGENICITY AND TOXICITY OF *Fusarium verticillioides* IN MAIZE

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INTRODUCTION

Fusarium verticillioides is a fungal plant pathogen known to cause Fusarium ear rot of maize and, more significantly, to produce toxic secondary metabolites called fumonisins in maize kernels. Fumonisins are categorized as class 2B carcinogens and are associated with mycotoxicoses in various animals. The toxin has also been linked to oesophageal cancer incidence in humans. The aim of this study was to evaluate *in planta* inoculation methods to distinguish isolates of *F. verticillioides* that are able to cause visual symptoms from those unable to cause symptoms, but still produce fumonisins in maize.

MATERIALS AND METHODS

Three cultivars and four *F. verticillioides* isolates were used for pathogenicity trials in growth cabinets and the field. Two inoculation techniques were compared in a plant growth cabinet. For the first technique, maize seed was inoculated by flooding maize kernels with a spore solution prior to planting. The second technique involves planting of maize seed in sand inoculated with *F. verticillioides* grown on autoclaved millet seed at an inoculum density of 3%. After two weeks root and shoot length and weight was determined. Two techniques were also used for field inoculation, *viz.* 1) silk inoculations and 2) toothpick inoculations. Silk inoculations involve injecting the maize ear with a spore suspension of each isolate and toothpick inoculation entails inoculating ears with an infested toothpick. The trial was planted in a randomised block design with four replicates. Disease severity was rated using percentage ear area infected at harvest. Maize grain samples were further collected and analysed for levels of fumonisin contamination using enzyme-linked immuno sorbent assay (ELISA) kits.

RESULTS AND DISCUSSION

Growth chamber data correlated poorly to results obtained in the field. The results obtained in both trials were not significant ($p \leq 0.05$), thus suggesting that none of the methods tested were able to distinguish between the pathogenicity of the isolates. The occurrence of disease symptoms did not compare well with fumonisin levels. Although direct inoculation of the ear occurred, disease severity remained low but ELISA tests showed fumonisin levels to be higher than 2 ppm (FDA and EU recommended limits).

CONCLUSION

Growth chamber and field tests for rapid identification of pathogenicity were arduous and time consuming. Further studies to refine a rapid, accurate screening test are underway.

ACKNOWLEDGEMENTS

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Keywords: ELISA, Fumonisin, *Fusarium verticillioides*, pathogenicity

EVALUATION OF THE SUITABILITY OF CACTUS PEAR FRUITS FOR JELLY MAKING

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INTRODUCTION

Cactus pear fruit (*Opuntia ficus-indica*) is an important food source in satisfying the nutritional needs (Ca, Mg, P and K) of populations of various first world, as well as developing countries. This fruit may be used in a wide range of products, such as juices and nectars, marmalades, gels and jams, dehydrated sheets, sweeteners, alcohol and wines, canned fruit and frozen fruit (Saenz, 2000). The aim of this study was to use descriptive sensory analysis to evaluate the suitability of the fruits of seven cactus pear cultivars for the making of jellies, in an attempt to find more applications for this under-utilized food source in South Africa.

MATERIALS AND METHODS

Fruit from six cultivars for human consumption, Directeur, Ficus-Indice, Muscatel, Skinners Court, Turpin and Vryheid, and one fodder cultivar, Monterey, were peeled. Juice was extracted, with a juice extractor, from the fruits and the peel, mixed and processed into jellies, using a standardized method (Food preservation, 1986). Descriptive sensory analysis was done, in triplicate, by the same seven trained panelists, who compared the texture of the jellies and three controls (water, orange juice and, orange juice + pectin), by using a consensus lexicon and ten point scale (Introductory Sensory Analysis Workshop, 1995). Physical analysis of texture, also done in triplicate, included the line spread test (Kim, 2007) and viscosity tests (Frey, 2009), to measure and detect flow properties of the jellies. A Fischer's Least Significant Difference test at $p < 0.001$ was performed on the data.

RESULTS AND DISCUSSION

Five sensory descriptors were generated, namely cloudiness, smoothness, pectin content, runniness and cutting edge. Scores for the jellies were generally low compared to two of the control samples (orange juice, and orange juice + pectin). There was no significant difference between the seven cultivars for the descriptors of smoothness, cutting edge, pectin content and runniness. Monterey was significantly less cloudy than Muscatel, Turpin, Vryheid, and Ficus-Indice. For the physical texture analysis, there was a significant difference between the seven cultivars. Ficus-Indice had the highest viscosity and line spread value, while that of Directeur and Skinners Court were the lowest.

CONCLUSIONS

None of the cactus pear cultivars were regarded high in terms of jelly-forming capabilities. Directeur and Skinners Court had the lowest viscosity and line spread values, which are substantially lower than would be required for a fruit jelly. The fodder cultivar, Monterey, which in a raw state has a beetroot-like taste, was found to have an extremely pleasant flavour, when prepared in this way. Future research should be focused on the use of the cladodes as possible source of pectin.

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Keywords: sensory analysis, cactus pear, jelly, texture

ASSESSMENT OF CASSAVA-BASED CROPPING SYSTEMS AT MSELENI KWAZULU-NATAL

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INTRODUCTION

Cassava is grown in Africa in a wide range of agro-ecological conditions and in very diverse cropping systems (Dahniya, 1994). Manipulation of cropping systems provides sufficient use of natural resources and an important pests and disease management tool that can be readily adopted by subsistence farmers. The aims of this study were to determine crops used in cassava-based cropping systems and to determine the effects of this cropping systems on cassava production.

MATERIALS AND METHODS

During 2006, a study was conducted at Mseleni village in Northern KwaZulu-Natal. This area is characterized by sandy soils and high annual average rainfall (600-800 mm). Agricultural production in this village fully relies on rain. Most farms ranged from 0.2-5 ha in size.

A questionnaire with open-ended questions, developed and reviewed by staff from the University of the Free State and ARC, was used. A multidisciplinary team composed of scientists from the Department of Agriculture (KwaZulu-Natal) and the ARC-IIC collected the data. A list of farmers was compiled randomly by the field assistants and extension officers during a preliminary survey, it comprise of 45 farmers who were known to be cultivating cassava. Seventy eight percent of the farmers (35) were selected systematically to take part in the follow up survey, among which 28 were females and 7 were males with ages ranging from 31-51 years.

RESULTS AND DISCUSSION

Most of the farmers in the village reported that they grow cassava under mixed cropping systems. Cassava is mainly intercropped with maize and groundnuts. From all the crops listed as being used in crop rotation and intercropping, 80% of the farmers intercrop cassava with maize and 25% intercrop with groundnuts. Fewer farmers practice crop rotation than intercropping with cassava. Some farmers rotate cassava with maize (14%) while 17% rotate cassava with vegetables. Fifty one percent of farmers indicated that they never rotate their cassava crops with any crop for many years (monocropping). Eighteen percent of the farmers indicated that they previously rotated cassava with sugarcane, but that was almost 10 years ago. Use of diseased plant material had a significant negative impact on cassava total yield. This was exacerbated by insect population that colonized farmer's fields including whitefly, *Bemisia tabacci* the vector for spreading cassava mosaic virus. Cassava mosaic virus was observed as the most severe disease in farmers fields, it contributed to 69% while other diseases ranged from slight (Cassava Bacterial Blight at 17%) to moderate infection (Leaf sport at 14%). Cassava mosaic virus can lead to yield reductions of up to 79% (Ranomenjanahary *et al.*, 1994), and lessening of root quality (Cours, 1951).

CONCLUSIONS

Practices such as monoculture resulted in low yield and insect population build up. Cassava is a heavy feeder and consequently the soil became depleted of nutrients since no rotation was done over a number of years. Some aspects that require more close attention to improve the situation include options for crop rotation and intercropping.

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Keywords: Cassava, cropping systems

LABLAB PRODUCTION IN THE LIMPOPO PROVINCE OF SOUTH AFRICA AND ITS MULTIPURPOSE USES

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INTRODUCTION

Mixed inter-cropping is a popular cropping system among smallholder farmers in the Limpopo province of South Africa (Ayodele and Mariga 2006). One of such leguminous crop is cowpea; another crop that could be of such significance is lablab. Although many diseases and pests are associated with cowpea; lablab has high tolerance to all of such. The objective of this study was to compare nodulation and biomass production of commercially available lablab study cultivar with exotic lines from Australia in the Limpopo province.

MATERIALS AND METHODS

The study was conducted at the University of Limpopo experimental farm, Syferkuil. Eight exotic accessions (CPI 52554, CPI 52530, CPI 525430, CPI 52552, CPI 52513, CPI 60795, CQ 3620, CPI 52533) from CSIRO, Australia were compared with commercially available Rongai brown cultivar. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each block was 44 m x 13 m with 1 m between blocks. Seeds were sown at 1 m apart and 30 cm within rows. Seeds were inoculated with *Bradyrhizobium japonicum* before planting.

RESULTS AND DISCUSSION

Majority of the exotic lines produced active nodules, while Rongai brown did not. The number of days to flowering among the exotic lines of lablab ranged from 87 to 93 days after planting (DAP). The eight accessions differ significantly among each other in terms of biomass production and partitioning of assimilate. The significantly highest stem dry weight (416.7 g plant¹) and root dry weight (31.7 g plant¹) were observed in Rongai brown while significantly highest leaf dry weight (98.3 g plant¹) was observed in CPI 52552. All the exotic lines produced pods. Number of pods per plant at 18 WAP ranged from 35.3 (CPI 52533) to 63.7(CPI 525430) even though at this stage Rongai brown did not produce any pod. From the study it was observed that Rongai brown had high biomass production, but no nodulation, late flowering and late maturity period. However all the exotic lines evaluated were early flowering and maturing; and two accessions had 100 % active nodules. The leaf, shoot tips, and green pods could be used as green vegetables, while the dried grains could be kept for future uses. At the post-harvest stage, both leaf and stem could serve as high quality forage to grazing animals in the farming systems. Because of its vigorous growth, it could also serve as a cover crop to suppress weeds and control soil erosion. Furthermore with active nodulation, nitrogen could be produced through biological nitrogen fixation to improve soil nitrogen status.

CONCLUSIONS

The multipurpose function of lablab crop could be of great benefit to smallholder farmers in the Limpopo Province.

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Keywords: lablab, biomass production, nodulation, smallholder farmers

MICROBIAL BIOMASS IN RECLAIMED SOILS FOLLOWING COAL MINING IN VIRGINIA, USA

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It is well known that soil microbial communities reestablish following disturbance, but limited research has been done on how long this takes in reclaimed coal mine soils. The objective of this study was to track the development of total microbial biomass in reclaimed mine soils following coal mining in southwestern Virginia. A chronosequence of sites was established based on locally documented shifts in vegetation species with succession (0-2, 5-7, 18-20, and 38-42 yr old) on reclaimed sites with undisturbed adjacent sites used as a reference. The 0-2 yr old sites were covered with annual and perennial grasses and forbs, the 5-7 yr sites by thick stands of *Lespedeza cuneata*, the 18-20 yr sites predominately with *Festuca arundinaceae* and patches of deciduous trees, and the 38-42 yr old sites with a mix of planted conifers and native Appalachian hardwoods with a grass understory. Undisturbed sites predominately supported mixed Appalachian hardwoods with a mixed forb/grass understory. Four samples were taken from each site age (3 replicates) at the 0-5 cm soil depth. Chloroform-fumigation-extraction was used to determine total organic carbon from lysed microbial cells as a proxy for microbial biomass. Microbial biomass carbon (MBC) did not vary significantly among any of the site ages sampled; however, a general trend of increasing MBC from a low level in the more recently reclaimed sites (131-138 g microbial C kg⁻¹ soil) to a higher level of MBC in the 16-20 and 38-42 yr sites (280 and 244 g microbial C kg⁻¹ soil, respectively) was observed. This indicated a recovery of soil microbial communities with time; possibly well within the 5-year vegetation liability release period mandated by the Surface Mining Control and Reclamation Act (SMCRA).

Keywords: succession, chronosequence, Appalachian hardwoods, soil quality

***Exserohilum turcicum* RESISTANCE OF SOUTH AFRICAN ULTRA-SHORT-SEASON MAIZE HYBRIDS**

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INTRODUCTION

Northern corn leaf blight (NCLB) is caused by the fungus *Exserohilum turcicum* (Pass.) K. J. Leonard and E.G. Suggs and can result in yield losses of up to 50% (Perkins & Pederson, 1987). The level of resistance of local short-season hybrids to NCLB has not been characterised. Such information is necessary when resistant hybrids are to be used for disease management.

MATERIALS AND METHODS

Four trials consisting of 22 short-season maize hybrids were planted respectively at Potchefstroom and Vaalharts over two (2007/08 and 2008/09) growing seasons. Trials planted as randomized-complete-block designs with three replicates, were inoculated twice (at 4 - 5 and 8 - 12 leaf stage) with NCLB. Trials were screened weekly from the 2nd inoculation onwards. Assessments were made at growth stages R1, R2, R3, R4 and R5 (Hanway, 1971). Total severity (y_t), diseased plant severity (y_{dp}) and area under disease progress curves (AUDPC) were determined for each replicate. AUDPC were standardised to obtain sAUDPC. Linearised forms of the exponential, logistic and Gompertz models were fitted to the disease-progress data and the best model was selected for each trial. Rate of disease increase (r) and level of disease at the onset of the epidemic (y_o ; time=0) were obtained from the linearised regression equations. Rates were standardised to the *weighted mean absolute rate* (ρ) of disease and initial amount of disease y_o^* was calculated by back-transformation from the intercept parameter y_o (Madden 2007). A canonical variate analysis (CVA) was used to determine which of the parameters discriminated most between the cultivars over the four trials combined.

RESULTS AND DISCUSSION

The CVA indicated y_t , y_{dp} and sAUDPC were responsible for 84.83% of the variation observed between groups, with ρ and y_o^* being responsible for 8.62% of the variation. Four groups were accordingly created. Group 1 consisted of hybrids that produced lower than trial average y_t , y_{dp} , sAUDPC and ρ . Group-2 hybrids obtained lower than trial average y_t , y_{dp} and sAUDPC but higher than trial average ρ . Group-3 hybrids higher than trial average y_t , y_{dp} and sAUDPC but lower than trial average ρ . Group 4 produced higher than trial average y_t , y_{dp} , sAUDPC and ρ . Hybrids from groups 1 and 2 were, however, clustered very close together and could be considered the more resistant hybrids. Group 1 consisted of eight hybrids, Group 2 of three, Group 3 of five and Group 4 of six.

CONCLUSIONS

CVA analysis facilitated grouping of maize hybrids according to their unique attributes as observed over four different environmental conditions. Eleven of the 22 hybrids evaluated indicated moderate to high levels of resistance to NCLB. These results will allow a higher rate of incorporation of disease resistance into integrated pest management systems.

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Keywords: Disease progress curves, *Exserohilum turcicum*, resistance, maize

EFFICACY OF MYCORRHIZAL INOCULATION ON THE GROWTH AND NUTRITION OF TOMATO (*Solanum lycopersicum*) IN THE PRESENCE AND ABSENCE OF A MYCORRHIZAL STIMULANT, IN SAND-BASED HYDROPONIC CULTURE

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INTRODUCTION

The benefits of arbuscular mycorrhizal fungi, for greenhouse production of vegetables have been well-demonstrated. The question arises whether similar benefits could be obtained in soilless mediums amid an abundance of nutrients, which could potentially restrict root colonization and subsequent benefits. If root colonization could be improved, inoculation could be made more feasible. The aim of this investigation was to assess the possibility of inoculating tomato plants with AM fungi, in the presence and absence of a mycorrhizal stimulant, and to quantify possible growth and nutritional benefits.

MATERIALS AND METHODS

The experiment involved sand-based hydroponically-grown tomato plants. Four treatments were applied:

1. Seed inoculation (0.05 g mycorrhizal inoculant (AM) / 25 ml seedling tray hole).
2. Drenching the medium (sterilised HYGROMIX®) with 10 ml dissolved mycorrhizal stimulant / seedling (0.05 g Stimulant diluted in ca 500 ml sterilised distilled water), when seedlings were six weeks old.
3. Both inoculant and stimulant (AM+Stimulant) applied as for treatments 1 and 2.
4. Control - received neither the inoculant nor the stimulant.

A second (double strength) dose was applied when the seedlings were transferred to 15 cm free-draining pots, containing sterilised water-rinsed CONSOL® sand. The experiment was terminated when the plants had reached the early fruit set stage. Percentage AM root colonisation was calculated, root and above-ground dry weight were measured, and plant nutrient concentrations determined. The data was statistically analysed.

RESULTS AND DISCUSSION

No colonization was observed in non-AM and control plants. AM-treated plants showed root colonization (14%), while AM+Stimulant-treated plants showed significantly higher colonization (25%). None of the colonisation treatments conferred benefits in terms of plant growth. With the exception of Cu, AM+Stimulant-treated plants showed no significant improvement over AM-treated plants, in terms of plant nutrient concentrations. In general, there was also no improvement in colonized plants over non-colonized plants, possibly due to the abundant supply of nutrients. However, Stimulant-treated plants, performed better than the other plants in terms of their P, K, Ca, Mg and Mn nutrition. The chemical contribution of the stimulant to plant nutrition should thus not be underrated.

CONCLUSIONS

AM root colonization of tomato plants is obtainable under strict sand-based hydroponic systems. The supplementary use of a mycorrhizal stimulant was shown to increase this level of root colonization, but no benefit due to AM inoculation or the addition of a stimulant could be quantified. The solitary use of the stimulant, for nutritional benefits, needs investigation.

Keywords: arbuscular mycorrhiza, inoculant, hydroponic, stimulant, tomato, root colonization

THE INFLUENCE OF VARIETY AND SEASON ON CACTUS PEAR FRUIT JUICE: A SENSORY QUALITY EVALUATION

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INTRODUCTION

The adaptation of cactus pear (*Opuntia ficus-indica*) to arid and semi-arid climates allows them to be an interesting agricultural resource. It can be cultivated in areas that offer very little growth possibility for common fruit and vegetables (Saenz, 2000). Fruit quality is highly influenced by environmental characteristics, such as climate and rainfall. The objective of the study was to evaluate the effect of variety and season on the sensory quality of fruit juice from cactus pears cultivated using standardised orchard management methods (Potgieter, 1997).

MATERIALS AND METHODS

Fresh fruit juice samples from 33 cactus pear cultivars were evaluated sensorically by means of Free-Choice Profiling (FCP) by ten semi-naïve panellists over two agricultural seasons: A (2006/2007) and B (2007/2008) to determine if differences exist between varieties. Cultivars included 31 *Opuntia* spp. and 2 *Robusta* spp (used as animal fodder). The fruit was peeled and the juice extracted manually. For each of the two seasons, two evaluation sessions per day were scheduled with a 60 min rest period between each session, amounting to a total of 5 cultivars per session. Ten cultivars were tested each day. The whole range of 33 cultivars was evaluated over 3 days. The whole process was repeated two weeks later. Generalized Procrustes Analysis (GPA) provided data on inter-relationships between samples and assessors and together with Principle Component Analysis (PCA) identified the principle variables between varieties (Deliza *et al.*, 2004).

RESULTS AND DISCUSSION

Among the ten panellists, FCP generated 21 idiosyncratic descriptors for the attribute taste, e.g. "sweet", "prickly pear", "fruity", "melon", etc. The frequency of use of the descriptors for seasons A and B indicated clear differences between the two seasons. The GPA biplot indicated that the assessors could clearly distinguish between seasons A and B, since the 33 cultivars from season A were all situated to the right hand side of the figure and those from season B on the left side. The two cultivars used mainly for animal feed (*Robusta* spp.), Robusta and Monterey, were characterized by descriptors "sour", "pungent", "vegetable", "bitter", "beetroot" and "raw potato" and were clearly distinguished from the 31 cultivars for human consumption. The assessors were not successful in distinguishing among the 31 cultivars.

CONCLUSIONS

The effect of variety on fruit juice sensory quality was evident by the distinction between the fodder varieties and the human consumption varieties. No distinction could however be made among the 31 cultivars because of using an untrained panel. The influence of the season was evident from the PGA biplot results.

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Keywords: cactus pear, free-choice profiling, generalized Procrustes analysis, sensory, quality

POST RELEASE MONITORING OF LEPIDOPTERA ON BT AND NON-BT MAIZE AT SIX SITES IN THE VAALWATER AND VENTERSDORP AREAS

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INTRODUCTION

Post release monitoring of target and non-target pests on genetically modified (GM) crops is required by the GMO Act in South Africa. This is done to determine potential impacts of Bt maize on non-target pests and to serve as general surveillance for resistance development. However, the diversity and abundance of Lepidoptera is known to increase after flowering of maize (Van Wyk *et al.*, 2008). In South Africa the maize agroecosystem is of particular interest because of the large area planted with Bt maize (Event MON810) for the control of the lepidopterous stem borers, *Busseola fusca* author (Noctuidae) and *Chilo partellus* author (Crambidae).

MATERIALS AND METHODS

Field surveys were conducted on Bt and non-Bt maize fields at four irrigated and 2 dry land sites in the Ventersdorp and Vaalwater areas during the 2008/2009 cropping season. Nine hundred plants in each field were inspected for Lepidoptera and damage symptoms were recorded. Three randomly selected plots consisting of 300 plants each were inspected inside each Bt and non-Bt maize fields. Plants were inspected for damage at six different plant growth stages. Larvae were collected from infested plants and reared until the adults (moths) appeared. Moths were pinned and preserved to facilitate identification.

RESULTS AND DISCUSSION

In the Vaalwater area the incidence of plants damaged by stem borer was very low. In the Ventersdorp area the level of stem borer infestation was high on non-Bt maize and virtually absent from Bt maize. There was, however, a notable difference between general stem borer infestation levels in irrigated and dryland maize. The numbers of African bollworm (*Helicoverpa armigera*) Hübner (Noctuidae) on Bt maize was lower than on non-Bt maize. No infestation was observed six weeks after seedling emergence since plants were too young and not suitable for bollworm feeding. The incidence of plants damaged by bollworm was higher on non-Bt fields under both dry land and irrigated fields.

CONCLUSIONS

Helicoverpa armigera, a non-target pest, was abundant on non-Bt maize but not on Bt maize, indicating that it is affected by Bt maize. This study indicated that stem borers have not yet developed resistance to Bt maize at the monitored field sites.

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ACKNOWLEDGEMENTS

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Keywords: Bt-maize, Lepidoptera

RESPONSE OF TWO NOCTUID SPECIES, THE AFRICAN BOLLWORM AND COMMON CUTWORM, TO BT MAIZE

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INTRODUCTION

Transgenic maize (Bt) was introduced in South Africa for control of the lepidopterous stemborers, *Busseola fusca* Fuller (Noctuidae) and *Chilo partellus* Swinhoe (Crambidae) during 1998. Other noctuid species, including the cutworm *Agrotis segetum* Denis & Schiffermüller (injurious to seedlings) and African bollworm *Helicoverpa armigera* Hübner (ear feeder), are exposed to Bt toxin for a part of their life cycle, although neither pest is regarded as a target for Bt-technology. In the present study the effect of Bt maize on the growth and survival of both *A. segetum* and *H. armigera* was investigated.

MATERIAL AND METHODS

A laboratory study was conducted in which survival, mass gain and pupation of *A. segetum* 4th instar larvae were recorded when fed on Bt- and non-Bt maize seedlings. The following varieties were used: DKC 7815B (transgenic, MON810), CRN 3505 (non-Bt iso-hybrid for DKC 7815B), NK Mayor B (transgenic, Bt11), and Brasco (non-Bt iso-hybrid for NK Mayor B). The longevity and fecundity of moths of *A. segetum* derived from surviving larvae were also recorded. *Helicoverpa armigera* larval survival and mass gain on Bt- and non-Bt maize ears were evaluated in a greenhouse trial. The hybrids tested were DKC 78-15B (event MON810) with iso-hybrid CRN 3505. Probability of the study is indicated by $P < 0.05$.

RESULTS AND DISCUSSION

No significant differences in mass and larval survival of *A. segetum* when feeding on any of the hybrids were observed. The incidence of pupation of larvae over time was higher on Brasco than on NK Mayor B, with no differences between CRN 3505 and DKC 7815B. Moths originating from larvae feeding on Brasco produced more eggs than those from NK Mayor B. Fertility was significantly higher in moths originating from larvae feeding on DKC 7815B compared to the other hybrids. The mean longevity of female or male moths did not differ between any of the hybrids. Larvae feeding on Brasco reached higher percentage pupation over a shorter period of time compared to larvae feeding on NK Mayor B.

Mass of *H. armigera* larvae feeding on DKC 7815 B ears were lower than larvae feeding on CRN 3505 ears. Mass of larvae feeding on the Bt hybrid did not increase over time but a consistent increase was observed when feeding on the non-Bt hybrid. Larval survival differed significantly between Bt and non-Bt ears for hybrid CRN 3505 and DKC 7815 B. *Helicoverpa armigera* larvae feeding on Bt ears were always smaller than larvae feeding on non-Bt hybrids which contributed to a delay in development. This may result in much less ear damage on Bt than non-Bt plants.

CONCLUSION

This study indicated that Bt maize will most likely not have a significant effect on the biology of *A. segetum* under field conditions. The study also quantified the effect of Bt maize on *H. armigera* and provided important information on the potential of Bt maize to protect maize ears from feeding damage.

Keywords: *Agrotis segetum*, Bt maize, feeding studies, *Helicoverpa armigera*

PRELIMINARY STUDIES ON THE UPTAKE OF COMMERCIAL POST HARVEST PRODUCTS BY GERBERA MAXI CULTIVAR 'OPTIMA'

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INTRODUCTION

Cut flowers are supplied to many markets world-wide and, as with most fresh products, require specific post harvest handling to ensure that quality after harvest is maintained for as long as possible. Cut flowers should be harvested at the correct maturity, under the appropriate conditions, and handled according to the variety's specific requirements. All handling, from harvest to market, will significantly affect the quality and longevity of the flowers - one of the most important steps requires that flowers be adequately hydrated before shipping to customers to ensure that maximum vase-life is obtained. Two commercial products developed for use by farmers were tested for their uptake potential and were compared with the currently used post harvest treatment for Gerbera cut flowers grown by the Timbali Technology Incubator growers.

METHODS AND MATERIALS

Harvested flowers were treated with either Product A, B (both commercial products) or C (currently used as a post-harvest treatment and is not a commercial product). All three products are chlorine-based. Flowers were harvested at the two-ring stage and were delivered to the laboratory within 30 minutes of harvesting. Solution uptake was recorded over a period of five hours. The trial was repeated three times. After treatment, flowers were placed in vases containing slightly acidified water (pH 6.0) containing a surfactant and maintained under ambient conditions to simulate customer conditions.

RESULTS AND DISCUSSION

Trends in uptake indicated that the flowers became less hydrated, i.e. appeared to lose water through transpiration over time for Products A and B compared with those flowers placed in Product C, which took up more solution during the trial. Solution pH may have played a role in uptake in that Products A and B had an extremely high average pH (pH 6.81 for Product A and pH7.56 for Product B) in comparison with Product C (3.56). Hydration solutions with a high pH are not readily taken up by flower stems, although sterilising chlorine species are more active in neutral pH solutions. However, it appears that combined with the low pH which facilitates water uptake, the lower pH level of Product C may in addition prevent bacterial bloom, thus further promoting uptake.

CONCLUSIONS

The commercial products did not promote uptake of water and the flowers rather appeared to lose water over time. Although this did not appear to affect the vase-life compared with Product C, it would not be economically feasible for farmers to make use of these commercial products without there being a major benefit in enhancing vase-life. It is extremely important that producers ensure that the products they are using are providing the benefits they require.

ACKNOWLEDGEMENTS

Timbali Technology Incubator staff and beneficiaries are thanked for providing the plant material for the trial. Ms Shirley Sihlangu, Ms Zodwa Ndimande and Ms Lucy Mthethwa from the Agricultural Research Council (ARC) are thanked for their assistance in the laboratory. The ARC partially funded the study.

Keywords: hydration, cut flower, post harvest quality, solution uptake

TOWARDS IMPROVING LONGEVITY OF CUT *Lilium* 'ACAPULCO'

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INTRODUCTION

Longevity of cut *Lilium* is often negatively affected by the premature abscission of flower buds, the accelerated opening of flowers, petal fading, wilting as well as the yellowing and abscission of leaves (Woltering and van Doorn, 1988). *Lilium* is generally considered to be sensitive to ethylene, therefore a pulsing treatment with silverthiosulfate (STS) is a standard postharvest requirement for cut lilies. However, the inappropriate or excessive use of STS may have phytotoxic effects on the stem which would include early leaf yellowing or bud blasting (abortion). Another postharvest disorder is the development of leaf yellowing on cold-stored stems. Foliar sprays containing growth regulators that include gibberellic acid and cytokinin as benzyladenine (BA) were reported to be effective in lowering foliar chlorosis (Han and Miller, 2003). The aim of this study was to evaluate various vase preservation solutions for oriental lily 'Acapulco' for their efficacy in extending the longevity of the foliage and flower under South African harvesting, storage and marketing conditions.

MATERIAL AND METHODS

The commercial 'Lily Food' solution was evaluated against distilled water (control), 8-hydroxyquinoline citrate (8-HQC) as a biocide or 2% sucrose (carbohydrate source) in conjunction with 8-HQC to facilitate bud opening. The preservation vase solution was used either in combination with clean tap water (control) or with commercial Pokon-Chrysal SVB as a pre-pulsed treatment. A range of pre-treatments for 'Acapulco' immediately following harvest was also assessed and consisted of pulsing with STS or the commercially recommended Pokon-Chrysal AVB, the continual use of an ethylene scrubber after harvest as well as a growth regulator spray containing GA₄₊₇:BA in a ratio 1:1.

RESULTS AND DISCUSSION

Concentration levels of sucrose in the vase solution did not significantly affect the number of buds opening per stem, but a vase solution containing 2% sucrose did extend the vase-life of the flowers to 22.8 ± 1.32 days compared with 19.2 ± 1.69 days recorded for the control. Treatment of flowering stems with Promalin® (180mg. L⁻¹) significantly retarded the development of leaf yellowing and extended the vase-life by eight days. A commercial Chrysal AVB pulsing was found to be the most effective anti-ethylene treatment and extended the vase-life to 27.6 ± 0.98 days.

CONCLUSIONS

The use of Promalin® to control postharvest leaf yellowing and to improve bud and flower longevity may be of commercial value and warrants further investigation.

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Keywords: ethylene, floriculture, postharvest, respiration

EFFECT OF SEED DRESSINGS AND SEED SIZE ON MAIZE GERMINATION AFTER STORAGE

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INTRODUCTION

Although small seeds may germinate sufficiently, seed vigour may be negatively affected by size. Smaller seeds also do not maintain viability in storage as well as bigger seeds (Khan *et al.*, 2005). Various seed dressings are available to protect seed from insect and fungal damage when in storage and infections shortly after planting (Saayman, 2002). Seed companies treat maize seeds with one or more seed dressings of different active ingredients to ensure effective germination and vigour of seed lots. Farm storage conditions are, however, not necessarily optimal and can play a major role in the vigour and germination of seed lots. The interaction between seed size, various seed dressings and storage conditions on germination of maize was therefore investigated.

MATERIALS AND METHODS

Four different seed sizes (3R, 3F, 4F and 5F) from one maize cultivar were treated with captab (50% flowable concentrate), fludioxonil/mefenoxam (25 + 10 g/l), imidacloprid (600 g/l) and thiamethoxam (350 g/l). Hundred seeds per seed size per replication were used for each treatment. These active ingredients were applied separately and in combination on maize seed. Seed was stored in airtight plastic containers under optimal conditions (15°C) or in a growth chamber at 35°C. Germination tests were done after three months of storage according to the International Rules for Seed Testing (ISTA Rules, 2009).

RESULTS AND DISCUSSION

Under optimal storage conditions seed dressing treatments and seed size had a significant ($P < 0.05$) effect on all variables tested. A significant interaction between seed dressing treatments and seed size was also observed for all variables tested. The lowest number of total seedlings germinated was for seed size 3R treated with a combination of fludioxonil/mefenoxam + thiamethoxam. Normal seedling germination varied between 60 – 96%, with the lowest percentage recorded for seed size 3R, treated with a combination of fludioxonil/mefenoxam + thiamethoxam (61%). The percentage abnormal seedlings were relatively low, with the highest percentage recorded for seed size 4F treated with a combination of fludioxonil/mefenoxam + thiamethoxam seed dressing (7.5%). The percentage normal seedlings germinated were significantly less for seeds stored at 35°C. Total number of seedlings germinated was significantly lower for seed size 3R, treated with captab + imidacloprid and fludioxonil/mefenoxam + thiamethoxam. The percentage seed which did not germinate was significantly higher under 35°C storage conditions compared to conditions for optimal germination (60.7%, compared to 13.4%, respectively).

CONCLUSIONS

Germination of smaller seed size (3R) was significantly affected by the seed dressing mixture of fludioxonil/mefenoxam + thiamethoxam under both storage conditions. Germination of all seed sizes was, however, significantly affected where seed was stored under sub-optimal conditions. Maize producers should be advised by seed companies of the importance of on farm storage conditions.

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Keywords: germination, maize, storage, seed dressing

TRENDS IN SOIL NUTRIENT STATUS OF CROPPED SOILS IN LOW EXTERNAL INPUT FARMING SYSTEMS OF THE EASTERN CAPE PROVINCE

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INTRODUCTION

In the Eastern Cape, studies comparing a variety of measured soil parameters in home gardens, fields and nearby uncultivated areas under low external input farming systems are scarce. Consequently, few data exist to assess the extent of the changes that have occurred in properties of soils tilled annually for many years and whether any changes were consistent from one soil type to another. The objectives of this study were to measure and compare the soil chemical properties of cultivated (gardens and fields) and adjacent uncultivated lands in a range of soils from the Eastern Cape.

METHODS AND MATERIALS

A soil sampling exercise was conducted in three district municipalities (Oliver Tambo, Chris Hani and Amatole). Topsoil samples (20 cm) of both home gardens and fields, and nearby uncultivated areas were analyzed for soil pH, acid saturation, texture, soil organic C and extractable Ca, Mg, K, P status. Limits for various chemical properties were set out using information taken from literature and were used as criteria for assessing the plant nutrient status of soils. Soil samples from each district municipality were arranged into three classes: poor fertility (low), marginal fertility (medium) or good fertility (high) status.

RESULTS AND DISCUSSION

Plant nutrient status of soils varied widely within as well as amongst districts. However, in most instances differences in soil nutrient status between either fields or home gardens and adjacent uncultivated lands were small. Organic C was highest in soils from the OR Tambo District Municipality. Nonetheless, the fertility status of soils from OR Tambo and Chris Hani District Municipalities was relatively lower than for soils from the Amatole District Municipality. In contrast to soils from Amatole, field and garden soils from OR Tambo and Chris Hani District Municipalities had low (< 5.0) soil pH values. Furthermore, in some localities soil acid saturation levels were high (> 25%) hence lime is needed to rectify the soil acidity problem. The application of calcitic lime will also provide Ca which was low (< 800 mg kg⁻¹) in soils from the OR Tambo and Chris Hani District Municipalities. Extractable Ca, Mg and K status was high in Amatole, whilst for OR Tambo and Chris Hani District Municipalities Mg was relatively high and K was heterogeneous. Amongst the three District Municipalities the extent of low (< 5 mg kg⁻¹) soil P contents reinforces the need for action to replenish P.

Keywords: cultivated and uncultivated lands, fields, home gardens, small-scale agriculture, soil fertility status

EFFECT OF PLANT POPULATION, ROW SPACING AND NITROGEN APPLICATION RATES ON KENAF PRODUCTION

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INTRODUCTION

Kenaf has attracted considerable attention as multipurpose plant having great potential for fiber, energy, feedstock, etc. (Komiyama *et al.*, 2008). The desired plant population, row spacing and nitrogen application rates will vary according to production regions, growing conditions, cultivar used and grower preferences. Row width and plant density affect stem diameter and plant height, which has been correlated to whole stalk yield (Baldwin & Graham, 2006). Data on the adaptability and yield of kenaf in South Africa are scares or conflicting (Liu & Labuschagne, 2009).

MATERIALS AND METHODS

A study was undertaken to investigate the effect of plant populations (200,000; 300,000 and 400,000 plants ha⁻¹), row spacings (17, 34, and 50 cm), and nitrogen application rates (0, 50, 100, and 150 kg N ha⁻¹) on yield components and composition of the photosensitive kenaf "Tainung 2" cultivar. The experimental (P<0.05) layout was a completely randomized split-split plot design, with plant population as main plot, N level as sub plot and row spacing as sub-sub plot. The growth characteristics (plant height, stem diameter), and the biomass productivity (leaves, stems, and storage organs) of the crop were recorded monthly throughout the growing season and at the harvest.

RESULTS AND DISCUSSION

As plant population increased, plant height and stem diameter decreased. However, stem dry mass increased as final plant population increased. The stem dry mass for plant populations of 300,000 and 400,000 plants ha⁻¹ increased by 55.8% and 102.3% respectively over than that of the lowest plant population. Although the highest yield was achieved in the 50 cm row spacing, kenaf did not respond to row spacing. The stem dry mass yield levelled off at 100 kg of N ha⁻¹.

CONCLUSIONS

The effort to increase total biomass yield should be based on using high plant population 400,000 plants ha⁻¹, wide-row spacing (50cm), and 100 kg N ha⁻¹. At 150 kg N ha⁻¹, there is a potential risk of decreasing stalk yield.

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Keywords: Kenaf, Multipurpose crop, Growth characteristics, Biomass production

IRRIGATION FREQUENCY AND PHOSPHATE APPLICATION RATE OF HYDROPONICALLY GROWN TOMATOES

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INTRODUCTION

The small root volume of soilless production systems require an accurate control of irrigation frequency to ensure that the water and nutrient uptake is not limited by availability between irrigation events. Soon after irrigation, nutrient concentrations in the rhizosphere rapidly decrease to deficiency levels and increased irrigation frequency can therefore increase the efficiency of water and fertilizer use (Rawlins & Raats, 1975) and enhance the uptake of water and nutrients through optimizing the root zone conditions (Silber *et al.*, 2003). An increase in irrigation frequency will be especially beneficial to the uptake of a less mobile element such as P (Silber 2003). Increasing the availability of P in the root zone can possibly provide a way of reducing P application rates without affecting fruit yield and quality. This study examined the effect of irrigation frequency and P application rates on plant growth, fruit yield and quality.

MATERIALS AND METHODS

During summer 2008/2009 different fertigation frequencies and P concentrations were applied to tomato plants growing in a coir medium in a greenhouse in Stellenbosch. A factorial design with four randomized blocks were established to evaluate the effect of irrigation frequencies of four times a day, eight times a day or twelve times a day and nutrient solutions containing 15 or 40 ppm H₂PO₄. Each block consisted of 96 plants at a density of 2.8 plants per m². All treatments received the same total daily irrigation volume and the nutrient solution was maintained at an EC of 2 ms/cm throughout the trial. Plant growth, truss development, fruit yield and quality were assessed weekly throughout the trial as well as changes in volume, EC, nutrient concentrations and pH in the leached nutrient solution. Analysis of variance was performed and treatments were compared with LSD (P≤0.05).

RESULTS AND DISCUSSION

Increased irrigation frequency resulted in a 19% yield increase and improved quality of the tomato fruit. Increased marketable yield under high irrigation frequency could be attributed to an increase in the number of inflorescence per plant, shorter internodes, and a 23% lower incidence in blossom end rot (BER). The combination of low irrigation frequency and low P supply resulted in visible P-deficiency symptoms and decreased yield that was not noticeable with a low P supply and increased fertigation frequency. The low irrigation frequency treatment resulted in an accumulation of salts in the growing medium which could have further contributed to a decreased availability and uptake of water and nutrients, negatively impacting on growth and yield.

CONCLUSIONS

Increased fertigation frequencies of greenhouse tomatoes grown in coir can increase fruit quality, especially reducing the number of BER-affected fruit. An increase in fertigation frequency enables a reduction in the concentration of P in irrigation water, lessening the environment pollution by discharge.

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Keywords: Fertigation frequency, hydroponics, phosphate, tomato

EFFECTS OF FIVE MANAGEMENT PRACTICES ON WEED SPECTRUM IN A CHARDONNAY/ 99 RICHTER VINEYARD

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INTRODUCTION

Weeds compete with crops for water and nutrients and can reduce yields by as much as 80% (Cousins & Mortimer, 1995). Management practices impact on weed population dynamics (Smith, 1970). The weed control efficacy of different soil management practices and their effect on species diversity and dominance was determined.

MATERIAL AND METHODS

Five management practices were applied from 1993 to 2008 in a Chardonnay/99 Richter vineyard established on a medium textured soil near Robertson (33⁰55'S, 18⁰52'E). The weed stand, species diversity and species dominance was determined end of August and end of November.

RESULTS AND DISCUSSION

The stand of winter and summer growing weeds was significantly less in the treatment with a full surface wheat straw mulch (WST) and full surface chemical control applied from grapevine bud break to harvest (WST), compared to that of the other treatments. A permanent cover crop in the work row resulted in the highest weed stand. The amount of dominant species per management practice applied varied from five in the WST treatment to nine in the treatment in which no cover crop was sown and full surface chemical control was applied from grapevine bud break to harvest. The selection for different species was also observed.

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Keywords: management practices, grapevines, weed stand, weed spectrum

EFFECTS OF IMIDACLOPRID AND ENVIRONMENT ON SEEDLING GERMINATION OF DRYLAND WHEAT IN THE SUMMER RAINFALL REGION

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INTRODUCTION

Imidacloprid is a systemic, chloro-nicotinyl insecticide providing protection against early-season infestations of RWA by preventing aphid colonization. Detrimental effects of Imidacloprid seldom occur but can easily pass unnoticed in large wheat fields. General agronomical characteristics of eighteen unadapted wheat genotypes were investigated in RWA field trials planted in a split-plot design at Alpha Estates (Clocolan), ARC-SGI (Bethlehem) and Moedersdeel (Reitz), enabling investigation of interactions between soil, genotype and seed dressing on germination.

MATERIAL AND METHODS

Seed planted originated from a common seed batch produced in 2008 and seed treatment (Imidacloprid) was applied at a rate of 400g.a.i/100kg seed. Emergence of all genotypes with or without the seed dressing was determined six weeks after planting by counting seedlings in a seven-meter row and ranked into a low-emergence (≤ 80 seedlings per 7m) or high-emergence (> 80 seedlings per 7m) groups. Seed samples from the untreated and seed treatments of all genotypes were analyzed by the Seed-testing laboratory of the ARC-SGI for percentage abnormal- and normal germination, percentage dead seed and coleoptile length using ISTA (International Seed Testing Association) prescriptions. Deficiencies were determined from seed germinated in moistened paper rolls in a germination cabinet at $\pm 20^{\circ}\text{C}$ after eight days. Data was analyzed (F.pr of 0.01, 0.05 and 0.001) with ANOVA using GENSTATS 8.1 for Windows.

RESULTS AND DISCUSSION

Two-way ANOVA indicates that the main effect of Treatment (seed dressing) significantly affected seedling emergence at Alpha-Estates (F.pr <0.01), ARC-SGI (F.pr <0.001) and Moedersdeel (F.pr <0.05). The number of emerged seedlings from untreated seed (88.8) at Alpha-Estates was significantly more than for treated seed (76.8). A similar trend occurred at Moedersdeel and seedlings from untreated seed (82.3) were significantly more than treated seedlings (74.5). Soil analysis of the three localities shows Alpha-Estates and Moedersdeel suffer from low pH and high percentage acid saturation. An opposite trend occurred at ARC-SGI and emerged seedlings from Imidacloprid-treated rows (78.5) were significantly more than untreated rows (66.2). Results from the three localities were also used to rank the genotypes in a low emergence (≤ 80) or high emergence (>80) group.

Germination analysis conducted at the ARC-SGI seed laboratory revealed three unadapted genotypes with germination percentages below the standard 85% required by SANSOR, generally attributed to high percentage dead seed. The laboratory findings correspond with seedling emergence data from the field trials and the same three genotypes ranked in the low-emergence group. Follow-up tests in the seed laboratory at three Imidacloprid rates (200-, 400- and 800 g.a.i/100kg seed) revealed no significant effect on root number but rather a large interaction between Entry (genotype) X Dosage on number of roots.

CONCLUSIONS

Wet planting conditions in the eastern Free State in 2009 do not appear to be responsible for varying germination results. Soil pH and percentage acid saturation may be more prominent in affecting general germination and in the interaction with Imidacloprid seem to have a phytotoxic effect on seed germination. The wheat genotypes tested in the trials exhibited varying responses to Imidacloprid treatment and can indicate possible varietal differences to Imidacloprid treatment. The two issues mentioned above warrants further investigation.

Keywords: Wheat, Russian Wheat Aphid, Imidacloprid, Seedling germination

HERBICIDE APPLICATION RATE AFFECT THE CONTROL OF THREE ANNUAL WEED SPECIES

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INTRODUCTION

Isoxaflutole (Balance) and flumetsulam (Python) are commonly used pre-emergence corn herbicides in Kansas, USA. The response of velvetleaf, Palmer amaranth and giant foxtail to different rates of pre-emergence herbicides were studied.

MATERIALS AND METHODS

Greenhouse experiments were conducted at Kansas State University. Twenty velvetleaf, Palmer amaranth, and giant foxtail seed were sown into 15 cm diameter pots at a depth of 0.5 to 1 cm. After planting the pots were sub-irrigated to field capacity. Isoxaflutole and flumetsulam were applied within 24 hrs of weed seed planting at rates of 0, ¼, ½, 1, and 2x the recommended rate (recommended rates are 0.07 kg a.i ha⁻¹ for both isoxaflutole and flumetsulam) using a spraying chamber. Sub-irrigation was used throughout the experiment. After 4 weeks, survivors (all plants with green tissue) were harvested individually and height per plant was measured. Number of dead seedlings was recorded. The plant material was dried in an oven at 70 °C for 2 days after which dry weight per plant was measured. The experimental design was a randomized complete block with four replications. The experiment was repeated.

RESULTS AND DISCUSSION

The control of velvetleaf by flumetsulam was unexpectedly variable. No relationship was found between velvetleaf control and flumetsulam application rate. Velvetleaf control by isoxaflutole increased as herbicide application rate increased. The dry weight of Palmer amaranth decreased with an increase in the rates of both isoxaflutole and flumetsulam. However, the isoxaflutole application gave the best control of the Palmer amaranth. The dry weight of giant foxtail was similar across the different application rates when either isoxaflutole or flumetulam was applied but less than that of the untreated control.

CONCLUSIONS

The pre-emergence application of broadleaf herbicides generally reduced growth of velvetleaf, Palmer amaranth, and giant foxtail. Greater biomass reduction was obtained with isoxaflutole than with flumetsulam application. It thus seems that although both these herbicides are registered to control these weeds, isoxaflutole will be the more effective one to use.

ACKNOWLEDGEMENTS

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Keywords: Flumetsulam, giant foxtail, Isoxaflutole, *Palmer amaranth*, velvetleaf

GENOTYPE BY ENVIRONMENT INTERACTION AMONG SELECTED SOYBEAN CULTIVARS FOR SEED YIELD AND NODULE FORMATION

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INTRODUCTION

The nature and magnitude of the genotype by environment interaction is important to identify superior and stable genotypes under targeted environments (Hayward *et al.*, 1993). This could assist in maximizing specific adaptation and to speed up the transfer of new cultivar to growers. The objective of this study was to determine yield stability of selected soybean (*Glycine max* L.) genotypes with suitable agronomic traits, high yield and active nodule formation.

MATERIALS AND METHODS

Field experiments were conducted under limited rainfall conditions (about 500 mm per year) during the 2007/2008 and 2008/2009 growing seasons at the University of Limpopo's experimental farm (Syferkuil) and at farmer's field at Gabaza community, Mopani District near Tzaneen. Ten selected soybean cultivars were field evaluated without inoculation using a randomized complete block design with three replications. Stability was assessed via joint regression analysis and superiority analysis.

RESULTS AND DISCUSSION

Significant differences were found for genotypes, environments, and genotype by environment interactions. Stability analysis after Eberhart and Russell's (1966) model suggested that the tested genotypes showed marked differences to environmental changes. The cultivar superiority measure for seed yield indicated that CLARK was the most stable genotype with an average seed yield of 5235 kg ha⁻¹, followed by ACCESSION 17 and BARC 17 with average seed yields of 4839 kg ha⁻¹ and 4582 kg ha⁻¹, respectively. In terms of number of nodules MAGOYE was identified to be stable with regards to number of nodules per plant followed by BARC 17.

CONCLUSIONS

Most of the genotypes performed better at Syferkuil than Gabaza. BARC 17 was selected as the most stable genotype for seed yield, nodule formation and other agronomical characters.

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Thanks to National Research Foundation for provision of funding

Keywords: *Glycine max*, stability analysis, soybean

PRELIMINARY INVESTIGATION INTO THE CAUSES AND CONTROL OF ORCHARD COLD/FREEZE DAMAGE AND GREY SPECKLING IN SOUTH AFRICAN AVOCADO

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INTRODUCTION

This poster reports on research surveys aimed at reducing orchard freeze damage and grey speckle disorders in South African avocado. During 2007, severe cold temperatures were recorded in various avocado growing regions. These caused considerable losses to most cultivars due to freeze damage. It further highlighted a second problem, grey speckling, which annually occurs in 'Fuerte' fruit from orchards located in cold areas. The classical symptom of freeze injury is a brown streak that runs along the longitudinal axis of the fruit. In the case of grey speckling, the symptom is less conspicuous in immature fruit and is only observable in cross section. However, later in the season the symptom becomes more prominent in longitudinally section. In severe cases the speckles may coalesce to form a smudged pattern. A survey was subsequently launched to determine the most important contributing factors and to develop mitigation strategies for both problems.

MATERIALS AND METHODS

In order to establish if a relationship exists between the prevalence of the two disorders and the maturity/mineral status of the avocados, moisture content and mineral analysis was performed on affected and non affected 'Fuerte' and Hass fruit from cold damaged orchards. To establish if a relationship exists between fruit size and grey speckling, the incidence of the disorder was scored in samples of 'Fuerte' fruit from two packinghouses.

RESULTS AND DISCUSSION

The study confirmed that grey speckling is an orchard temperature related disorder. The results further indicated that both freeze damaged and grey speckled fruit have lower moisture contents than healthy fruit. A relationship was also established between fruit size and grey speckling. At both packinghouses, grey speckling was more prevalent in bigger avocados than in smaller fruit. Preliminary investigations into the possible role played by fruit mineral content indicated that 'Hass' orchards with a low nitrogen status are most susceptible to orchard cold/freeze damage. Mineral analysis of grey speckled fruit revealed that the calcium content of fruit affected by speckling may be six times lower than that of healthy fruit.

CONCLUSIONS

The study confirmed that grey speckle is an orchard cold/freeze damage related symptom. Relationships between fruit moisture contents, size and nitrogen/calcium contents were also established. It was recommended that, in susceptible orchards, larger 'Fuerte' fruit be harvested first. Preliminary minimum pulp N content norms were also formulated.

ACKNOWLEDGEMENTS

The authors would like to thank the South African Avocado Growers' Association for financial support.

Keywords: Avocado, fruit physiological disorders, grey speckle, grey speckling, orchard cold/freeze damage

CASSAVA FOR FOOD SECURITY: EVALUATION OF IMPROVED VARIETIES FOR SMALLHOLDER FARMERS IN MPUMALANGA

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INTRODUCTION

Cassava (*Manihot esculenta* Cranz) is a minor, but important food crop for the smallholder farmers in the Lowveld region of Mpumalanga province where its swollen roots are consumed by boiling or frying. Average yield obtained by these farmers is very low (<10 t ha⁻¹), which is attributed to lack of improved varieties, poor agronomic practices, African cassava Mosaic Virus (ACMV) and mealy bugs (Mathews, 1999).

MATERIALS AND METHODS

Variety evaluation was commenced in 2002-03 season with 29 genotypes obtained through the Southern African Regional Root Crops Research Network (SARRNET). Outstanding genotypes (14) from these were evaluated for two subsequent seasons at Nelspruit (25° 26' 25" S, 30° 58' 57" E and 676m above sea level) along with two local accessions. Data on growth and yield parameters were collected at 6, 12, 18 & 24 months after planting (MAP). Cooking quality was assessed in terms of taste and time taken to cook on a 5-point scale (1=very good and 5=very poor). Analysis of variance was performed using MSTAT-C (1983).

RESULTS AND DISCUSSION

All the introduced genotypes showed good degree of resistance to ACMV. Significant differences ($p=0.05$) in plant height, stem length, top weight, number of stem, roots plant⁻¹ and root yield were observed. The highest fresh root yields were recorded in the genotypes 081/00247 (74 t ha⁻¹) and I-89/00715 (70 t ha⁻¹) with cooking quality scores of 4 and 2 respectively. However, farmers preferred the susceptible and low yielding (32 t ha⁻¹) local accession **Lal** for its excellent quality (score 1) and significantly ($p=0.05$) longer stems.

CONCLUSIONS

Planting materials of **Lal** are being distributed as demanded by local farmers. Introduction of high yielding genotypes with lower cyanogenic glucoside content, and further in-depth studies on the optimum time of planting and harvesting (MAP) are suggested as the way forward. Cassava production by smallholder farmers could be boosted if efforts are made in value adding of the high yielding bitter types in preparing secondary food products such as *gari* to meet its increasing demand locally.

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Keywords: smallholder farmers, SARRNET, Mpumalanga, Gari, Cyanogens

DRY BEAN VARIETY EVALUATION IN THE LIMPOPO PROVINCE

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INTRODUCTION

Dry bean is an important protein crop in South Africa grown mostly for human consumption. Of all the popular field crops grown in SA, dry beans have always commanded good producer prices relative to other crops. Beans in both their unprocessed and canned forms, constitute a vital, palatable and nourishing part of the diet of many people, particularly for those in the low income groups (DPO, 2006). Dry beans have the advantage over other legumes in that the seed can be stored for long periods of time without any serious loss of nutritional value. Limpopo is producing 8% of the total production of dry beans (DPO, 2006) in SA. Small scale farmers in the Limpopo Province have been producing dry beans since 2005. The objective of the study is to evaluate dry beans varieties for better performance in the Limpopo Province.

MATERIALS AND METHODS

The trial was planted at two locations Nguvamuni project (30km outside Tzaneen) and Mamabolo village (31 km outside Polokwane). It is a randomized complete block design with five bean varieties (Jenny, Kranskop (control), Mkunzi, OPS-RS4 and Majuba) with four replications. It consisted of four 5m rows and between rows spacing of 90 cm. The data was collected from two middle rows and the other two were border rows.

RESULTS AND DISCUSSION

Results showed that at Nguvamuni the grain yield of Kranskop was significantly different ($P < 0.05$) from the other four varieties with the mean of 710 kg ha⁻¹. There was no significance difference between the other four varieties. At Mamabolo the grain yield of Kranskop (656 kg ha⁻¹) and OPS-RS4 (734 kg ha⁻¹) were significantly different ($P < 0.05$) from that of Jenny, Majuba and Mkuzi. The interaction effect between variety and location was non-significant.

CONCLUSION

Results revealed that Kranskop was the best at Nguvamuni. At Mamabolo OPS-RS4 and Kranskop were the best. Follow up trials are planned to further research on the topic.

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The farmers of the two localities are acknowledged for allowing us to use their land.

Keywords: drybeans, germination

EVALUATION OF DRY WHITE BEAN (*Phaseolus vulgaris* L) CULTIVARS FOR CANNING QUALITY

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INTRODUCTION

Dry beans are inexpensive sources of protein, carbohydrates and fibre. They are also good sources of minerals (Ca, Cu, Fe, Mg, P, K and Zn). South Africans eat about 2.5kg of beans per person per year of which canned bean products account for \pm 20% thereof. About 80% of small white beans are used by the canning industry in South Africa (De Lange & Labuschagne, 2000). The purpose of the study was to evaluate the canning quality of dry bean cultivars to identify and select suitable cultivars with acceptable canning traits. The quality of canned dry beans grown in different regions was evaluated based on appearance, texture, seed size and water absorption properties.

MATERIALS AND METHODS

Six cultivars, namely Teebus (reference cultivar for choice grade), Teebus RR1, Teebus RCR2, OPS- KW1, PAN 185 and PAN 123 were used. The cultivars were grown in the North West, Mpumalanga and Free State regions of South Africa during the 2008/2009 growing season. The canning procedure of Van Loggerenberg, (2004) was used. Briefly, a 100g sample (2 per cultivar) were soaked in deionised water for 30 min, at 30°C and blanched for 30 min at 88°C. The soaked beans were weighed to determine the water uptake (WU), where-after it was canned in tomato sauce and sterilised at 121°C for 30 min. After 14 days the cans were opened and the beans washed with tap water to remove the tomato sauce, and then drained. Visual appearance was evaluated subjectively on a scale of 1 (most unacceptable) to 10. The percentage washed drained weight and percentage splits were calculated for each can. The texture of the beans was determined by means of a FTC Texture Press.

RESULTS AND DISCUSSION

Of the six cultivars, only OPS-KW1 and PAN 185 had optimal WU (>80%) across localities. WU of at least 80% has been suggested as suitable for canning (Hosfield et al., 1984), hence used in the screening process. These two cultivars (small kernel cultivars) also took up water faster than the other cultivars. The percentage washed drained weight was expected to be about 60% (Balasubramanian et al., 2000) and all cultivars had acceptable drained weights. There were differences in textural properties of the cultivars with Teebus, Teebus RR1, Teebus RCR2 and PAN 123 showing higher texture values. The cultivars with low WU had less splitting, and more acceptable visual appearance despite the hard texture which could affect sensory properties. Comparing growing regions, generally canned beans of cultivars grown in the North West had high levels of splits and lower textural values indicating that they were softer than those of Mpumalanga and Free State.

CONCLUSIONS

There were differences between cultivars for all canning parameters across localities. Small kernel size beans take up water faster than larger beans and are prone to splitting affecting their overall appearance. Therefore it may be necessary to optimise soaking time for each cultivar.

ACKNOWLEDGEMENTS

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Keywords: Dry Beans, Canning Quality, *Phaseolus vulgaris* L

PLANT GROWTH AND PROLINE ACCUMULATION IN WILD MUSTARD GERMLASM SUBJECTED TO WATER STRESS

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INTRODUCTION

Wild mustard (*Brassica spp.*) is an indigenous plant that is consumed as a wild leafy vegetable in many parts of South Africa. Limitations in its agronomic use are likely due to lack of scientific studies about its management. Recent work at the University of KwaZulu-Natal, Tshwane University of Technology and the Agricultural Research Council prompted by the efforts of the Water Research Commission in South Africa suggests that some wild leafy vegetables have a potential horticultural role. The potential role of wild leafy vegetables in horticulture is likely due to their nutritional content and drought tolerance. Proline accumulation has been shown as a widespread response by plants to water stress. The objective of this study was to determine the effects of water stress on wild mustard plant growth and proline accumulation under non-irrigated and irrigated conditions.

MATERIALS AND METHODS

Seeds of three wild mustard landraces, Isaha, Masihlalisane [*Brassica juncea* (L.) Czern & Coss] and Kwayimba [*Brassica nigra* (L.)W.D.J. Koch], were produced and used for a field experiment at Ukulinga Research Farm, University of KwaZulu-Natal, Pietermaritzburg. To create more variation in genotypes, seeds of each cultivar were separated into black and brown types. A completely randomized design with three replications was used and plots were either irrigated or not. The different irrigation treatments were only started 14 days after planting (DAP) with one half not receiving any further irrigation while the others received 25 mm week⁻¹. Emergence was measured up to 21 DAP. Determination of plant height and leaf number was done every 7 days. The experiment was terminated at the flowering stage and leaf samples taken for proline determination.

RESULTS

There were significant differences ($P < 0.05$) in dry mass, fresh mass, plant height and leaf area in response to watering, but there was no effect of water stress on leaf number. All three cultivars were able to tolerate water stress but Isaha and Masihlalisane were significantly ($P < 0.05$) better than Kwayimba in their response to water stress. The interaction between cultivar and irrigation was only significant ($P < 0.05$) in terms of leaf area. There was a significant ($P < 0.05$) difference between landraces with respect to proline accumulation. Proline accumulation was negatively correlated with the ability to withstand water stress. Isaha displayed the highest proline content, followed by Masihlalisane and last was Kwayimba. Brown seeds accumulated more proline than plants from black seeds, an indication of water stress tolerance by plants from black seeds.

CONCLUSION

This study showed that in wild mustard water stress tolerance is physiologically negatively correlated with proline accumulation. This study could be used as a first step towards genetic selection for water stress tolerance in an attempt to identify, select and develop wild mustard as a horticultural crop.

Keywords: Water Stress, Wild Mustard, Proline

MYCORRHIZAL ROOT COLONISATION AND MICROBIAL ENZYME ACTIVITY AS AFFECTED BY DIFFERENT SOIL CULTIVATION PRACTICES IN AN APPLE ORCHARD SOIL

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INTRODUCTION

The rhizosphere represents the zone which immediately surrounds the roots of plants and forms the interface between the roots and the bulk soil. This zone, which is rich in root exudates, is home to an extraordinarily diverse assemblage of fungi, bacteria and other organisms, plus the chemical products of their metabolic processes. Past research suggests that the activity and balance of the soil microbial community in this zone is dynamic, and may change quickly in response to practices such as mulching, the growth of cover crops, cultivation and irrigation. One way of determining whether such changes in soil conditions had taken place, as a result of these practices, is by measuring the changes in the activity of microbial enzymes. Three enzymes that have been reported to be sensitive to such changes are β -glucosidase, urease and phosphatase. The rhizosphere is also home to arbuscular mycorrhizal (AM) fungi, which naturally colonise fruit tree roots and render a growth and nutritional benefit to the host. Root colonization is triggered by the constant supply of root exudates. Neither enzyme activity nor mycorrhizal activity has been investigated thoroughly under such soil surface management practices in apple orchards. The objective of this study was to assess the effect of such practices on the β -glucosidase, urease and phosphatase activity, as well as the root activity of AM fungi in an apple orchard soil.

MATERIALS AND METHODS

The investigation was conducted in the form of a factorial field trial in an existing 0.7 ha orchard at Elgin Experiment Farm in Grabouw involving 8 year old Cripps Pink/M7 (Pink Lady) apple trees. Treatments consisted of two management practices applied to the tree row, namely chemical weed control or mulching. These were applied in combination with different treatments applied in the work row. The latter treatments included (a) full surface mulching or (b) cover crops during winter, killed chemically or slashed during summer or (c) weed growth during winter, killed chemically or slashed during summer. Each treatment consisted of four replicates applied to randomly isolated plots. Soil samples were taken at the tree row at a 30 cm depth in spring 2008. Colorimetric assays were performed to measure the β -glucosidase, urease and phosphatase activity. The root colonisation level was measured under a compound microscope and metabolic profiles of the microbial community were measured using microtiter plates.

RESULTS AND DISCUSSION

Phosphatase activity did not differ significantly between the treatment combinations. However, β -glucosidase and urease activities associated with the two chemical control treatments, were significantly lower than those associated with the mulch treatments. Metabolic profiles of the microbial community appear to support this. Likewise, AM root colonization levels associated with the two chemical controls were significantly lower (41% - 59%) as oppose to the other treatments (65% - 71%). These could be as a consequence of the negative effects of weed-killers on the microbial community and development of AM fungi.

CONCLUSIONS

Chemical weed control clearly had negative impacts on AM root colonisation levels and microbial enzyme activity compared with mulching.

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

AN ASSESSMENT OF ARBUSCULAR MYCORRHIZAL (AM) FUNGI IN APPLE ORCHARDS OF THE WESTERN CAPE: A PRELIMINARY INVESTIGATION

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INTRODUCTION

Arbuscular mycorrhizal (AM) fungi are a group of beneficial fungi that forms an integral part of the root systems of most vascular plant species through natural symbiosis. These fungi have long been believed to render a nutritional benefit and promoting healthy growth and development of agricultural crops, all of which may help prevent current problems related to nutrition and growth of many of our local agricultural crops, in particular that of stunting of apple trees. However, very little is currently known about the natural occurrence of the local mycorrhizal fungal species associated with apple orchard soils. The present study was aimed at collecting preliminary data on the nature and scope of these fungi (spore counts and glomalin content of the soils) in various apple orchards soils of the Western Cape.

MATERIALS AND METHODS

The study was in the form of a survey. A total of 30 orchards (26 conventional and four organic orchards), covering various areas in the Western Cape, were monitored. The experiment also consisted of four scion/rootstock combinations (Pink Lady/M7, Pink Lady/M793, Golden Delicious/M7 and Golden Delicious/M793), of eight to 12 years old, grown in either a sandy or a heavy soil. The production areas include Ceres Koue Bokkeveld, Ceres Warm Bokkeveld, Villiersdorp, Grabouw, Vyeboom, Joubertina, Piketberg, Somerset West and the Langkloof area. Standard soil chemical analyses were carried out. Soil cultivation practices of all the orchards were managed in similar fashion. Samples were collected at a 30cm depth from February to April 2009. Spore enumeration was carried out under a stereo microscope and only viable spores were counted. Glomalin was measured using the Bradford assay method.

RESULTS AND DISCUSSION

Soil nutrient status varied much among different orchards. Effects thereof on spore counts and glomalin contents were inconsistent, but it is clear that high soil phosphorus had little effect on mycorrhizal status. There were no significant differences in spore counts between heavy and sandy soil types; neither were there significant differences between conventional and organic farms, although there were strong tendencies of this nature. Ceres, Piketberg and Villiersdorp areas tend to contain more spores as oppose to Grabouw, Vyeboom, Joubertina and Somerset West. Pink Lady/M7 orchards hosted significantly more spores than Pink Lady/M793, GoldenDelicious/M793 and GoldenDelicious/M7. When rootstock was considered alone, M7 attracted the most spores compared to M793 and significantly so in conventional heavy soils. With regard to glomalin, there seems to be no difference when scion/rootstock combinations were compared, independent of soil type and farm type. More glomalin were, however, associated with the M7 rootstock than M793, in particularly in conventional heavy soils. The Witzenbergvalley in the Ceres Warm bokkeveld had the highest glomalin content and the Vyeboom area the lowest. Data collected in spring 2009 will shed more light on these findings.

CONCLUSIONS

The rootstock M7 may attract more mycorrhizal activity than M793, especially if planted in conventional heavy soils. Data on root colonization levels and species richness should shed further light on these findings.

Keywords: AM, orchard, conventional, glomalin, spore, survey

POSTHARVEST EVALUATION OF NEW MANDARIN CULTIVARS

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INTRODUCTION

'Valley Gold' and 'African Sunset' are promising new mandarin selections from the ARC's breeding programme. In order to be marketable, the fruit must be able to withstand the rigors of postharvest handling and reach the consumer in good condition. Thus, it is crucial that the postharvest characteristics of these new cultivars be evaluated, to ensure that they meet the aforementioned criteria and are of commercial appeal to the consumer. To achieve this, the fruit quality and postharvest performance of these new cultivars was tested against a commercial cultivar, 'Afoura'.

MATERIAL AND METHODS

The trial was conducted in the post-harvest laboratory of the ARC-ITSC experimental farm in Nelspruit. New cultivars 'Valley Gold' and 'African Sunset' were evaluated and compared to a commercial cultivar, 'Afoura'. The following treatments were performed on each cultivar:

1. 5 days preconditioning @ 2°C followed by 35 days storage at 5°C
2. 5 days preconditioning @ 2°C followed by 16 days cold sterilisation @ 2°C and 19 days storage @ 5°C
3. 5 days preconditioning @ 10-15°C followed by 35 days storage at 5°C
4. 5 days preconditioning @ 10-15°C followed by 16 days cold sterilisation @ 2°C and 19 days storage @ 5°C

Samples were kept in cold storage for a period of 35 days. Evaluations included firmness, soluble solids content (SSC), titratable acidity (TA), chilling injury (CI) and pathological disorders. For consumer acceptance (i.e. peelability, firmness, appearance and taste), the fruit was evaluated by 18 — 20 untrained panelists using a 9-point Hedonic scale (9 = like extremely, 5 = neither like nor dislike, 1 = dislike extremely).

RESULTS AND DISCUSSIONS

The results showed that the different cold treatments and storage temperatures did not affect the sugar content of mandarins. All 'African Sunset' and 'Valley Gold' fruit preconditioned at 2°C had a significantly higher organic acid content than those preconditioned at 10°C. Preconditioning at low temperatures (2°C) followed by storage at low temperatures resulted in better organic acid retention with no CI observed. The effects of preconditioning treatments on the TA and Firmness values were only slight, although significant. 'African Sunset' and 'Valley Gold' flavour and texture were positively affected, as reflected by the results of the sensory evaluation. Based on the sensory evaluation results, it was deduced that consumers preferred the new mandarin cultivars, 'African Sunset' and 'Valley Gold' to 'Afoura'.

CONCLUSIONS

Results indicated that the new cultivars 'African Sunset' and 'Valley Gold' have good storage qualities and may perform better than 'Afoura' as commercial cultivars, when treated and stored under commercial conditions.

Keywords: Mandarin, Valley Gold, African sunset, cold storage, postharvest

SOIL CLASSIFICATION FIELD PRACTICAL: PARADIGMS, PERSPECTIVES AND SOCIAL LEARNING THEORIES

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RATIONALE

This study was conducted on the basis that, research in the cognitive sciences indicated that knowledge gained through activity is more useful than knowledge gained through memorization (Moran, 1997).

INTRODUCTION AND OBJECTIVES

The pragmatism of the soil science field practical as part of visual literacy can potentially facilitate learning by students with limited knowledge of relations between factors and processes of soil formation (McBean, 1988). This paper hypothesizes the effectiveness of soil science field practical as part of visual literacy that has potential to enhance students' understanding of factors and processes of soil formation. We present this hypothesis because that Warner (1992) reported that an effective training program in many fields of science puts emphasis on observation (seeing), understanding (thinking), and action (doing). The objective of the study was to assess the efficiency of soil science field practical in enhancing, providing opportunities, and challenges for students to understand soil formation.

METHODOLOGY/APPROACH

The study was conducted over four months at University of Limpopo, Turfloop Campus. Students were taken out on weekly field visits to identify soils formed under different climatic conditions, parent materials, and topography. Students submitted reports for every soil profile classified using the South African Binomial Soil Classification System. At the end of the semester students wrote a field practical examination, incorporating class theory and field observations about soil profiles, factors, and processes of soil formation.

OUTPUT

The majority of soil science students at the University of Limpopo are from community based societies and follow an organismic approach in their learning, meaning that teamwork by people sharing similar goals are customary. This study showed that students have identified with the value of visual learning from field practical and ideally integrated visual education with in class theory. These observations were predominately true after students were given a field practical examination and obtained marks as high as 94%. We believe that soil science field practicals can facilitate and reinforce students' autonomous motivation towards learning the soil sciences.

Keywords: paradigms and perspectives, social learning theory, soil classification, field practical, visual learning

THE EFFECT OF 2,4-D ON FRUIT SPLITTING AND FRUIT QUALITY OF 'MARISOL' CLEMENTINE MANDARIN

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INTRODUCTION

Fruit splitting is a physiological disorder in citrus that develops as a result of cracking of the rind, usually from the styler end of the fruit. It occurs in most citrus types but is more widespread amongst the thin peeled mandarin cultivars and, to some extent, in navel oranges. Under South African conditions 30% split fruit is common in mandarins, sometimes reaching up to 45%. Affected fruit usually drops during the last two to three months before fruit maturity, resulting in yield loss.

MATERIAL AND METHODS

The study was conducted on 'Marisol' Clementine mandarin trees grafted on Troyer citrange rootstock. Treatments included an untreated control, 2,4-D applied at 15 mg·L⁻¹ or 25 mg·L⁻¹ at full bloom (FB) and 15 mg·L⁻¹ or 25 mg·L⁻¹ at 100% petal drop (PD). Split fruit were removed from the trees and counted every two weeks from mid-March until harvest in early May. At harvest a sample of 12 fruit per tree was collected to determine internal and external fruit quality.

RESULTS AND DISCUSSION

The application of 2,4-D significantly reduced the total number of split fruit collected in all treatments except 15 mg·L⁻¹ at FB. Internal fruit quality was not affected by 2,4-D application. Externally, the fruit colour and the fruit shape were not affected. However, treated fruit had coarser rinds due to enlarged oil glands and the styles persisted on the treated fruit until fruit maturity.

CONCLUSION

Although 2,4-D reduced fruit splitting in this study, it cannot be recommended at the concentrations used. Future work should include the use of lower concentrations of 2,4-D to attempt to reduce the coarse rinds with enlarged oil glands.

Keywords: Citrus reticulata, external quality, fruit splitting, internal quality, rind coarseness

EVALUATING THE EFFECT OF MOISTURE STRESS ON TOMATO PLANTS USING REMOTE SENSING TECHNIQUES

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INTRODUCTION

Crop water stress has a major effect on crop production, yield and crop health. It is because of this effect that rapid, low-cost techniques are required to monitor and evaluate moisture stress. While many field-based techniques have proved suitable, they have sometimes proved problematic in application over large areas of land (Dreyer, 1990). For this reason remote sensing technology in the form of Normalized Differential Vegetation Index (NDVI) data by Green Seeker sensor and a thermal infrared thermometer, as well as agronomic traits were used to evaluate moisture stress on tomato plants.

MATERIALS AND METHODS

Non-stressed plants received 500ml of water daily, while stressed plants received 500ml of water every 3 days. Canopy temperature was measured using an infrared thermometer, NDVI values were recorded using a green seeker hand-held optical sensor unit and stomatal conductance was determined using a leaf porometer. The data was collected in the morning from 9:00 to 11:00 and in the afternoon from 13:00 to 15:00. Other agronomic traits, including days taken for 50% flowering, plant height, number of fruits per plant and fruit yield per plant were recorded.

RESULTS AND DISCUSSION

Leaf temperature in stressed plants was high compared with non-stressed plants under both greenhouse and field conditions, which confirms the findings of Jackson (1982), whereas NDVI and stomatal conductance values were low. Number of fruits per stressed plant was low, with 4 fruits per plant under field conditions and 5 fruits per plant under greenhouse conditions, compared with 9 fruits per plant under field conditions and 13 fruits per plant under greenhouse conditions for non-stressed plants.

CONCLUSIONS

The experiment showed that it is possible to evaluate the effect of moisture stress on tomato plants by the use of canopy temperature, NDVI, stomatal conductance and agronomic traits. Infrared thermometer measurements, a remote sensing technique, clearly detected canopy temperature increases that occurred as a result of a reduction in transpiration as plants became stressed

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Keywords: NDVI, Stomatal conductance, canopy temperature, remote sensing, greenhouse

INVESTIGATING THE ROLE OF MANGANESE IN GLYPHOSATE SUSCEPTIBILITY OF TWO RYEGRASS (*Lolium* spp.) POPULATIONS BY MEANS OF A PETRI DISH METHOD

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INTRODUCTION

Manganese (Mn) is the most prevalent trace metal on the earth's crust. It was shown that glyphosate efficacy is antagonized by manganese in spray solutions. It was therefore decided to investigate the possibility that additional manganese in the growing environment can antagonize glyphosate action in plants. The petri dish method (involving glyphosate and distilled water) may be used to detect glyphosate resistance in ryegrass (*Lolium* spp.). In order to detect the efficacy of glyphosate optimally, it was postulated that the replacement of distilled water by a balanced nutrient solution as germination solution in the petri dish should be investigated. The aim of the study was to determine the impact of 1) adding nutrient solution and 2) additional manganese on glyphosate efficacy in two ryegrass populations.

MATERIALS AND METHODS

Previously determined resistant (Pop D) and susceptible (Pop E) ryegrass populations were germinated in 90 mm diameter petri dishes containing two sheets of filter paper. Twenty ryegrass seeds were added to each petri dish. Each of the petri dishes contained 6 ml aliquots of germination solution. The germination solution consisted of different treatment combinations with factors as follows: glyphosate (0, 10, 20, 40, 80 or 160 mg a.e. L⁻¹), manganese (0, 10 or 50 mM) and nutrients (distilled water and balanced nutrient solution) arranged in a 6X3X2 factorial experimental design with three replications. The petri dishes were transferred to a growth chamber at 22°C constant temperature and a 12h photoperiod for seven days. After seven days the number of germinated seeds and shoot length of the seedlings were recorded. The two ryegrass populations were tested separately.

RESULTS AND DISCUSSION

Nutrient level of the germination solution had no significant ($P < 0.05$) effect on the parameters investigated. Significant interaction between manganese level and glyphosate concentration was observed in Pop D i.e. at Mn 10 and 50 mM a decreased effect of glyphosate on germination and root length compared to Mn 0 mM at 160 mg a.e. glyphosate L⁻¹ was observed. In Pop E there was no interaction between manganese and glyphosate i.e. the inhibition of germination and growth by glyphosate was independent of the manganese concentration.

CONCLUSIONS

The addition of nutrients to the germination solution did not influence efficacy of glyphosate in any of the two ryegrass populations. Glyphosate efficacy was however reduced at increased levels of manganese in a glyphosate resistant ryegrass population.

ACKNOWLEDGEMENTS

The NRF and the University of Stellenbosch are gratefully acknowledged for financial support.

Keywords: Glyphosate, *Lolium*, Manganese

INTERACTION OF HERBICIDE CHOICE AND RATE BASED ON WEED SPECIES AND DENSITY

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INTRODUCTION

Weed distribution is not uniform across a field as weeds tend to be clumped in patches of high densities along with areas of low to no weeds present (Wiles et al. 1992). Percent control, as a standard method of assessing herbicide efficacy, does not take into consideration the interaction between weed density and mortality.

MATERIALS AND METHODS

Experiments were conducted in 2006 and 2007 to evaluate how grass and broadleaf weed density interacts with herbicide choice and rate. Soybean was planted at 300,000 seed ha⁻¹ in 0.76-m rows. Within the herbicide main plot, either large crabgrass (*Digitaria sanguinalis* L.) or shattercane (*Sorghum bicolor* L. Moench); or Palmer amaranth (*Amaranthus palmeri*) or velvetleaf (*Abutilon theophrasti*) seed were sown in separate subplots (0.36 m²) at nine targeted densities (5, 10, 20, 40, 80, 160, 320, 640 and 1200). Clethodim or glyphosate was applied to grass species plots, while lactofen or glyphosate was applied to the broadleaf species plots at 1.0, 0.5, 0.25, 0.125, 0.0625, and 0.03125X of labeled rates. Four weeks after herbicide application, plants that were still alive were counted and severed at ground level, dried in an oven and biomass measured. The reduction in biomass due to postemergence herbicide applications were described by dose-response curves using non-linear regression analysis.

RESULTS AND DISCUSSION

As large crabgrass density increased, percent mortality decreased with clethodim while both grass species were not affected by density when treated with glyphosate. Shattercane was more susceptible than large crabgrass to both herbicides. The choice of herbicide is critical; at higher densities, systemic herbicide such as glyphosate should be used. With lactofen, low velvetleaf densities had high survivorship; while low Palmer amaranth densities had low survivorship. Before weed control measures are taken, weed species, weed densities, herbicide choice and herbicide rate should be taken into consideration. The use of lower herbicide rates should be done with caution as weed species respond differently. For large crabgrass and velvetleaf, the use of reduced herbicide rates may need to be integrated with other weed management practices.

CONCLUSIONS

Weed management outcomes are dependent on weed species, weed density, herbicide choice, and herbicide rate.

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Keywords: Weed density, herbicide rate, herbicide choice

THE EFFECT OF NITROGEN FERTILIZER, PLANTING DENSITY, AND VARIETY IN MAIZE YIELD AT LWAMONDO, LIMPOPO PROVINCE

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INTRODUCTION

Maize (*Zea mays* L.) is the main crop grown by smallholder farmers in Limpopo Province. However, grain yields are often very low because of poor soil fertility (compounded by extremely low fertilizer inputs into the systems), low and erratic rainfall, and poor agronomic practices. For example, in a survey carried out in Vhembe district, Limpopo Province in 2004, inadequate rainfall (49%), weed infestation (23%) and low soil fertility (20%) were reported as the most important factors limiting grain yields of maize (Ogola & Ngobeni, 2005). Therefore appropriate application of nitrogen (N) fertilizers, together with the use of an improved maize variety sown at a suitable plant density may lead to improved maize productivity in this region.

OBJECTIVES

To assess the effect of N fertilizers, planting density and genotype on maize grain yield in Lwamondo.

MATERIALS AND METHODS

This study was sown on the 23 December 2007 at Lwamondo communal fields situated 20 km south west of Thohoyandou (Alt: 30°24' and lat: 23°01') on a deep Hutton soil. The area receives an annual rainfall of \pm 500 mm that fall predominantly in the summer. The average maximum and minimum temperatures are 33°C and 21°C respectively (ARC-ISCW, 2008). The treatments were a factorial combination of two maize varieties (Tshikundanwedzhi - local variety and SNK 2147 - improved variety), three plant densities (22 000, 44 000 and 66 000 plants ha⁻¹), and three fertilizer N rates (0, 50 and 100kg N ha⁻¹) arranged in a randomized complete block and replicated three times. N in the form of Urea (46% N) was applied in two equal splits; at the 2 and 8-leaf stages. Maize growth was determined by measuring plant height and stand count at tasseling stage, and grain yield was determined at harvest maturity.

RESULTS AND DISCUSSION

The tallest plants and greatest stand count was obtained in plots that had a combination of Tshikundanwedzhi, 100 kg N ha⁻¹ and 22 000 plants ha⁻¹. In contrast, the lowest stand count was recorded in plots of Tshikundanwedzhi, 0 kg N ha⁻¹, and 66 000 plants ha⁻¹. Maize grain yield ranged from 333.3 kg ha⁻¹ (Tshikundanwedzhi, 0 kg N ha⁻¹, and 66 000 plants ha⁻¹) to 2444.4 kg ha⁻¹ (SNK 2147, 100kg N ha⁻¹, and 66 000 plants ha⁻¹).

CONCLUSIONS

Clearly genotype selection and manipulation of planting density and fertilizer N application may help in improving maize productivity in one region of Limpopo province. However, further trials are recommended before definite conclusions on the right combination of genotype, fertilizer N rates and planting density for this region can be drawn.

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Keywords: Nitrogen fertilizer, planting density, maize variety, maize yield

ASSESSMENT OF PIGEON PEA (*Cajanus cajan* L.) –BASED INTERCROPPING SYSTEM WITH MAIZE

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INTRODUCTION

Pigeon pea (*Cajanus cajan*) is one of the newly introduced crops in South Africa. It had been known in some African countries like Malawi, Tanzania and Mozambique as a cash crop for a number of years. Pigeon peas had been grown successfully under dryland conditions as a mono crop with low production inputs, Pigeon peas is a legume crop, its roots nodules enrich the soil by adding about 40kg of nitrogen per hectare back to the soil. After harvesting the pods for human consumption, it can be used as a fodder for feeding animals. The pods contain about 19-28% protein.

MATERIALS AND METHODS

A dryland pigeon pea based intercrop trial was established during 2008/2009 at the Agricultural Research Council Experimental farm Rustenburg North-West Province to assess the compatibility and intercropping advantages of non inoculated pigeon pea and maize. Trial design was randomized complete block design (RCBD) in factorial consisting of two pigeon pea cultivar (ICEAP 00360 and ICPL 87091), two open pollinated maize Variety (Zim 423 and Zim 523), and three intercropping intervals (Simultaneously planted intercrop; maize planted 20 DAP and 30 DAP of pigeon pea) and included are two monocropping of Maize and pigeon pea. Treatments were replicated 4 times. Parameters measured Maize Grain, pigeon pea grain yield, pod yield and land equivalent ratio (LER) was computed. Data collected was analyzed using Genstat 3.5 while means were separated using least significant different (LSD) at $P \leq 0.05$.

RESULTS AND DISCUSSION

Grain yield of maize cultivars was significantly different between intercropping interval and maize cultivars. Maize grain yields were high when maize was planted simultaneously with pigeon peas, this accounted for 6719 kg ha⁻¹ grain yield, Maize grain yields were lower when planted 20 days after pigeon peas but better than when planted 30 days after pigeon peas. ZIM 523 had good grain yields across intercropping intervals dates as compared to ZIM 423. Pod yield (Pods before thrashing) also varied between intercropping interval and pigeon pea cultivars, thus pod yield was high in the 20DAP intercropping, followed by the 30 DAP intercropping. Pod yields were lower at simultaneously planted intercrops compared to when intercropped at 20DAP and 30DAP. Cultivar ICEAP 00360 yielded best in intercropping compared to ICPL 87091. Pigeon grain yield differed significantly between intercropping interval and cultivars. Higher yields were observed when pigeon pea was intercropped at 20 DAP. Land equivalent ratio revealed intercrop advantage with a ratios ranging from up to 1.9 except for when pigeon pea was intercropped at 30DAP with cultivar ICEAP 00360 which was lower than 1.

CONCLUSIONS:

Pigeon peas seem to be compatible with all maize cultivars intercropping, especially when maize is brought in the system 20 DAP of pigeon peas. It was observed that simultaneous intercropping of these crops favours maize yield while it suppress pigeon pea yield. Intercropping at 30 DAP reduce yield of both crops. Generally the ratios have shown intercrop advantage.

Keywords: Pigeon peas, maize, intercropping intervals

THE INFLUENCE OF VARIOUS ADJUVANTS ON BIPYRIDYLIUM HERBICIDE EFFICACY

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INTRODUCTION

Bipyridylum herbicides are primarily used for the post-emergence control of terrestrial plants. Bipyridyliums are used to control annual grass and broadleaved weeds and to top-kill and suppress the growth of perennials. Herbicides from this mode of action group are recommended for use with non-ionic surfactants in aqueous spray mixtures. This enhances herbicidal effectiveness. The problem is that there are over sixty adjuvants registered in South Africa for use with various herbicides. Although adjuvants do not have any herbicidal effects of their own, they play an important role to increase herbicide efficacy. There is a perceived misconception in that all adjuvants are similar and that one adjuvant may be substituted for another. This may be true if the rate of the herbicide is high enough to give total weed control but not when the herbicide is applied at low economical rates under adverse climatic conditions. This study was conducted to determine if different adjuvants have different effects on bipyridylum efficacy and to determine which group of adjuvants generally works best with bipyridylum herbicides.

MATERIAL AND METHODS

Multiple greenhouse trials were conducted at ARC-SGI, Bethlehem. Three different representatives of the bipyridylum group were used (Gramoxone[®], Skoffel[®] and Paraquat[®]). Twenty different adjuvants, representative of ten different adjuvant classes, were applied to cultivated oats, cv. Potberg. A treatment without any adjuvant was used as control. A randomized complete block design was used for all experiments. Distilled water was used to eliminate the effect of poor water quality. Some adjuvants that were applied are not recommended for use with bipyridyliums and were included in the trials to determine their effect on bipyridylum efficacy. The experiments were evaluated after fourteen days by means of weighing fresh shoot mass and data was analyzed using Genstats 11th ed.

RESULTS AND DISCUSSION

By adding any type of adjuvant the percentage control obtained were increased significantly, when compared to the treatment where the bipyridylum only was applied. The two best treatments both included spreaders, although not all spreaders performed equally well. The reason for this is that different spreaders have different chemical characteristics and carry different ionic loads. Stickers did not improve the efficacy of bipyridylum herbicides.

CONCLUSION

It is important to make the right informed choices with regards to adjuvant and bipyridylum combinations, because the right choice will likely determine how successful the weed control will be.

Keywords: adjuvants, bipyridyliums, herbicide efficacy

EVAPORATION ESTIMATION USING A TEMPERATURE VARIANCE METHOD ABOVE SUGARCANE

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INTRODUCTION

Accurate evaporation estimation using simple and inexpensive methods, from sensible heat flux (H), is crucial for water resources management. The temperature variance (TV) method, including adjustment for air temperature skewness (S_k), of Tillman (1972) allows $H = H_{TV(S_k)}$ to be estimated using high frequency air temperature data. Our objective is to compare this method with eddy covariance (EC) estimates of H above sugarcane.

MATERIAL AND METHODS

Field experiments were conducted at the Baynesfield Estate, KwaZulu-Natal for a year. Unshielded and naturally-ventilated fine-wire thermocouples at 0.20, 0.50, 0.75 and 1.50 m above sugarcane were used to measure high frequency air temperature from which $H_{TV(S_k)}$ was estimated. A three-dimensional sonic anemometer was used for obtaining EC sensible heat flux (H_{EC}). The latent energy flux (LE) and hence evaporation was estimated as a residual of the shortened energy balance using net irradiance (R_n), soil heat flux (G_{soil}) and H measurements as: $LE = R_n - G_{soil} - H$ where H corresponds $H_{TV(S_k)}$ or H_{EC} .

RESULTS AND DISCUSSION

The TV method for estimating $H_{TV(S_k)}$ and $LE_{TV(S_k)}$ was evaluated against EC. For all heights, there was very good agreement between daily total $H_{TV(S_k)}$ and H_{EC} with a coefficient of determination that increased with increase in height. Improved $H_{TV(S_k)}$ estimates were observed at 1.50 m since this height was in the inertial sub-layer for which similarity theory is valid. The slope values for the first three-heights were not significantly different. The $H_{TV(S_k)}$ resulted in a good estimate of LE , at 1.50 m. Daily total EC and TV evaporation estimates (mm) were in very good agreement.

CONCLUSIONS

- * Good agreement between $H_{TV(S_k)}$ and H_{EC} with an improved result at 1.50 m. $H_{TV(S_k)}$ resulted in a good estimate of LE , at 1.50 m.
- * The TV method provides a simple and inexpensive method for estimating evaporation if net irradiance and soil heat flux are measured.

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ACKNOWLEDGEMENTS

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Keywords: Sensible heat flux, shortened energy balance, skewness

ARE REST BREAKING AGENTS NECESSARY ON APPLES IN SOUTH AFRICA?

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INTRODUCTION

Environmental concerns limit the use of agricultural chemicals to the essential minimum. The efficiency of rest breaking agents (RBA's), under conditions of insufficient winter chilling, depends on application at the correct stage of dormancy, their chemistry and concentration and the cultivar. The objective of this study was to evaluate the long term effect of three RBA's applied to 'Royal Gala' and 'Granny Smith' apples at various stages of dormancy.

MATERIALS & METHODS

One-year-old shoots of mature 'Royal Gala' (RG) and 'Granny Smith' (GS) apple trees in Elgin, were removed on six occasions between early August and end September 2008 and forced at 25°C to indicate depth of dormancy. Three RBA's (Dormex^R/oil (0.5%/3% v/v); Lift^R (3% v/v); Symphony^R (16%N, ½ & ¼ volume) were applied on these same six occasions and bud-break (BB), fruit set, yield and fruit quality recorded.

RESULTS & DISCUSSION

Rate of emergence from dormancy and %BB of forced and RBA treated RG and GS shoots significantly increased after mid September and after mid August respectively. Dormex^R/oil and Lift^R increased (>35%) the normal bud break (<50%) of RG but application date had no effect. RBA's did not affect RG total yield but early applications increased production of early, larger fruit with improved colour but reduced total production. Untreated GS bud break was low (<20%), and was significantly increased (>40%) by applications from early September of Dormex^R/oil and Lift^R. Neither RBA nor application date influenced GS yield.

CONCLUSIONS

The results suggest that some RBA's, if applied correctly during the optimum stage, promote bud break, and thus longer term yield potential of both RG and GS. However, in the short term, only the early applications to RG increased the first harvest of larger and better coloured fruit.

ACKNOWLEDGEMENTS

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

Keywords: apple, delayed foliation, rest breaking

NITROGEN MINERALIZATION OF SUNHEMP GREEN MANURE AND MAIZE STOVER RESIDUE MIXTURES IN SOIL

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INTRODUCTION

Leguminous green manure crops fix atmospheric nitrogen (N) into the soil and upon decomposition, increase soil N availability through N mineralization. However, decomposition and N release pattern, which is critical for synchronization of N release and uptake by a subsequent crop, depend on the chemical composition of the residue.

OBJECTIVES

To determine the N release pattern and amount in soil after the addition of a mixture of sunhemp green manure and maize stover residues.

MATERIALS AND METHODS

The N mineralization experiment was carried out according to the method described by Kuo and Sainju, (1998), with slight modification. Soil sample was collected, air-dried, ground and passed through a 2-mm sieve. Sunhemp was mixed with maize stover in ratios of 100:0, 75:25, 50:50, 25:75 and 0:100. The residue mixtures were added to the soil at the rate of 10 g kg⁻¹ soil on a dry weight basis. A 300 g sample of the residue-amended soil was placed in a plastic bag (50 µ thickness) and mixed thoroughly and the moisture content brought to about 70% of field capacity with distilled water then incubated in the dark at room temperature. A polyethylene "breather tube" (0.5 cm in diameter) was placed in the opening of each bag, and the top of the bag was wrapped around the tube to allow air to diffuse in and out. A control without residue addition was included. Each residue treatment was replicated twice. After 2, 4, 8 and 16 weeks of incubation, the soil was weighed and distilled water was added to bring the soil moisture to its original level. Ten grams of soil from each bag was removed and extracted with 100 mL of 1N KCl. The NH₄⁺-N and NO₃⁻-N was then analyzed by auto-analyzer (Automated Segment flow analyzer).

RESULTS AND DISCUSSION

After 16 weeks of incubation, the cumulative amount of mineral N in the soil was 66.4, 29.3, 25.5, 23.5 and 19.4 mg kg⁻¹ for the 100:0, 75:25, 50:50, 25:75 and 0:100 of Sunhemp:maize stover mixtures, respectively. This represented 30, 15.4, 15, 16.8 and 17.7% of the initial added N contained in the residues with the proportions of 100:0, 75:25, 50:50, 25:75 and 0:100 sunhemp:maize stover, respectively.

CONCLUSIONS

Addition of non-legume component modified the N release pattern and had an effect on the cumulative amount of N released during the 16-week incubation period. This information may help in synchronizing N release pattern with demand by a subsequent crop, especially in maize-based cropping systems where the stovers are left to decompose in the field.

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ACKNOWLEDGEMENT

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Keywords: Incubation, field capacity, release pattern, synchronize

THE INCIDENCE OF NON-TARGET LEPIDOPTERA SPECIES ON BT AND NON-BT MAIZE IN THE GROBLERSDAL AREA OF SOUTH AFRICA

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INTRODUCTION

The use of Bt maize could directly or indirectly affect non-target organisms. Assessment of the impacts of Bt crops is hampered by the lack of even the most basic checklist of the species present in most systems. In South Africa the maize agroecosystem is of particular interest because of the large area planted with Bt maize for the control of the stem borers, *Busseola fusca* (Fuller) (Lepidoptera: Noctuidae) and *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae). The aims of this study were to determine the diversity of Lepidoptera species that feed on maize and to assess the possible effects of Bt maize on the incidence of Lepidoptera damage.

MATERIALS AND METHODS

Field surveys were conducted on six sites during the 2008/2009 cropping season in the Groblersdal area (Limpopo). Three randomly selected plots consisting of 300 plants each were demarcated inside the Bt maize part of the field as well as the non-Bt refuge. Each plant was inspected for stem borer damage, boll worm damage, and the incidence of maize streak virus at three two-week intervals starting at the milk stage. Larvae of Lepidoptera were collected from maize and brought to the laboratory where they were reared until adults emerged. The moths were then killed and pinned for identification.

RESULTS AND DISCUSSION

Eight species of Lepidoptera was found of which two were new host records on maize (*Caradrina tenebrata* [Noctuidae] and *Ascotis reciprocaria* [Geometridae]). The incidences of Lepidoptera-infested plants and infestation levels were generally lower in Bt fields than in non-Bt fields. On the basis of the high incidence and exposure of the noctuids *Helicoverpa armigera* and *Acantholeucania loreyi* they can be considered important non-target herbivores that are exposed to Cry 1Ab protein. *Helicoverpa armigera* numbers were suppressed on Bt maize. No target pest larvae were recorded on Bt maize, indicating that they have not developed resistance at the surveyed sites.

CONCLUSIONS

Two new host plant records of Lepidoptera on maize were recorded. Bt maize significantly suppressed boll worm numbers.

ACKNOWLEDGEMENTS

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Keywords: Helicoverpa armigera, Caradrina tenebrata, Ascotis reciprocaria, checklist, surveyed

EFFECT OF SYSTEMIC FUNGICIDES AND GROWTH REGULATORS ON THE OIL YIELD AND COMPOSITION OF ROSE GERANIUM (*Pelargonium cv. rose*)

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INTRODUCTION

The essential oil yield of rose geranium is low, approximately 1.5 kg.tonne⁻¹, but of high value in monetary terms. By increasing the oil yield per mass of crop produced, the income generated can be significantly increased. The growth regulators chloromequat chloride and Ethepon have been found to increase the oil yield and the menthone content of Japanese mint respectively. Systemic fungicides (e.g. Bion[®] & Alexin[®]) usually act by stimulating the systemic activated resistance (SAR) response in plants, thereby increasing the production of secondary metabolites involved in the plant's chemical defence mechanism, including some essential oil components. The aim of this investigation was to determine if application of these chemicals may influence the oil yield and composition of rose geranium. The chemicals used are not registered for use on Rose Geranium and efficient application rates will need to be established.

MATERIALS AND METHODS

A rose geranium trial was planted in a completely randomized block trial with 3 replications. One treatment, namely the application of Mycoroot (a fungal inoculate), was applied at planting. Four treatments namely Bion[®] (fungicide), Alexin[®] (fungicide), Ethepon (growth retardant) and chloromequat chloride (growth retardant) were applied one week before harvesting commenced. Material was harvested from each treatment plot and steam distilled in an 8kg laboratory still. Oil yield was measured gravimetrically, and composition was determined using gas chromatography with flame ionization detection. For each treatment plot, an adjacent control plot was harvested and distilled.

RESULTS AND DISCUSSION

Oil yields in the 30 plots harvested ranged from 1.22 to 2.66 g.kg⁻¹. The yields in all three Bion[®] treatment plots were raised compared to their respective control plots. An opposite effect was observed in the case of Ethepon and Alexin[®]. No consistent tendency was observed in the cases of the Mycoroot and CeCeCe 750[®] treatments. Results obtained from GC analysis of the oils showed an increasing effect on linalool in the Alexin treatment and a decreasing effect on citronellyl formate in the CeCeCe 750[®] treatment. Harvesting and distillation was performed over a period of about 4 weeks and a large variation in oil yields was observed that appeared to be related to weather conditions preceding harvesting.

CONCLUSIONS

The results indicate a potential of at least one of the products tested to have the ability to increase the oil yield of rose geranium. Further investigations are needed to determine the effect of different application rates and the duration of the effect. The results also indicate the possibility to manipulate the concentrations of some oil components by the use of specific growth regulating compounds. Further investigations are needed to confirm these effects.

Keywords: rose geranium, systemic fungicides, growth retardants, oil yield, oil composition

PRELIMINARY INVESTIGATION OF YEAST DIVERSITY IN MAIZE PRODUCING SOILS

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INTRODUCTION

When studying soil ecology, very often the role of yeasts is overlooked. These eukaryotic microbes, however, form a significant contribution to biodiversity (Fleet, 1998). Yeasts play a vital role in complex soil processes such as producing novel enzymes and biomolecules, which serve as agents for the breakdown of xenobiotics. The presence of yeast organisms in soil depends also on many factors, e.g. type of soil, rainfall, and climate. It is evident that the ability of yeasts to survive in this habitat plays a fundamental role (Phaff and Starmer, 1987). Reports on soil microbial life showed that this particular habitat has a rich diversity of yeasts. However, very little is known on the yeast population of maize-producing soils.

AIM

Identification of yeasts from a local maize-producing soil.

MATERIALS AND METHODS

Soil was collected from a representative locality (Buffelsvallei, 26.49°S, 26.60°E) in the North West Province of South Africa. A soil dilution series was setup with yeasts isolated on thymine-mineral-vitamin agar. Yeast identification was done by ID32 C assimilation testing and sequencing of the D1/D2 domain of 26S rDNA. Maximum growth tests were also conducted at 25°C, 30°C, 37°C and 45°C.

RESULTS

Approximately 10% of the yeast isolates were of ascomycetous and 90% of basidiomycetous nature. The ascomycetous yeast species belonged to the genus *Candida*. Basidiomycetous yeasts were members of the genus *Cryptococcus*.

CONCLUSION

In the case of the maize-producing soil the yeast diversity was low, only two genera were identified; viz. *Candida* and *Cryptococcus* species. *Cryptococcus* spp. were the predominant yeast microflora in the soil samples. A potential human pathogenic yeast *C. laurentii* was isolated from the maize producing soil.

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Keywords: soil yeast diversity, maize production

SUNBURN REDUCTION ON 'MIHO WASE' SATSUMA MANDARINS USING PARTICLE FILM TECHNOLOGY

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INTRODUCTION

Sunburn is a major problem in early maturing mandarins such as 'Miho Wase' Satsuma. Currently, optimal irrigation during critical periods and shade nets are the only measures to reduce losses due to sunburn. Previous work using particle film technology (kaolin) on citrus to reduce sunburn was very effective, but the formulation used resulted in insect repercussions, especially red scale, due to the product's dust-like properties. ScreenTM is a new formulation containing processed and refined kaolin with some advances compared to the previous formulation. Previous research concluded that kaolin applications on grapefruit reduced midday leaf temperatures by 3°C, increased midday water use efficiency, increased stomatal conductance of leaves and reduced photoinhibition of photosynthesis. Therefore the objective of the study was to determine if ScreenTM can reduce tree canopy temperature, heat and light stress and thereby reduce sunburn on fruit.

MATERIALS AND METHODS

Treatments consisted of an untreated control and ScreenTM applied three times on 'Miho Wase' Satsuma trees in Stellenbosch at 2.5 kg/100 liter water on 4 December 2008, 1.25 kg/100 liter water on 23 December 2008 and 1.25 kg/100 liter water on 29 January 2009. Ten single tree replicates per treatment in a randomized complete block design were used. Fruit were tagged on control and treated trees and fruit diameter of tagged fruit were measured monthly until harvest. At harvest the number of sunburned fruit per tree was counted and a representative sample per tree was taken for external and internal fruit quality evaluations. Leaf surface temperature and fruit surface temperature were determined on a hot afternoon in February 2009 on treated and control trees.

RESULTS AND DISCUSSION

ScreenTM reduced the number of sunburned fruit per tree significantly and reduced the severity of sunburn, possibly due to a reduction in leaf temperature by 1°C and fruit temperature by 2°C. ScreenTM had no effect on fruit colour at harvest. However, ScreenTM significantly reduced juice %, resulted in a slight decrease in the total soluble solids (TSS), a slight increase in the titratable acidity (TA) and a significant decrease in the TSS:TA ratio. ScreenTM also reduced fruit growth significantly from February until harvest and reduced mean fruit diameter at harvest.

CONCLUSIONS

Sunburn on 'Miho Wase' Satsuma mandarins was reduced by the application of an advanced formulation of kaolin particle film technology, most likely due to a reduction in the fruit surface temperature. Treated fruit had poor internal fruit quality and were smaller compared with untreated fruit.

Keywords: Citrus, kaolin, particle film technology, sunburn

PRELIMINARY EVALUATION OF RESIDUAL HERBICIDES FOR CONTROL OF SILVER-LEAF BITTER APPLE (*Solanum elaeagnifolium* CAV)

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INTRODUCTION

Solanum elaeagnifolium Cav., commonly known as silver-leaf bitter apple, silverleaf nightshade or “satansbos” has the potential to spread throughout some major crop growing areas of the country. Consequently, it has been declared a weed of national importance in terms of the Agricultural Resources Act (Act No 43 of 1983). Previous research revealed the difficulty in killing the extensive root system when using foliar herbicides. Since herbicides capable of being absorbed by the roots may stand a better chance of being absorbed in greater quantity, it was the aim of this study to evaluate a range of residual herbicides in the hope of improving control.

MATERIALS AND METHODS

Treatment plots, measuring 10 m x 10 m, were established in homogeneous, dense stands of silver-leaf bitter apple at three locations (Winburg, Kendrew and on the Springbok Flats) representing a wide range of soil and climatic conditions. These plots were spaced more than 10 m apart to avoid drifting or leaching of herbicide treatments to the adjacent plots. Fixed monitoring plots of 1 m x 2 m in size were established towards the centre of each treatment plot, thereby allowing at least a 4 m buffer zone against possible edge effect. Five different herbicide formulations (bromacil 500 g.l⁻¹; bromacil/tebuthiuron 250/250 g.l⁻¹; hexazinone 750 g.kg⁻¹; imazapyr 250 g.l⁻¹; tebuthiuron 500 g.l⁻¹) were applied individually as broadcast sprays to each treatment plot, replicated three times in a completely randomized block design. Individual stem counts were made in each monitoring plot prior to herbicide application and again during the following autumn and every summer thereafter for up to three years in order to track plant population change. Percentage mortality was expressed as the difference in the number of stems before and after treatment as a percentage of the original stem count.

RESULTS AND DISCUSSION

Imazapyr (250 g.l⁻¹) applied at 8 l.ha⁻¹ achieved the most significant reduction in silver-leaf bitter apple population during the first year at all three locations. However, it was tebuthiuron (500 g.l⁻¹) and tebuthiuron/bromacil (250/250 g.l⁻¹) mixtures applied at 32 l.ha⁻¹ that sustained the best long-term control over the 3 year duration of the trial.

CONCLUSION

The high cost and long soil residual nature of these products would limit their application value in cropping areas and sensitive habitats, but may be useful for controlling isolated dense patches on fallow land and in veld away from desirable vegetation, steep slopes and watercourses. The registration holders of these products are encouraged to conduct further evaluations using lower rates alone and in combination with foliar herbicides to reduce the cost and environmental impact in sensitive habitats.

Keywords: alien invader plant, chemical control, residual herbicides, noxious weed, satansbos, silverleaf nightshade