

WHEAT PRODUCTION IN THE WESTERN CAPE USING A FERTILIZER COATED WITH K-HUMATE & MICRONUTRIENTS

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INTRODUCTION

Wheat producers in the Western Cape are faced with unpredictable rainfall and soils of varying fertility especially in terms of micronutrients. The aim of a balanced fertilizer program is to optimize plant growth throughout the crop cycle and to mitigate the risk of crop failure. Key to this is the establishment of the crop. Coating fertilizer with K-humate and micronutrients enables the producer to place essential micronutrients close to the seed at planting and to ensure that they remain available for uptake.

MATERIALS AND METHODS

A 4:1:0 (30) applied at planting was coated with K-humate and micronutrients. The trial was laid out as a statistical strip trial with 34 treated strips paired with 34 control strips which were received an uncoated fertilizer. The strips were located in eight districts across the Western Cape. Measurements were made of grain yield, protein content, hectolitre mass and yield components.

RESULTS AND DISCUSSION

Overall a statistically significant yield increase was achieved of 0.261 t/ha ($P = 0.05$). This increase in production had an economic benefit of R624/ha* and was not to the detriment of the protein content or the hectolitre mass.

Plants sampled on a half square metre area from each strip were analyzed and the number of ears/m² increased by an average of 13 ears/m² ($P = 0.05$) on the treated strips. Five plants were randomly selected from the first group and analyzed in more detail. This data showed an increase in the primary stem diameter of 0.120 mm, an increase in the amount of spikelets formed per ear of 3.9 as well as an increase in the amount of kernels formed on the primary stem of 3.8.

CONCLUSION

Coating fertilizer with K-humate and micronutrients is an effective strategy to assist the crop to set, and realize its yield potential. Improvements were seen in the numbers of ears produced, the number of kernels set per ear and in the thickness of the primary stems. This resulted in an increase in yield contributing significantly to the profitability of the farming operation.

*Wheat price of R2392/t.

Keywords: Wheat, Yield, Micronutrients, K-humate

EVAPORATION ESTIMATION OVER SPARSE VEGETATION USING SINGLE- AND DOUBLE-LAYER MODELS

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INTRODUCTION

The increasing demand for water highlights the need for accurate determination of water-use from agricultural lands for purposes of water resources management. The Penman–Monteith (PM) equation (Monteith, 1965) is widely used to estimate water–use assuming the canopy is a single–layered uniformly vegetated surface. But agricultural lands may exhibit horizontal heterogeneity and hence require separate representation of canopy and soil component parts for water–use estimation. The PM equation was extended by Shuttleworth and Wallace (1985) (SW) to estimate evaporation over sparse vegetation from vegetation and underlying surfaces separately. The objective of this study is to estimate evaporation using PM and SW models.

MATERIALS AND METHODS

Field experiments were conducted over sole stands of *Jatropha curcas* at Ukulinga, KwaZulu-Natal from when the trees had no leaves until they attained a leaf area index (LAI) of 1.82 m² m⁻². The model inputs were solar irradiance, air temperature, water vapour pressure, wind speed, soil water content and LAI. The SW model also included a three-dimensional solar irradiance transmission sub–module. Latent energy flux, and thereby evaporation, was ‘measured’ as a residual of the energy balance using net irradiance, soil heat flux and eddy covariance (EC) sensible heat flux measurements assuming closure is met.

RESULTS AND DISCUSSION

The PM model failed to reproduce the ‘measured’ EC total evaporation during periods when the LAI was low, with improved agreement with increased LAI. The SW model total evaporation agreed well with the ‘measured’ EC total evaporation with a slope of 0.96, r^2 of 0.91 and root mean square error of 0.45 mm. The SW model–estimated soil evaporation and plant transpiration were 66% and 44% of the total evaporation respectively.

CONCLUSIONS

Modelling evaporation from sparse vegetation should consider the canopy and soil component parts separately. For better evaluation of the models, model-simulations should be compared against more direct measurements of total evaporation.

REFERENCES

- MONTEITH, J.L., 1965. Evaporation and the environment. *Symp. Soc. Exp. Biol.* 19, 206–234.
- SHUTTLEWORTH, W.J. & WALLACE, J.S., 1985. Evaporation from sparse crops – an energy combination theory. *Q. J. R. Meteorol. Soc.* 111, 839–855.

ACKNOWLEDGEMENTS

Funding from WRC, UKZN and CSIR is gratefully acknowledged.

Keywords: Evaporation, double–layer, modelling, shortened energy balance, single–layer

PREDICTING N-MINERALIZATION IN SOIL OF THE WESTERN CAPE WHEAT PRODUCING AREA

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INTRODUCTION

Worldwide, nitrogen is next to moisture, regarded as the most important yield limiting factor in crop production. Nitrogen fertilization is, however, expensive and may attribute as much as 30% of the total variable production cost of winter cereals in the Western Cape winter cereal producing areas. During the last number of years, crop rotation systems which include legumes and conservation tillage with no till planting became very popular in these areas. This may result in improved soil fertility levels and higher N-mineralisation potentials. Under these conditions, presently used N fertilization programs which do not make use of soil N measurements may not be accurate any more.

MATERIALS AND METHODS

Soil samples were collected from different localities in both the Swartland and Southern Cape wheat producing areas. After analysing these soil samples to determine their physical and chemical properties they were subjected to a series of incubation experiments at different temperature and soil water levels to measure the N-mineralization potential. Multiple regression analysis was done on the data and a prediction model was developed, using the N-balance approach.

RESULTS AND DISCUSSION

The model showed that N-mineralization during the first 40 days after planting, when most of the yield potential of spring wheat cultivars is established, can be predicted by using the soil pH, clay content, organic C, total N and C:N ratio. Residual N at planting, however, can not be predicted by the model and needs to be measured. In this model, long term climatic data is used to accommodate different planting dates while yield records are used to determine the total nitrogen needs.

CONCLUSIONS

The model seem to be quite accurate when used in the Swartland area where very little rain occurs during the summer and wheat is planted after the first rains in autumn, but seem to be less accurate in the Southern Cape where as much as 40% of the total annual rainfall is received during summer. In order to improve the model for field use, more research is needed to determine the percentage recovery of applied nitrogen in different soils and rainfall conditions.

Keywords: N-mineralization

SCREENING OF SOME MAIZE CULTIVARS FOR ACETOCHLOR TOLERANCE

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INTRODUCTION

Acetochlor containing a safener is registered for pre-emergence use on maize for the control of mainly annual grasses. It is normally applied at rates of between 0.49 to 1.89 kg ai ha⁻¹ on soils with a clay content ranging from <10% to 55%. Some cases of acetochlor injury to maize have occurred in the field despite using the correct application rates. Most phytotoxicity can be traced back to incorrect application or unsuitable weather conditions following application, but sometimes no explanation can be found. Chloroacetanilide herbicide damage in many crops has been shown to be due to genetic differences, and some cultivars are more susceptible to damage than others.

MATERIALS AND METHODS

A glasshouse trial was conducted to screen 21 maize cultivars commonly recommended for use in the central areas of South Africa for their tolerance to acetochlor. Planting took place in pots containing a sandy loam soil (15 % clay) and five rates of acetochlor (0, 0.74, 1.47, 2.94 and 5.88 kg ai ha⁻¹) were applied and leached into the soil using the equivalent of 6 mm of rainfall. The trial was laid out in a randomised complete block design in a glasshouse set to 28/18°C day/night. Phytotoxicity was visually rated 21 days after planting and harvesting took place 30 days after treatment. Data on seedling emergence, plant height and mass of seedlings was collected. Data were converted to percentage of control to negate inherent growth differences due to cultivars and then subjected to standard statistical analysis.

RESULTS AND DISCUSSION

Characteristic symptoms of acetochlor phytotoxicity were noted at the higher rates of application (2 and 4X). Time for seedling emergence increased with increasing acetochlor application rate, and this was significantly delayed by the 2 and 4X application rates. All cultivars reacted to acetochlor application in the same way regarding the effect on seedling height and dry mass, with a significant decrease occurring at the recommended application rate. Significant differences were also noted between cultivars, with slight variations between analyses for seedling height and dry mass. Cultivars were grouped into tolerant, intermediate and sensitive classes based on their reaction. The tolerant and sensitive classes each contained a single cultivar – PAN 6Q521R and DKC 73-76R respectively. The other 19 cultivars were classified as intermediate. Rowe *et al.* (1990) found a similar trend in cultivar tolerance to metolochlor, another chloroacetanilide herbicide.

CONCLUSIONS

Both seedling height and dry mass were good indicators of acetochlor activity in maize. The existence of cultivar differences with respect to acetochlor tolerance was also confirmed.

REFERENCES

ROWE, L., ROSSMAN, E. & PENNER, D., 1990. Differential response of corn hybrid and inbreds to metolochlor. *Weed Sci.* 38, 563-566.

ACKNOWLEDGEMENTS

ACAT are gratefully acknowledged for providing the funding for this study.

Keywords: Acetochlor, corn, cultivar, maize, phytotoxicity, tolerance

PRUDENT USE OF MUNICIPAL SLUDGE FOR AGRICULTURAL PRODUCTION

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INTRODUCTION

Agricultural use of sludge is expected to increase due to its agricultural benefits and possible economic advantages. The current South African sludge guideline is considered prudent, and allows an upper limit of 10 t ha⁻¹ yr⁻¹. However, a dynamic decision support system would be useful to responsibly utilize sludges as valuable nutrient (N and P) sources in agriculture. The overall objective of this study was to investigate the dynamic nature of sludge loading and assess the environmental impacts associated with N based sludge application through nitrate leaching and soil profile P build up.

MATERIALS AND METHODS

Nutrient balances of four cropping systems, dryland maize, an irrigated maize/oat rotation, dryland pasture (*Eragrostis curvula*), and turfgrass, were investigated on a clay loam soil, at ERWAT, Ekurhuleni district apart from an inorganic fertilizer control treatment. The first three cropping systems were treated with four sludge rates of 0, 4, 8, and 16 t ha⁻¹ yr⁻¹. The fourth cropping system was treated with five sludge rates of 0, 8, 33, 67, and 100 t ha⁻¹ yr⁻¹. The sludge used in this study was anaerobically digested and paddy-dried having the quality that allows it to be utilized in agriculture. Field results were used to validate a nutrient (N & P) version of the Soil Water Balance (SWB) model developed as a decision support tool for site specific sludge loading recommendations.

RESULTS AND DISCUSSION

Mean forage N uptake by the irrigated maize/oat rotation was equivalent to the N supply from 22 t ha⁻¹ yr⁻¹ sludge, while the dryland maize was only able to utilize an N equivalent of 6 t ha⁻¹ yr⁻¹ sludge. The turfgrass on the other hand, was able to export as much as 33 t ha⁻¹ sludge per harvest, without reducing turf growth and quality. Nitrate concentration of soil solutions collected from 0.3 m deep wetting front detectors in the 16 t ha⁻¹ irrigated maize/oat rotation and the 33 t ha⁻¹ turfgrass treatment, were below drinking water standards. However, soil P accumulation was evident in all agronomic cropping systems. The N model was successfully calibrated and validated with acceptable accuracy for dryland maize and an irrigated maize/oat rotation. The model was also successfully calibrated for dryland pasture. Model accuracy, however, was low during corroboration due to the non-mechanistic approach followed by the model when simulating the growth of perennial grasses.

CONCLUSION

Sludge loading to satisfy crop N demand is dynamic, as it depends on sludge N content and cropping intensity. Ultimately, maximum cumulative municipal sludge loading to an area will depend on the accumulation of P and heavy metals and the risk this poses for pollution. The model developed is a useful decision support tool for sustainable sludge use in agricultural lands.

ACKNOWLEDGEMENTS

Funding from WRC, ERWAT, and SASOL is gratefully acknowledged

Keywords: sludge, nutrient balances, cropping systems, leaching, SWB, modelling

DETERMINATION OF THE OPTIMAL TIME FOR SHOOT TIP MICROGRAFTING OF WALNUT

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INTRODUCTION

Vegetative propagation of walnut is difficult due to the high level of polyphenolic compounds in its tissues. However, seedlings can be grafted at an early stage by using a micrografting procedure that reduces the degree of unsuccessful grafting. The aim of this study was to determine the most appropriate time for shoot tip micrografting.

MATERIALS AND METHODS

Walnut seedlings germinated in pots were micrografted at two stages; namely the 3- and 5-leaf stages. Micrografting was carried out in June, using cleft microscions 1-2 cm in length. After grafting, seedlings were maintained under greenhouse conditions at high humidity. Twenty five grafts were performed for each treatment.

RESULTS AND DISCUSSION

The highest percentage of successful grafts was observed at the 5-leaf stage (40%) compared with the 3-leaf stage (32%). Carbohydrate concentration in the microscion is an important factor in terms of improving successful micrografting, and microscions with a larger diameter have higher carbohydrate reserves. The higher percentage graft take using seedlings at the 5-leaf stage may be due to the larger size and, therefore, higher carbohydrate concentration of both the rootstock and microscion.

CONCLUSIONS

Micrografting is a useful procedure for walnut vegetative propagation but it is necessary to do it at the appropriate time. In this investigation, it was determined that the 5-leaf stage is optimal. This stage occurs approximately 20 days after rootstock seed germination.

REFERENCES

- RODRIGUES, M., RYAN, G.F. & FROLICH, E.F., 1960. Some factors influencing grafting success with avocados. *Calif. Avo. Soc. Yrbk.* 44: 89-92.
- ISLAM, M.M., HAQUE, M.A. & HOSSAIN, M.M., 2003. Effect of age of rootstock and time of grafting on the success of epicotyl grafting in jackfruit (*Artocarpus heterophyllus* L.). *Asian J. Plant Sci.* 2(14), 1047-1051.

Keywords: micrografting, walnut

IS LATE MATURITY α -AMYLASE A REALITY IN SOUTH AFRICA?

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INTRODUCTION

Late maturity α -amylase (LMA) is a genetic defect present in some genotypes that can result in high levels of α -amylase and low falling numbers (FNs) in ripe grain in the absence of preharvest sprouting (PHS) or rain. During recent years high levels of low FNs in wheat was experienced in parts of South Africa, especially in the summer rainfall area of the Free State and Mpumalanga. A lot of wheat has been downgraded at intake level due to low FNs, but without any visible sprouting damage. Was this due to LMA expression? Research was conducted to determine if LMA is a reality in South African wheat cultivars.

MATERIALS AND METHODS

During 2007 and 2008 trials were planted according to a randomised complete block design with four replicates under a rain shelter to prevent rain on the physiologically ripe ears. Trial plots consisted of five rows of 2 m length each and an inter-row spacing of 45 cm. Nine South African wheat cultivars, varying in PHS resistance, as well as four international standards, of which the LMA status is known, were included in the trials. The induction of LMA was done by removing tillers 25 – 30 days post anthesis, and placed in water in a controlled environment growth room at lower temperatures (13-18°C). After 7 days in the cool environment, the detached tillers were transferred to a similar growth room at higher temperatures (16-30°C) until maturity (Mares & Mrva, 2008). In order to determine the effect of cool temperatures on PHS, ears that received the cool treatment, as well as the control ears that remained in the field and ripened under normal growing conditions, were subjected to simulated rainfall. FNs, as well as the direct measurement of α -amylase through the Phadebas method, were also determined on both cool treatment ears and control ears.

RESULTS AND DISCUSSION

The PHS scores of certain cultivars were significantly ($P < 0.05$) lower after being subjected to a cool treatment than the controls, indicating a higher PHS resistance under these conditions. Falling numbers in certain cultivars were significantly ($P < 0.05$) lower after a cool treatment, indicating a higher α -amylase activity which was confirmed by direct α -amylase measuring. Results indicated that PHS and LMA are not correlated.

CONCLUSIONS

In five of the cultivars tested LMA was expressed after a cool treatment. The direct measurement of α -amylase indicated that Elands was the only cultivar with a low enzyme activity after exposure to simulated rainfall. It is clear that, even if Elands is prone to LMA and can sometimes produce low FNs, the PHS resistance of this cultivar is exceptional. From the results it is clear that LMA is indeed a reality in certain South African wheat cultivars and it should be addressed in future research.

REFERENCES

Mares, D. & Mrva, K., 2008. Late maturity α -amylase: Low falling numbers in wheat in the absence of preharvest sprouting. *J. Cer. Sci.* 47(1), 6-17.

Keywords: late maturity amylase, preharvest sprouting, wheat

CARBOHYDRATE PATTERNS PRESENT DURING THE ONTOGENETIC DEVELOPMENT OF 'HASS' AVOCADO

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INTRODUCTION

Avocado (*Persea americana* Mill.) is one of very few plant species able to synthesize and translocate significant amounts of heptose sugars. The heptoses D-mannoheptulose, and its polyol form, perseitol, are found in all tissues/organs and during various phenological stages of avocado development (Liu *et al.*, 1999). These heptoses, as well as starch, are recognized forms of carbohydrate reserves in avocado (Bertling & Bower, 2005). An ontogenetic approach was used to elucidate the role of various sugars present in 'Hass' avocado, in an attempt to understand carbohydrate partitioning, transport and storage in avocado.

MATERIALS AND METHODS

Fruit were collected from an orchard located in the KwaZulu-Natal Midlands, South Africa. Monthly sampling of 20 fruit at characteristic stages (from early fruit set to commercial fruit maturity) was carried out as well as sampling from seedlings grown under controlled environment conditions, either with or without light. At specific ontogenetic stages plants were either destructively harvested or leaf and fruit material was removed from mature trees. Sugars were analyzed using HPLC. Statistical analyses were performed using GenStat, 11th edition.

RESULTS AND DISCUSSION

The embryo of the mature seed contained hexoses and heptoses during seed germination, while ontogenetically mature tissue contained mainly heptoses. Hexoses and heptoses were produced in different amounts at the examined phenological stages. The shoots of etiolated seedlings contained significantly higher concentrations of perseitol, glucose, fructose and mannoheptulose than seedlings grown under light. However, the starch concentration of etiolated seedlings was lower than that of light-exposed ones.

CONCLUSION

The dominance of heptoses during early ontogenetic stages compared to that during the later stages seems to be a typical feature of the ontogenetic development of 'Hass' avocado.

REFERENCES

- BERTLING, I. & BOWER, J.P., 2005. Sugars as energy sources – is there a link to avocado fruit quality? *S. Afri. Avocado Growers' Assoc. Yrbk.* 28, 24-27.
- LIU, X., ROBINSON, P.W., MADORE, M.A., WITNEY, G.W., & ARPAIA, M.L. 1999. 'Hass' Avocado Carbohydrate Fluctuations. II. Fruit Growth and Ripening. *J. Am. Soc. Hortic. Sci.* 124, 676–681.

Keywords: D-mannoheptulose, Perseitol

HIGH TEMPERATURE EFFECTS ON VEGETATIVE AND REPRODUCTIVE PHYSIOLOGY OF *Protea* CV. PINK ICE

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INTRODUCTION

Climate change is threatening the long-term survival of South African indigenous fynbos, as well as sustainable commercial *Protea* production. Temperatures are predicted to increase by 2-3°C in the Western Cape over the next 30-40 years. The effects of increased temperature on vegetative growth and floral bud induction in *Protea* cultivars are not known and, in addition, changes in seasonal temperature may affect the phenology, growth and physiology of plants. The objective of this study was to investigate the role of temperature during various phenological stages in *Protea* cv. Pink Ice. This will enable producers to better predict (inter-annually and regionally) the flowering period and intensity, to aid with harvest distribution, for more effective marketing and timely adaptations to a warmer climate.

MATERIALS AND METHODS

Greenhouse-based warming experiment:

A gradient of five temperature ranges was established in a glass-roofed greenhouse in Stellenbosch, ranging from ambient to ambient + 3.1°C, using infra-red lamps. The experiment started on 19 May 2008, using four drip-irrigated 2-year old *Protea* cv. Pink Ice (*P. compacta* X *P. susannae*) potted plants per temperature treatment. Bud break, vegetative growth, reproductive development and leaf gas exchange were measured throughout the year. A final harvest was done on 22 March 2009.

Field verification experiment:

In a commercial 8-year old 'Pink Ice' block on a farm near Stellenbosch, two temperature treatments were established in July 2008 using infra-red lamps, ambient and ambient+2.9°C, with six plants per treatment. Gas exchange, vegetative and reproductive growth were measured.

RESULTS AND DISCUSSION

Bud break occurred up to two weeks earlier at warmer temperatures, both in the greenhouse and the field. At ambient temperatures, inflorescences initiated mostly on the spring flush. At higher temperatures initiation shifted to the first summer flush, with progressively lower flowering intensity as temperature increased. Net CO₂ assimilation rates acclimated on a leaf area-basis, but decreased on a leaf dry mass-basis. Morphological adaptation to higher temperatures was observed, with thicker leaves developing on successive flushes and changes in dry mass allocation and partitioning recorded over the temperature treatments.

CONCLUSION

Temperature is a major factor in *Protea* cv Pink Ice plant development. At elevated temperatures, growth was promoted during the cooler periods, whereas during the warm months plants displayed altered assimilation and allocation patterns as an adaptation to high temperatures, linked with elevated respiration. These changes could be detrimental to commercial flower production.

ACKNOWLEDGEMENTS

Protea Producers of South Africa and the National Research Fund.

Keywords: ecophysiology, global warming, *Protea*

MECHANIZATION OF THE IN-FIELD RAINWATER HARVESTING TECHNIQUE: A CASE STUDY AT PARADYS EXPERIMENTAL FARM

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INTRODUCTION

It was hypothesised that the in-field rainwater harvesting technique (IRWH), which is used by more than a thousand households in their homestead yards in the Thaba Nchu district, can be mechanized to suit crop production on 50 to 150 ha fields.

MATERIALS AND METHODS

Tractor drawn implements were designed, built and tested to replicate the soil surface structure of IRWH. Tests indicated that two implements were required to reproduce the structure, viz. the ridge and puddle ploughs. The ridge plough was designed as a primary tillage tool, making a ridge along a contour which serves as a wall for the basin strip. The puddle plough was designed as a secondary tillage tool, making micro-basins on the up-slope side of the ridge for controlling lateral runoff. These implements were used to cultivate more than a 100 ha of maize under IRWH at Paradys Experimental Farm of the University of the Free State. As part of the mechanization planning, the soils and climate were analysed with respect to its potential to harvest and store runoff. Cumulative probability function showed that the Paradys-Tukulu/Sepane ecotope is suitable for IRWH, which direct the research to fully mechanise IRWH.

RESULTS AND DISCUSSION

A procedure was developed for land preparation which entails a detail topographical map to divide the field into terraces and how to plan and make the guide-ridges and micro-basins. Width of runoff strips depends on traffic control of the secondary tillage operation, which includes planting, weeding, pest control and harvesting. Two runoff strips width (2.3 m and 2 m) were tested for accommodating the tillage operations associated with silage and maize grain production, respectively. Both mechanization systems worked well. The capacity and strength of basins were thoroughly tested during the first two months after the basins were established. It rained about 250 mm, mainly in the form of high intensity storms. Observations showed that the micro-basins helped to control lateral runoff and directly contributed to uniform storage of rain over the entire field. Results showed further that there is a high potential for breaking the basins if the slope of the ridge-wall deviates from the targeted zero angle contour line, especially in or near old gullies. However, runoff water never gathered momentum to the extent that it caused basin-walls to brake over a series of runoff strips.

CONCLUSION

It was possible to developed implements and agronomical procedures for the mechanization of the IRWH technique. Small scale farmers will be able to produce crops on 50 -150 ha.

Keywords: Mechanization, IRWH, ridge plough, puddle plough

HYDRAULIC PROPERTIES OF A HUTTON SOIL PROFILE IN THE SOUTH-WESTERN FREE STATE

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INTRODUCTION

A soil survey was conducted in the south-western Free State to identify soils suitable for a large (2000 ha) irrigation scheme. There is a scarcity of water in South Africa. Understanding the hydraulic properties of soils can optimize irrigation and drainage.

MATERIALS AND METHODS

Profiles were chosen along the hillslope and monoliths prepared according to Hillel's procedure of internal drainage measurement. ECH₂O soil water sensors were installed at different depth intervals and the profile was wetted until saturation. Soil water potential was derived from a water retention curve measured in the laboratory. Saturated hydraulic conductivity was measured using the double ring infiltrometer at different depths.

RESULTS AND DISCUSSION

The K_{sat} values obtained from the double ring infiltrometer were high as the lowest value was 211 cm day⁻¹ and the highest was 453 cm day⁻¹.

The K- θ relationship of all the layers of a deep Hutton exhibited similar characteristics (Figure 1).

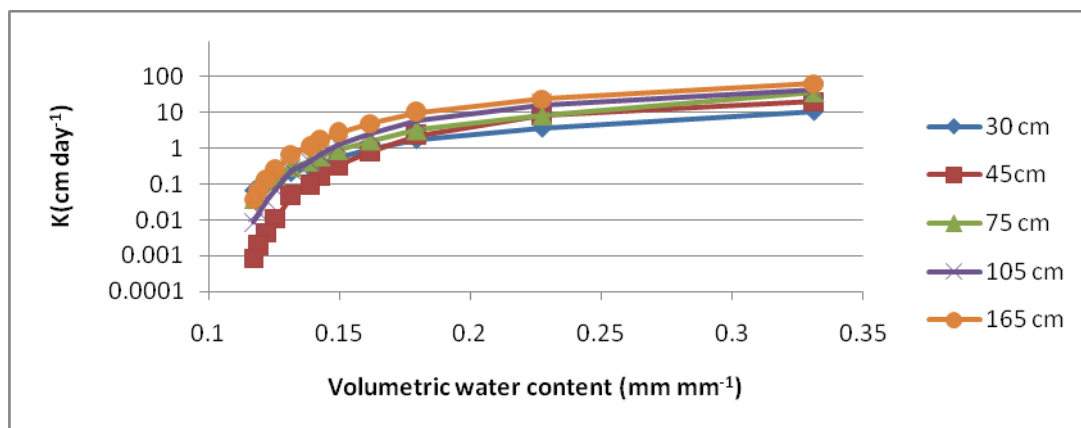


Figure 1- K- θ relationships for the different soil layers in Profile 1.

CONCLUSION

The soil is truly freely drained as indicated by the red apedal B horizon. The soil is suitable for irrigation but precautionary measures must be taken as excess irrigation will drain down to bedrock quickly and on the bedrock laterally to lower lying areas. Lower lying areas may become water logged soon after commencing of irrigation.

Keywords: K_{sat}, Double ring infiltrometer, ECH₂O soil water sensor, K- θ relationship, Soil-water potential

EFFECT OF LIGHT AND PACKAGING ON SHELF LIFE OF FRESH-CUT SWEET BASIL AND ROSEMARY

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INTRODUCTION

The sale of fresh-cut herbs is often adversely affected by poor storage life. Temperature and humidity levels are known, but not concentrations of gases in the packaging. Light is believed to delay chlorophyll breakdown and thus senescence (Lopresti and Tomkins, 1997). The correct levels of gasses such as CO₂ and O₂ are difficult to apply and maintain, and with relative humidity, can be influenced by packaging. The objective was to investigate different forms of packaging, storage conditions and atmosphere for packaged herbs.

MATERIALS AND METHODS

Rosemary and sweet basil were used. Micro-perforated packaging (Thompson, 1998), was tested against non-perforated polypropylene bags, with normal and modified atmospheres applied to the non-perforated bags. Rosemary was stored at 1°C for 21 days and basil for 9 days at 12°C, with and without light.

RESULTS AND DISCUSSION

In the non micro-perforated bags, carbon dioxide levels increased rapidly and caused deterioration. While a modified atmosphere may be advantageous (Thompson, 1998; Amodio *et al.*, 2005), concentrations are important, not only at the time of packing, but also changes during storage. It is suggested that in the presence of light some photosynthesis may have continued, thus reducing CO₂ in the packages. The micro-perforated packaging also appeared to adequately control water loss, which is essential to maintaining good appearance and texture.

CONCLUSIONS

The micro-perforated packaging decreased the potential for CO₂ build-up (Aharoni *et al.*, 1989), but at the same time controlled water loss. Light further controlled CO₂ build-up, and it is recommended that such packaging be used.

REFERENCES

- AHARONI, N., REUVENI, A. & DVIR, O., 1989. Modified atmospheres in film packages delay senescence and decay of fresh herbs. *Acta Hort.* 258, 255-262.
- AMODIO, M.L., PERI, G., COLELLI, G., CENTONZE, D. & QUINTO, M., 2005. Effects of atmosphere composition on postharvest quality of fresh basil leaves. *Acta Hort.* 682, 731-735.
- LOPRESTI, J. & TOMKINS, B., 1997. Postharvest handling and packaging of fresh herbs. Rural Industries Research and Development Corporation of Australia 5, 7-32.
- THOMPSON, A.K. 1998. Controlled atmosphere storage of fruits and vegetables. CAB International, Wallingford.

Keywords: packaging, shelf life, fresh-cut, basil, rosemary

SCANNING THE EFFICACY OF A NEW GENERATION TRANSPORT VESICLE FOR USE WITH PLANT REMEDIES IN AGRICULTURE

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The potential of a unique new generation adjuvant, AnnGro™, to enhance the efficacy of agricultural remedies was scientifically tested *in vivo*. According to the manufacturers AnnGro™ consists of micro sponges acting as transport vesicles that have the ability to package diverse hydrophilic and/or hydrophobic active compounds and swiftly transport them over plant membranes after coming in contact with root or leaf tissue. The latter is mainly ascribed to the fact that the outer layer of the transport vesicle consists of unsaturated fatty acids that show homology with plant cell membranes. Once the transport vesicle containing the packaged compounds is absorbed by the plant, it assists in the translocation of the active compounds within the plant in a relatively short period of time. In this study the potential of AnnGro™ to act as an adjuvant that improves the efficacy of fertilizers, herbicides, fungicides and a plant growth regulator was tested. Fertilizer and AnnGro™ combination treatments were tested on wheat, maize and potatoes while a standard group of fungicides namely Unizeb (a.i. mancozeb) and Flint (a.i. trifloxystrobin) was used together with AnnGro™ in an attempt to improve the control of citrus black spot caused by *Guignardia citricarpa*. Additionally, the use of AnnGro™ in combination with the non-selective herbicide glyphosate was tested on different weeds. Lastly, addition of AnnGro™ to a plant growth regulator, ComCat®, was followed in terms of the potential of this combination treatment to improve yield and quality in maize, wheat, sunflower and potatoes. Although the above are perceived as scanning trials and more research is necessary in this regard, results confirmed in all cases that AnnGro™ can indeed be regarded as a new generation adjuvant that possesses the potential to improve the efficacy of diverse remedies applied in crop production practices, as claimed by the manufacturers.

Keywords: Adjuvant

FARMERS' SOIL FERTILITY PERCEPTION AND ASSESSMENT IN EZIGENI AND OGAGWINI VILLAGES, KWAZULU-NATAL, SOUTH AFRICA

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INTRODUCTION

In the past the soil fertility knowledge of small-scale rural farmers has been largely ignored in scientific research. Hence consequential prescriptive scientific techniques have often failed to improve agricultural land use systems in rural areas. It is therefore necessary to understand the farmers' indigenous knowledge, perceptions and assessment methods of soil fertility in order to develop methodologies and interventions relevant to the local people and thus ensure the sustainability of soil and land resources.

MATERIALS AND METHODS

Indigenous knowledge was elicited from 59 households in two villages (Ezigeni and Ogagwini) in KwaZulu-Natal using questionnaires. Detailed information was collected from six households on the cropping history, knowledge specific to the cultivated lands, detailed soil description and fertility. Soil samples were taken from these homesteads under different land use (taro, fallow, veld and vegetable) at 0-30 and 30-60 cm for fertility analysis. Farmer vernacular suitability evaluation was compared to scientifically surveyed suitability maps. Yield was used as a quantifiable indicator to test the effect of fertility management practices.

RESULTS AND DISCUSSION

Farmers had comprehensive and well defined soil fertility indicators. These include crop yield, crop appearance, natural vegetation, soil texture, colour and mesofauna. Moreover, farmers acknowledged the influence of soil type on soil productivity. Results showed that farmers' fertility perceptions are more holistic than those of researchers. However, despite this, their assessment correlated with soil analysis. There was also a positive correlation between scientific and indigenous suitability evaluation for taro, dry beans and maize. This was further substantiated by yield measurements which were significantly higher at Ogagwini that was rated by both farmers and scientific evaluation as the more suitable.

CONCLUSION

Farmer soil indigenous knowledge is rather abstract when compared to the more commonly obtained scientific knowledge. Despite this, results showed farmer soil fertility assessment knowledge and their soil suitability evaluation correlates well with scientific evaluation. These significant agreements between the scientific and indigenous approaches imply that there are fundamental similarities between these two methodologies. The inclusion of indigenous knowledge into scientific approaches will hence lead to the development of land use plans that are more relevant and profitable to small-scale farmers.

Keywords: Soil fertility, Indicators

CAN DEMONSTRATION PLOTS IMPROVE WEED CONTROL PRACTICES OF EMERGING FARMERS?

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INTRODUCTION

Emerging farmers are an increasingly important sector of the South African Sugar Industry, and yet for a variety of reasons are not successful in improving or sustaining yields. This paper does not address socio-political constraints, but rather focuses on the economics of reclaiming weed-infested sugarcane, and offers a step-wise strategy to increase the area of well-managed cane for emerging farmers, using a worst-case weed scenario, where fields have been infested with *Cynodon dactylon* (L.) Pers. (cynodon). Input costs and returns calculated from results of several trials at the South African Research Institute have shown that although a slow process, progress with cynodon control and subsequent yield improvements can be made. Establishing demonstration plots with sugarcane planted under local growing conditions are proving a highly successful tool for training and to encourage more rapid adoption of technology by the end-user, e.g., variety choice for local conditions, weed control principles, and the need to replant (Gillespie, *et al.*, 2009).

MATERIALS AND METHODS

Data have been collated to offer a standard for a realistic and sustained rate of cynodon control, replanting, and expansion of area under well-managed sugarcane. This included herbicide input costs for cynodon control, and the resulting benefits from reduced competition, in terms of improved yields.

RESULTS AND DISCUSSION

Sugarcane yields are affected by many factors such as rainfall, heat units, soils and level of management. A high potential rain-fed field may yield 65 tons cane/hectare, and yet this can be reduced to 41 tons cane/hectare in cynodon-infested fields. The best opportunity to control cynodon is in fields due for replanting (Campbell, 2008). However, total replanting costs/hectare is beyond the affordability of emerging farmers and requires two new proposed strategies. Firstly, by scaling down operations, where systematic control and replanting in one hectare is accomplished over four or more years. Secondly, by subsequent scaling up control and replanting operations, and with a gradual expansion of one hectare to around 16 hectares, considered a more viable area for sugarcane production. The value of demonstration plots is enhanced by teaching these principles during farmer days.

CONCLUSIONS

Progress with cynodon control can be achieved by emerging farmers, and demonstration plots established in local growing conditions can provide a valuable focus for technology transfer of control principles, costs and benefits.

REFERENCES

- Gillespie WA, Mitchell FJ, Way M and Webster T (2009). Demonstration plots double as seedcane nurseries for small scale growers in the Noodsberg area. *Proc S Afr Sug Technol Ass (2009) 82: 623 – 625.*
- Campbell PL (2008). Efficacy of glyphosate, alternative post-emergence herbicides and tillage for control of *Cynodon dactylon*. *S Afr J Plant Soil*, 25(4): 220-228.

Keywords: *Cynodon dactylon*, sugarcane, emerging farmers, demonstration plots, technology transfer

GEOPHYSICS FOR GROWTH THE LATEST IN SOIL & CROP SCIENCE GEOPHYSICS: WHAT CAN IT DO FOR YOU?

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INTRODUCTION

Non-invasive geophysical techniques are traditionally used in the study of near-surface geological, archaeological, engineering and hydrological problems, yet their application to soil and crop science is less common. Methods such as Electromagnetic Induction (EM) and Electrical Resistivity Imaging (ERI) are particularly good at mapping variations in electrical conductivity that, in turn, can be attributed to sub-surface moisture contents (with appropriate calibration factors). Ground-penetrating radar (GPR) is an excellent stratigraphic imaging technique and when used in combination with ERI and EM, can become a powerful analysis tool for decimetre-scaled, sub-surface characterisation.

However, the processing and interpretation of geophysical data can be both difficult and time consuming, particularly in complex, heterogeneous environments. In the past few years, advanced modelling and analysis methods (such as finite-difference time-domain modelling and tomographic inversion techniques) have led to a more sophisticated approach to data analysis and the ability to 'extract' material property information from the results. Although this degree of interpretational refinement has allowed the expansion of geophysics into areas such as land contamination, hydrology and arboriculture, there still remains significant potential for geophysics in the agricultural community.

MATERIALS AND METHODS

In this presentation, methods as diverse as transient electromagnetics, induced polarisation (IP), nuclear magnetic resonance (NMR), surface wave seismics, self-potential (SP), GPR and electrical resistivity will all be discussed in the context of soil and crop science. Case study examples (ranging from the mapping of soil structures with GPR to the effects of tillage methods on a soil's moisture content and electrical properties) will illustrate the merits and limitations of each technique. In particular, the latest results from an ongoing study into the desiccation of clay-rich soils by tree roots will highlight how simple, low-cost geophysical techniques can be used as proxy tools for moisture content mapping and water retention characterisation.

Keywords: Geophysics, non-invasive investigation, soil and crop sciences.

POSTHARVEST PIGMENT AND CARBOHYDRATE CHANGES IN RELATION TO THE INCIDENCE OF RIND BREAKDOWN OF 'NULES CLEMENTINE' MANDARIN FRUIT

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INTRODUCTION

The progressive disorder referred to as rind breakdown (RBD) of 'Nules Clementine' mandarin (*Citrus reticulata* Blanco) starts to develop during storage approximately 3 to 5 weeks after harvest. Fruit developing inside the tree canopy and shaded from direct sunlight exposure until stage III of fruit development, are known to be more sensitive to RBD. These fruit have a weaker rind condition which is ascribed to lower carbohydrate, pigment, Mg and Ca contents, coupled with a higher K content in the flavedo.

MATERIALS AND METHODS

Postharvest ethylene degreening treatment, as well as storage temperature (chilling and non-chilling conditions) and the storage duration were evaluated with respect to the incidence of RBD. In the first experiment, fruit were subjected to ethylene degreening and a delay in commencement of cold storage (2003). In the second experiment, fruit from the inside and outside of the canopy were cold-stored at -0.5 °C or 7.5 °C during two seasons (2005 and 2007). The rind pigment and carbohydrate contents as well as rind colour and RBD incidence were recorded during a prolonged storage period.

RESULTS AND DISCUSSION

Ethylene application, delay in induction of fruit into the cold chain and high temperature storage treatments are all known to promote senescence in fruit, as was seen in this study. This senescence was seen in the decrease in chlorophyll and increase in carotenoid content of the flavedo. Additionally, the flavedo reacted negatively to these treatments and in all instances resulted in an increase of RBD incidence. The only exception was for storage at -0.5°C, which resulted in a lower occurrence of RBD and was expected due to the low storage temperature. Carbohydrate content was not altered drastically from preharvest levels during postharvest storage. However, the higher storage temperature (7.5°C) resulted generally in higher glucose and fructose levels and lower sucrose compared to the -0.5°C treatment. Differences of carbohydrate content in the flavedo between inside and outside fruit stayed the same and there was no evident lack of carbohydrate content in the flavedo during prolonged storage leading to increases in RBD.

CONCLUSIONS

Overall, results (specifically changes in pigmentation) indicate that the incidence of RBD in the modified leaf-like flavedo can be aggravated by senescence-promoting factors during the postharvest storage of fruit. This is thought to lead to a premature senescence of the flavedo. Anatomical studies supported this conclusion. Furthermore the relationship between colour development and rind condition could potentially be used to distinguish fruit susceptible to RBD.

Keywords: Citrus, rind breakdown, carbohydrates, postharvest, physiological disorder

NAA EFFECTIVELY THINS TABLE OLIVES IN THE “ON” YEAR THEREBY DECREASING ALTERNATE BEARING AND INCREASING FRUIT QUALITY

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INTRODUCTION

Alternate bearing is one of the major challenges in olive production (Kreuger *et al.*, 2005). High fruit set in an “on” year decreases flower initiation for the subsequent “off” year (World Olive Encyclopedia, 1996). Early fruit thinning in an “on” year with naphthalene acetic acid (NAA) is used to reduce fruit numbers and increase fruit size in the “on” year, and increase the return crop in the subsequent “off” year (Kreuger *et al.*, 2005). However, NAA has not been used for olive thinning in South Africa and effective concentrations for local conditions and cultivars are not known.

MATERIAL AND METHODS

NAA, at 100 to 400 mg.L⁻¹, was applied with a truck mounted motorized sprayer until drip-off to ‘Barouni’ (2007/08), ‘Manzanillo’ and ‘Mission’ (2008/09) cultivars to determine the optimum NAA concentration. Barouni and Manzanillo are table olives while Mission is a dual purpose cultivar.

RESULTS AND DISCUSSION

NAA thinned fruit in all three cultivars but was most effective in Mission, where fruit numbers were reduced by 60% and yield decreased by 50% from 18 to 9 t ha⁻¹ at the highest concentration of 400 mg L⁻¹. Fruit diameter increased by 13%, which is important since larger olives fetch higher prices. Effective NAA concentrations for optimal thinning under South African conditions appear to be considerably higher than those used in California (Kreuger *et al.*, 2005). Despite a significant decrease in yield (16%), the subsequent “off” season yield (2008/09) in ‘Barouni’ was not affected by chemical thinning. Return yields in ‘Mission’ and ‘Manzanillo’ will not be available in January, but the effect on the return bloom will be discussed.

CONCLUSIONS

The results indicate that NAA may decrease “on” year yield and improve table olive quality under South African conditions.

REFERENCES

KREUGER, W.H., MARANTO, J. & SIBBETT, G.S., 2005. Olive fruit thinning p. 101 – 104. *In: G.S. Sibbett & L. Ferguson (eds.) Olive Production Manual 2nd ed.* University of California Agriculture and Natural Resources Publication 3353.
LAVEE, S., NAVERO, D.B., BONGO, G., JARDAK, T., LOUSSERT, R., MARTIN, G.G. & TRIGUI, A., 1996. Biology and Physiology of the Olive p. 71 - 105. *In: World olive encyclopedia.* IOOC, Madrid.

ACKNOWLEDGEMENTS

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Keywords: NAA, Chemical thinning, *Olea europaea*, Biennial bearing

A BREEDING PROGRAM TO ENHANCE MAIZE RESISTANCE TO BIOTIC STRESS: I. NORTHERN CORN LEAF BLIGHT RESISTANCE IN TROPICAL INBREDS

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INTRODUCTION

The staple food, maize is grown without fungicide protection in sub-Saharan Africa. Therefore recent upsurge of northern corn leaf blight disease (NLB), caused by *Exserohilum turcicum*, threatens maize grain productivity with negative impact on food security. With the aim of breeding for resistance to NLB in maize varieties, 2000 F₃ to F₇ inbred progenies (hybrid parents), from the program at the University of KwaZulu-Natal and CIMMYT program in Harare, were evaluated in nurseries.

MATERIALS AND METHODS

Single row plots of 5 m were established for each inbred at Cedara and Ukulinga Research Farms during the 2007/8 and 2008 /9 summer and at Makhathini Research Station during the 2009 winter. One set of hybrids, check inbreds and test inbreds was replicated twice at Cedara, but most test inbreds were not replicated. Standard cultural practices except fungicide application were followed. Irrigation was applied to supplement rainfall at Ukulinga and Makhathini. Nurseries were subjected to natural infection and were rated at the hard dough stage using a 1 (resistant) to 9 (susceptible) scale.

RESULTS AND DISCUSSION

Results indicated high level of disease incidence with highly significant ($P \leq 0.01$) genetic variation for disease scores. Disease scores of inbreds ranged from resistant to very susceptible depending on their background. Severity scores were highest in late planted nurseries. Popcorn inbreds were very susceptible; whereas the dent and flint subtropical inbreds were less vulnerable to NLB than their tropical counterparts reflecting their superior adaptation to these South African environments. Genetic analysis of hybrids involving a sample of the inbreds revealed that predominantly genes with additive effects (75-86%) controlled resistance, while genes with non-additive effects played a minor (14-25%) but significant role. Therefore breeding procedures that emphasise general combining ability will be used to enhance the resistance in inbreds, while specific combining ability will be exploited in designing hybrids for deployment in sub-saharan Africa.

CONCLUSION

Overall results indicated huge genetic variation which can be exploited in a breeding program to enhance NLB resistance in maize varieties targeted at African ecosystems.

ACKNOWLEDGEMENT

The maize breeding program at the University of KwaZulu-Natal is funded by the Alliance for a Green Revolution in Africa.

Keywords: Disease resistance, *Exserohilum turcicum*, genetic variation, maize inbred lines, northern corn leaf blight, plant breeding program

SOIL INFORMATION AND EDUCATION FOR A SUSTAINABLE MANAGEMENT: THE SOIL ATLAS OF AFRICA

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Soil is a fundamental component for supporting life. It regulates the climate, provide raw materials, is an important habitat and a large pool of biodiversity, it is a fundamental component of our landscape and cultural heritage but once degraded, soil resources are not renewed easily.

The richness of African soil resources need to be protected. A number of threats are affecting the functioning of African soils. The Soil Atlas of Africa are published to raise the awareness of the general public, policymakers and other scientists to the importance of soil in Africa and to educate. The Atlas is a joint publication by JRC, AUC, ASSS, FAO, ISRIC and scientists from both Africa and Europe.

Contents

- Introduction
- Soils of Africa
- Soil Maps at regional and continental scale
- Derived maps at continental scale with descriptive text (e.g. vulnerability to desertification, soil nutrient status, carbon stocks and sequestration potential, irrigable areas and water resources)
- Case studies (e.g. soil erosion)
- Sources of soil information for Africa, including national contacts and institutions

Dominant soil types are presented in World Reference Base for soil resources (WRB) classification system. Soil keynote properties - texture, pH, organic carbon, water storage capacity, topsoil and subsoil properties, regional maps and case studies are presented as maps.

Format

The atlas is presented as a book of 174 A3 pages (Portrait).

The effort put into the Atlas will also be making soil data accessible through the

- Web: <http://eusoils.jrc.ec.europa.eu>
- Soil Profile Analytical Database for Africa (SPADA)
- African Soil Bureau Network (ASBN)

A side effect is stimulating and supporting the exchange of soil information for Africa based on the successful model of European Soil Bureau Network with contribution by a network of leading African soil scientists and soil survey institutions.

Your contribution is welcomed

- Additional mapping information
- Case study
- Illustrations, photographs

Keywords: soil atlas

THE EFFECT OF CHICKEN MANURE ON SOILS CHEMICAL PROPERTIES IN SELECTED SOIL TYPES IN BOTSWANA

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The use of chicken manure in enhancing soil fertility has been on the increase particularly in Gaborone, Botswana due to escalating prices of inorganic fertilizers. Chicken manure provides nutrients essential for plants growth. The study was designed to assess the effect of chicken manure on some soil chemical properties (pH, EC, exchangeable bases, P and N) of selected soil types in greenhouse pot experiments. Chicken manure (more than 2 months old of chicken layers) was collected poultry farms in Gaborone while the soil samples were collected from Glen valley farm- an active horticultural farm also near Gaborone city. The soils are predominantly sandy loam to sand occurring in an alluvial-cum-colluvial landscape, with patches of vertisolic clayey materials alternating with areas of more sandy and, even, gravelly deposits. The soils are classified as Luvic Calcisol and Ferrallic Arenosol and Vertic Luvisol (FAO, 1998) with the following textural classes; sandy clay loam, loamy sand and clay, respectively. To quantify the effects of application rate on chemical properties of soils, we added chicken manure to three different types of soils at the rates of 5:95, 10:90, 20:80 and 40:60 w/w % chicken manure-soil mixture into equally sized pots. Samples were analysed for soil pH, EC, exchangeable bases and nutrients using samples from the chicken manure-soil mixed samples. The EC and pH were measured potentiometrically in water suspension while the exchangeable bases were measured using Atomic absorption spectrometry methods (van Reeuwijk, 1993). The samples were also analysed for P and N nutrients with Phosphorous determined using the classic method of Olsen-P extraction while for the nitrogen, samples was extracted with 2 M KCl. The soil pH increased with addition of chicken manure with the exception for a Vertic Luvisol which changed from being moderately acidic. Generally the EC together with N, P, K, Ca, Mg and Na increased with application rate for all soil types. Potassium increased to about 10 times in the soil – chicken manure mixtures. Nitrogen doubled in Ferrallic Arenosol, tripled in Vertic Luvisol and about 6 times in Luvic Calcisol suggesting high sorption and retention of N in fine textured or clayey soils. Pronounced effects of chicken manure were also realized in P as it increased to at least 80 times in all soil types. In conclusion, the results suggest that chicken manure has positive effects on soils fertility in addition to acting as a soil chemical condition or amendment. Thus chicken manure has beneficial effects to farmers in increasing soil fertility and hence productivity of crops in particular horticultural crops.

Keywords: chicken manure, soil chemical properties, soil types, Botswana

INTEGRATING HYPERSPECTRAL AND PHYSIOLOGICAL DATA TO DETERMINE THE WATER STATUS OF SATSUMA MANDARIN TREES

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INTRODUCTION

Traditional irrigation scheduling of crops normally involves indirect monitoring of environmental variables e.g. climatic and /or soil water conditions. Irrigation scheduling based on detecting drought stress directly from the plants is currently a subject of scientific interest because many aspects of the plant's physiology respond directly to changes in the water status in the plant tissues rather to changes e.g. in the bulk soil water content. In this study we investigate the potential of hyperspectral sensing as a tool for plant-based stress detection. We propose a method which integrates hyperspectral and physiological data to improve the accuracy of estimates of tree water status.

MATERIALS AND METHODS

Leaf reflectance of young potted citrus trees subjected to different drought stress regimes was monitored outdoors using an ASD spectroradiometer that detects reflectance in the 350 - 2500 nm spectral region at fine spectral resolutions. Water status indicators commonly used for irrigation scheduling namely the midday stem, midday leaf, and predawn leaf water potentials were quantified with the leaf water content and sap flow as ancillary data. Relationships between changes in leaf reflectance and the drought stress indicators were determined using existing spectral indices, logistic regression and a tree level water balance model.

RESULTS AND DISCUSSION

Most spectral indices were highly correlated with the leaf water content of both stressed and unstressed trees with a narrow band spectral ratio of the reflectance at 960 and 950 nm giving the highest leaf water content estimates for citrus leaves. The spectral indices predicted fairly accurately the water potentials of severely stressed trees but they failed to predict the water potentials of the moderately stressed and unstressed trees with $R^2 < 0.20$. However, using the leaf water content data predicted by the spectral methods on unstressed trees as inputs to the tree water balance model significantly improved the midday stem water potential estimates with sap flow as the other model input.

CONCLUSIONS

Hyperspectral indices seem to have a limited use in directly predicting the water potential of trees under light drought stress. Integrating the hyperspectral with physiological data potentially improves the accuracy of prediction of the stem water potential although this approach still needs to be evaluated under field conditions.

ACKNOWLEDGEMENTS

We acknowledge funding from the collaboration between Stellenbosch University and the Katholieke Universiteit Leuven, Belgium and Citrus Research International.

Keywords: Citrus, drought stress, model, spectral indices, water potential

EFFECT OF HYDROGEN CYANAMIDE, MINERAL OIL AND THIDIAZURON IN COMBINATION WITH TIP PRUNING, ON BUD BREAK IN 'EVITA' FIG

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INTRODUCTION

Commercial fig production is relatively new to the Mediterranean-type climate of the Western Cape Province of South Africa. Very little research on fig production has been conducted in South Africa and producers struggle to implement effective commercial practices to ensure adequate yields of quality fruit.

MATERIALS AND METHODS

The chemical rest-breaking agents, Lift® (thidiazuron 3 g·L⁻¹) at 6%, Dormex® (hydrogen cyanamide, 520 g·L⁻¹) at 4%, mineral oil at 4% and a combination of mineral oil and Dormex® at 2% each were evaluated over two seasons in a split plot design in combination with tip-pruning versus no pruning, to overcome apical dominance and increase complexity (Experiment 1). During the 2008/2009 season, an additional investigation was conducted to evaluate the use of thidiazuron and hydrogen cyanamide for harvest scheduling (Experiment 2). Dormex® at 3% and Lift® at 6%, were applied to dormant trees on 30 June 2008, 3 August 2008, 15 August 2008 or 30 August 2008.

RESULTS AND DISCUSSION

In Exp. 1, Lift® increased, and tip-pruning decreased, bud break in both 2007/2008 and 2008/2009. No significant differences between chemical treatments in total new shoot growth or number of fruit were found in either season. Tip-pruning increased average shoot length in both seasons, but decreased the number of fruit per one-year-old shoot unit. In Exp. 2, Lift® applied on 3 August 2008 and Dormex® applied on 30 June 2008 advanced 50 % bud break (of total buds breaking) by ten and seven days respectively, compared with control trees. Lift® application on 30 June significantly increased bud break and new growth. There were no significant differences in harvest distribution in Exp. 2.

CONCLUSIONS

Thidiazuron can be applied to fig trees when buds reach green tip to increase bud break, but without any significant effect on yield. It can also be applied at the end of June to increase both bud break and new growth. Bud break can be advanced by applying Lift® early in August and Dormex® at the end of June, but without any significant harvest scheduling effect.

Keywords: dormancy, *Ficus carica* L., harvest scheduling, rest breaking

VEGETATIVE AND REPRODUCTIVE PHENOLOGY OF 'EVITA' FIG (*Ficus carica* L.) UNDER SOUTH AFRICAN CONDITIONS

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INTRODUCTION

Evita, a European fig cultivar, has recently been introduced to the Western Cape Province of South Africa. Producers struggle to implement effective commercial practices that will optimize yield of quality fruit. A phenological study was conducted to establish the optimum one-year-old shoot length to maximise yield and optimise fruit size.

MATERIALS AND METHODS

The number of fruit, bud break and shoot growth on one-year-old shoots of four different length categories (10 - 15 cm, 25 - 40 cm, 50 - 65 cm and 75+ cm) were evaluated.

RESULTS AND DISCUSSION

The best one-year-old shoot length for sustainable yield of quality fruit was found to be 25 - 65 cm. Shoots 25 - 40 cm long produce good yield as a current shoot and as a one-year-old shoot, and their development can be stimulated by light pruning. Shoots 50 - 65 cm long can be stimulated by more severe pruning. Increased stimulation of vegetative growth may reduce yield of the current season's 50 - 65 cm long shoot, but lead to production of a good crop the following season from the one-year-old shoot.

CONCLUSIONS

Pruning for an on-tree balance of shoots 25 – 40 cm and 50 - 65 cm long will ensure renewal of optimal shoots for yield. Coupled with thinning cuts, optimal yield of quality fruit should be obtained.

Keywords: commercial practices, yield, pruning, shoot length

PHYSICAL, BIOCHEMICAL AND MOLECULAR METHODS FOR THE IDENTIFICATION OF HYBRID EMBRYOS DERIVED FROM CONTROLLED POLYEMBRYONIC CITRUS ROOTSTOCK CROSSES

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INTRODUCTION

One of the major breeding objectives of any citrus breeding programme is the development of new hybrids, and rootstocks are no exception. Rootstocks confer resistance to various abiotic and biotic factors. However, breeding programmes focusing on the development of improved rootstock selections are challenged by the fact that rootstock cultivars are generally polyembryonic. Controlled crosses, and therefore zygotic embryos, are impeded by nucellar embryos which compete with the zygotic embryo for space and nutrients - often resulting in zygotic embryo abortion if not rescued early in their development. Furthermore, it is almost impossible to identify the zygotic embryo at an advanced enough developmental stage for *in vitro* rescue, due to the excessive development of nucellar embryos. Physical, biochemical (Isozymes) and molecular (RAPDs and SSRs) methods were investigated in attempts to identify hybrid seedlings derived from polyembryonic x polyembryonic crosses.

MATERIALS AND METHODS

The following methods were used to determine if hybrid seedlings could be identified:

- Simple leaf morphology of hybrids was assessed
- Microscopic analysis of zygotic vs nucellar embryo identification
- Isozyme studies using PGI, PGM and GOT systems
- Selected SSR primers (TAA41, TAA45, CaC23, TAA1, TAA27 and TAA33) were investigated using standard PCR methods
- Selected RAPD primers (OPH11, P141, P140 and OPH15) were investigated using standard PCR methods

RESULTS AND DISCUSSION

Leaf morphology could only be used where the male and female parents had different leaf morphologies i.e. simple vs trifoliate. A trifoliate seedling with simple leaved female parent, was identified as a hybrid. Isozyme analysis could not distinguish between the parents although one system, PGM, did elicit differences. Of the SSR primers tested, very little variation was detected and a maximum of 4 of the 11 parents used could be discerned using primer TAA45. The RAPD primers tested (particularly OPH11) resulted in specific banding profiles for each of the 11 parents used.

CONCLUSIONS

Zygotic embryos cannot be identified at the naked eye or microscope level when polyembryonic crosses are made. Hybrid plants can be identified only if male and female parent leaf morphology differs. The SSR primers tested are able to distinguish between a limited number of the eleven rootstocks used in controlled crosses. Currently, the RAPD primers tested produce profiles/banding patterns specific to each parent used in the controlled crosses in the citrus rootstock improvement programme.

ACKNOWLEDGEMENTS

Grateful thanks are extended to Zelda Bijzet and Nikki Combrink who carried out the pollinations and harvested fruit after pollination. The ARC is thanked for provision of funding.

Keywords: zygotic embryos, nucellar embryos, molecular analysis

CHARACTERISATION OF RAW AND CHEMICALLY OXIDISED BIOCHAR FOR USE AS A SOIL AMENDMENT

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INTRODUCTION

Biochar (charred biomass) has the potential to not only improve the quality of typically low-fertility soils in the tropics and humid subtropics, but also to contribute to long-term C sequestration (Laird, 2008). The objective of our study was to investigate chemically oxidising biochar in order to increase its cation exchange capacity (CEC), and to develop a protocol for characterising biochar for use as a soil amendment.

MATERIALS AND METHODS

Commercial biochar produced using slow pyrolysis from invasive *Pinus* tree species, was chemically oxidised using hydrogen peroxide. Selected chemical and physical properties, related to use of biochar as soil amendment, were investigated in the raw and oxidised biochar. This included elemental analysis, functional group characterisation using CPMAS ¹³C NMR and FTIR spectroscopy, CEC, pH, plant available nutrients, bulk density, water holding capacity and BET specific surface area.

RESULTS AND DISCUSSION

The data show that the peroxide treatment results in the preferential oxidative decomposition of selected aliphatic and O-alkyl C materials in the biochar. This leads to enrichment of resistant aromatic materials and increases the C and ash content, while decreasing the O content. The treatment did not enhance the carboxylic group content or the CEC of the biochar. The CEC of the raw biochar was about 20 cmolc/kg which is approximately one order of magnitude lower than the values reported for soil organic matter.

CONCLUSIONS

Hydrogen peroxide conditioning of biochar results in the preferential oxidation of the more labile C fractions and subsequently results in aromatic C enrichment. It did not enhance the CEC of the biochar.

REFERENCES

LAIRD, D.A., 2008. The charcoal vision: A win-win scenario for simultaneously producing bio-energy, permanently sequestering carbon, while improving soil and water quality. *Agron. J.* 100, 178-181.

ACKNOWLEDGEMENTS

We would like to thank Allbrick, Thembaletu for funding this research.

Keywords: biochar, CEC

EFFECT OF FERMENTATION TEMPERATURE AND TIME ON CHEMICAL COMPOSITION OF BUSH TEA (*Athrixia phylicoides*)

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INTRODUCTION

Athrixia phylicoides (DC.), commonly known as bush tea, is indigenous to South Africa. It is used as a herbal tea and a medicinal plant by traditional African people (Roberts, 1990). McGaw *et al.* (2007) reported that bush tea leaves contain no caffeine or pyrrolizidine alkaloids, justifying its medical potential. Total polyphenols in tea leaves are the main indicators for medicinal potential due to their antioxidant activities (Hirasawa *et al.*, 2002). This study was initiated to determine the effect of fermentation temperature and time on the quality of bush tea.

MATERIALS AND METHODS

Fermentation temperatures and times were investigated separately, with each treatment replicated three times. Temperature treatments comprised 24°C (control), 30°C, 34°C, 38°C and 42°C, with the tea leaves being fermented for 30 minutes in an incubator. To determine the optimal time, fermentation was carried out for 0 (control), 60, 90 and 120 minutes at 22-26°C in an incubator. Chemical analyses (polyphenols, tannins and antioxidants) were according to the methods of Waterman and Mole (1994).

RESULTS AND DISCUSSION

This study demonstrated that fermentation temperatures of 30, 34 and 38°C significantly increase polyphenols, whereas tannin content showed a great reduction at 38 and 42°C. Increasing fermentation time achieved a significant increase in both polyphenols (60 and 90 minutes) and tannin contents (90 and 120 minutes). However, changes in either fermentation temperature or time did not have a significant influence on antioxidant content of bush tea.

CONCLUSION

Different fermentation temperatures and times of bush tea exhibited significant influence on polyphenol and tannin contents, but had no influence on the antioxidant content of the tea. Further studies are required to determine the sensory quality parameters, such as taste and aroma.

REFERENCES

- HIRASAWA, M., TAKADA, T., MAKIMURA, M. & OTAKE, O., 2002. Improvement of periodontal status by green tea catechin using a local delivery system: A clinical pilot study. *J. Periodontal Res.* 37, 433-438.
- McGAW, L.J., STEENKAMP, V., & ELOFF, J.N., 2007. Evaluation of *Athrixia* bush tea for cytotoxicity, antioxidant activity, caffeine content and presence of pyrrolizidine alkaloids. *J. Ethnopharmacol.* 110(1), 16-22.
- ROBERTS, M., 1990. *Indigenous Healing Plants* (first edition), Southern Book Publishers, Halfway House, South Africa.
- WATERMAN, P. & MOLE, S., 1994. *Analysis of phenolic plant metabolites* p. 85 – 88. Blackwell Scientific, London.

ACKNOWLEDGEMENTS

The authors would like to thank Tshumisano for providing funds.

Keywords: *Athrixia phylicoides*, fermentation, temperature, chemical composition

CHILLING INJURY IN 'EUREKA' LEMONS: COULD POLYAMINES REDUCE THE INCIDENCE?

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INTRODUCTION

The polyamines (PAs) putrescine, spermidine and spermine are ubiquitous molecules, present in both plants and animals. They are believed to play roles in a wide variety of plant functions, from floral initiation to rhizogenesis and cell division. The ability of PAs to impact these functions suggests that they could perhaps be used as a plant growth regulator to influence fruit set or fruit growth and fruit quality. The potential of PAs to reduce Chilling injury (CI) occurrence in lemons was investigated, as these molecules influence membrane permeability and cell wall rigidity.

MATERIALS AND METHODS

CI was simulated by storing lemons in a cold room set at 2 °C ± 2 °C. Storage conditions were adapted from USDA Phytosanitary Requirements for citrus export. Temperature and relative humidity within the cold room were measured at regular intervals. Harvest-ready lemons were treated with two concentrations i.e. 1mM and 0.1mM of the three PAs, putrescine, spermidine and spermine, seven days prior to harvest. An untreated control was included. Following harvest these lemons were stored in a cold room. Additional lemons were also treated post-harvest by dipping them in the same concentrations of PAs for 30 seconds, following which they were transferred to the cold room. CI was evaluated after 48 days of storage and PA levels within the fruit rind quantified using HPLC. Micrographs were prepared to investigate the effects of PA applications on cell membranes. A complete randomized design was used, with 40 replicates of each treatment. The Kruskal-Wallis test was performed to test for significant differences between treatments and a t-test (LSD) to determine differences between means with a probability level of 0.05%.

RESULTS AND DISCUSSION

CI could be found under simulation conditions on treated and control fruit. These symptoms occurred mainly in the rind of the fruit, without greatly influencing internal fruit quality. Occasionally CI was found on the whole fruit surface, rendering fruit soft to the touch, and when cut open the rind had a halo-like appearance. Certain PA-treatments appeared to reduce the incidence of CI, but this was dependent on the timing of application, the PA applied and the concentration thereof.

CONCLUSION

PAs could be used as a possible method to reduce CI in export citrus fruit. The reduction in CI is a result of interaction with cell membranes, reducing membrane permeability and increasing cell wall rigidity.

Keywords: Chilling Injury, polyamines, putrescine, spermidine, spermine

EFFECT OF SILICON APPLICATION ON 'HASS' AVOCADO FRUIT PHYSIOLOGY

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INTRODUCTION

Avocado fruit are prone to post-harvest physiological disorders such as anthracnose and mesocarp discolouration. Silicon has been used to minimize the adverse effects of biotic and abiotic stress on fruit quality (Gong *et al.*, 2005; Liang *et al.*, 2007). This study investigated the effect of silicon application on fruit firmness, CO₂ production and ethylene evolution of 'Hass' avocado fruit.

MATERIALS AND METHODS

Four different sources of silicon (potassium silicate (KSil), Nontox-Silica (NTS), calcium silicate and sodium metasilicate pentahydrate) were used as postharvest applications. Fruit were dipped into the Si sources at 80 ppm to 1470 ppm Si and subsequently stored at either -0.5, 1, 5 or 25°C (room temperature). Firmness, CO₂ and ethylene measurements were taken every two days as the fruits ripened.

RESULTS AND DISCUSSION

Fruit stored at 5°C were firmer than fruit stored at other temperatures. Fruit dipped into KSil 80 (80 ppm Si) showed the highest levels of firmness. With respect to net CO₂ production, there were significant differences due to storage temperatures. Fruit stored at -0.5°C produced the highest amount of CO₂ whereas fruit stored at 5°C produced the lowest. There were no significant differences between the treatment means. Results of ethylene evolution showed that there were differences ($p < 0.05$) due to storage temperature. There were no differences between treatment means and there were no significant interactions between the treatments and storage temperatures. Further ultra-structural analysis (EDAX) was conducted to determine the extent of Si infiltration within each treatment. Si passed through the exocarp into the mesocarp tissue in fruits treated with high concentrations of silicon, i.e., KSil 1470 ppm. Fruit dipped into very dilute Si solutions (80 ppm and 160 ppm) showed very little to no infiltration of Si into the mesocarp. Treatments with NTS showed very little Si infiltration.

CONCLUSIONS

Postharvest application of 1470 ppm Si in the form of KSil seems to be most beneficial, probably as respiration was most suppressed in the KSil 1470ppm at 5°C treatment.

REFERENCES

- GONG, H., ZHU, X., CHEN, K., WANG, S., & ZHANG, C., 2005. Silicon alleviates oxidative damage of wheat plants in pots under drought. *Plant Sci.* 169, 313-321.
LIANG, Y., SUN, W., ZHU, Y.G., & CHRISTIE, P., 2007. Mechanisms of silicon-mediated alleviation of abiotic stresses in higher plants: A review. *Environ. Pollut.* 147, 422-428.

Keywords: Avocado, Silicon, Fruit firmness, carbon dioxide, ethylene

LOW TEMPERATURE SHIPPING AND COLD CHAIN MANAGEMENT OF 'HASS' AVOCADOS: AN OPPORTUNITY TO REDUCE SHIPPING COSTS

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INTRODUCTION

With the South African avocado industry being largely export orientated, new and effective technologies are vital to improve quality and shelf life. The 'Hass' cultivar comprises 50% of South African avocado exports. Current technologies to delay ripening, such as 1-MCP and CA, are costly and have disadvantages (Maré *et al.*, 2002). It has been shown that breaks in the cold chain are highly detrimental to fruit quality, even if the fruit recover to normal physiological functioning. Premature softening, mass loss and colour change resulted from cold chain breakage in Chilean fruit (Undurraga *et al.*, 2007). This study examined whether storage at 1°C is comparable to 1-MCP during simulated shipping, and ascertained the effects of cold chain breaks on the final fruit quality of 'Hass' avocados.

MATERIALS AND METHODS

'Hass' avocado fruit were subjected to treatments of temperature (1°C and 5.5°C), 1-MCP (treated and untreated), waxing (waxed and non-waxed) and cold chain breaks (no break, 24 hour delay, break at 5, 10 and 20 days). The 40 treatment combinations (10 fruit each) were placed into simulated shipping for 28 days. The weight, fruit softness, water content, CO₂, ethylene, and days to ripening were measured and recorded. Statistical analysis was conducted in the form of a factorial design in order to determine significant differences between the treatments used.

RESULTS AND DISCUSSION

The results indicated that the effect of ripening with the use of 1°C was comparable to the use of 1-MCP, although 1-MCP slightly extended the time to ripening. There were signs that the occurrence of cold chain breaks did in fact reduce the quality and ripening period, but results were variable. It was interesting to note that the temperature of 1°C nullified the effect of the breaks to some extent.

CONCLUSIONS

It is possible that 1°C will be the protocol temperature for the 'Hass' cultivar due to the advantageous effects. This temperature may not entirely match the performance of 1-MCP, but it may be a viable alternative with respect to the economics involved. The effect of cold chain breaks are also reduced at this temperature but the physiological aspects still need to be investigated.

REFERENCES

- MARÉ, L., TRUTER, A.B., DODD, M.C. & HOLCROFT, D.M., 2002. The use of CA storage, CO₂ shock treatments and / or 1-MCP treatments on 'Fuerte' and 'Hass' avocados. *S. Afr. Avocado Growers' Assoc. Yrbk.* 25, 35-44.
- UNDURRAGA, P., OLAETA, J.A. & SAN MARTIN, J., 2007. Effect of Temperature Break in the Behaviour of Avocados (*Persea americana* Mill.) Hass cv. During Refrigerated Storage. *Proceedings VI World Avocado Congress*, Viña Del Mar, Chile.

Keywords: low temperature shipping, 1-MCP, cold chain breaks

LOW LEVELS OF REFUGE COMPLIANCE RESULTED IN RESISTANCE DEVELOPMENT OF THE MAIZE STEM BORER TO BT MAIZE AT THE VAALHARTS IRRIGATION SCHEME

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INTRODUCTION

Interest in Bt maize refuge compliance, pest incidence and production practices at Vaalharts was recently stimulated by the first report of field resistance of *Busseola fusca* (Lepidoptera: Noctuidae) to Bt maize (Van Rensburg, 2007). Objectives of this study were to evaluate farmer's perceptions of the regulatory aspects guiding the planting of Bt maize and refugia and how the field situation developed between 1998 and 2008. One of the specific objectives was to determine the history of the level of compliance to refuge requirements since this could contribute to resistance development.

MATERIALS AND METHODS

A structured survey was conducted amongst 80 farmers at the Vaalharts irrigation scheme and addressed signing of contracts upon purchasing GM seed, refuge compliance, refuge design, size of fields and general farming practices that could relate to managing the maize stem borer. Farmers were randomly chosen to cover the whole geographical region of the irrigation scheme. All farmers at the irrigation scheme practice mixed farming with maize being the most important farming activity. Mean values were determined for the responses to questions.

RESULTS AND DISCUSSION

Only 46% of the farmers planted Bt maize during the 1998 season when it was first available. The two greatest advantages associated with Bt maize was indicated to be convenient management (88 %) while 42.5 % indicated that they perceived Bt technology to be environmentally friendly. Initial levels of refuge compliance were low and only 7.7 % of farmers planted refuges during 1998. This number increased to 100 % during 2008. Eight percent of farmers, however, indicated that they did not plant a refuge field for each Bt maize field. The reasons provided by farmers for not planting refugia were that they did not know that they had to, or did not realize its importance, and that their neighbors planted conventional maize that functioned as refugia.

CUNCLUSIONS

It seems that the low levels of refuge compliance were the main reason for resistance development of the target pest to Bt maize at the Vaalharts irrigation scheme (Kruger *et al.*, 2009). Other factors such as variance in time of planting providing a continues supply of moths and other insect behavior characteristics could, however, also have played a role.

REFERENCES

- Kruger, M., Van Rensburg, J.B.J. & Van den Berg, J. 2009. Perspective on the development of stem borer resistance to Bt maize and refuge compliance at the Vaalharts irrigation scheme in South Africa. *Crop Prot.* 28: 684 – 689.
- Van Rensburg, J.B.J. 2007. First reports of field resistance by the stem borer, *Busseola fusca* (Fuller) to Bt-transgenic maize. *S. Afr. J. Plant Soil* 24: 147-151.

Keywords: Bt-maize, *Busseola fusca*, refuge compliance, resistance development

COMPARISON OF THE DEGREE OF WATER SATURATION OF SELECTED DIAGNOSTIC HORIZONS IN THE CATHEDRAL PEAK VI AND WEATHERLEY CATCHMENTS

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INTRODUCTION

Degree of water saturation has been studied in the Weatherley and Cathedral Peak VI catchments. The degree of water saturation of a soil (s) is defined as the fraction of the porosity that is occupied by water. This is considered to be a useful parameter due to its correlation with redox conditions in the soil. It was shown by Van Huyssteen *et al.* (2005) that for the Weatherley catchment high s values (>0.7) for relatively long durations are generally associated with defined morphological signs of wetness. Since the hydraulic conductivity of a soil decrease very rapidly as the water content decreases from field saturation (about $0.9s$) down to the drained upper limit (around $0.6s$), $s > 0.7$ in the profile implies drainable water of which its duration becomes important to redox reactions. Weatherley results were compared to results from the Cathedral Peak VI catchment which have a different environment.

METHODOLOGY

Using the long term soil water content data, we assumed that the degree of saturation (s) at which anaerobic conditions would be acute enough to cause redox reactions of sufficient intensity to produce visible signs of redox morphology was $s > 0.7$ in both catchments. In accordance with this assumption the daily soil water regime was used to obtain the the average duration in days year⁻¹ that s was above 0.7 of porosity ($AD_{s>0.7}$) for the diagnostic horizons for each modal profile.

RESULTS

The average s values for the diagnostic horizons in each catchment were: red apedal B (17 ± 10 days year⁻¹), yellow-brown apedal B (82 ± 56 days year⁻¹), saprolite (230 ± 22 days year⁻¹) and orthic A (43 ± 17 days year⁻¹) in the Weatherley catchment and red apedal B (54 ± 38 days year⁻¹), yellow-brown apedal B (40 ± 27 days year⁻¹), saprolite (294 ± 32 days year⁻¹), and humic A (0 days year⁻¹) in the Cathedral Peak VI catchment.

CONCLUSIONS

Diagnostic topsoil horizons of Cathedral Peak VI soils have drier soil water regimes than in Weatherley because humic soils probably drain faster. This trend changes in the diagnostic subsoil horizons of Cathedral Peak VI soils which have wetter soil water regimes than in the Weatherley catchment.

REFERENCE

Van Huyssteen, C.W., Hensley, M., Le Roux, P.A.L., Zere, T.B. & Du Preez, C.C. 2005. The relationship between soil water regime and soil profile morphology in the Weatherley catchment. Report No. 1317/1/05, WRC, Pretoria.

Keywords: saturation, soil water regime, redox, porosity

BASELINING THE NUTRIENT ELEMENTS OF *Mimusops zeyheri* UNDER NATURAL CONDITIONS

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INTRODUCTION

Mimusops zeyheri, indigenous to south Saharan Africa, has fruits with highest vitamin C among both exotic and indigenous tested fruit trees. Currently, it is found in mountainous areas and along the rivers in Limpopo Province. Attempts are currently under way to domesticate the plant in order to use it for both aesthetic and nutritional purposes. A baseline study was conducted to determine factors that influence its nutritional status.

MATERIALS AND METHODS

The experiment was arranged as a 2 x 3 factorial in a randomized complete block design, with the first and second factors being sampling time and location, respectively. Five matured leaves from fruit-bearing branches were sampled from each of the four cardinal positions. Soil samples were collected from the cardinal points at 0.5 m from the trunk using a 2-cm-diameter auger. Leaf nutrient elements were regressed against soil Ca, Cu, K, Fe, Mn, Na, Zn, P, pH (H₂O) and EC.

RESULTS AND DISCUSSION

The stepwise regression eliminated factors that the plant was saturated with. For any nutrient element in the leaf, certain soil factors might be limiting for the accumulation of that element during fruiting, but after fruiting the same soil factors became limiting, optimal or inhibitory to the accumulation of the same element in leaves. For instance, for accumulation of Cu in leaves, Mg was inhibitory during fruiting and after fruiting, whereas it had limited effect on accumulation of K during fruiting. Identification of limiting nutrient elements could improve the determination of fertilizer requirement for this plant.

CONCLUSIONS

Physiological studies will be necessary to assess the importance of "limiting" mineral nutrients in the accumulation of certain mineral nutrients in *M. zeyheri* in relation to its productivity.

ACKNOWLEDGEMENT

The authors are grateful to the National Research Foundation for funding the study.

Keywords: *Mimusops zeyheri*, nutrient elements, stepwise regression

SEED DRESSING AND FOLIAR-APPLIED INSECTICIDE EFFICACY AGAINST RUSSIAN WHEAT APHID (*Diuraphis noxia*) ON DRYLAND WHEAT IN THE SUMMER RAINFALL REGION

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INTRODUCTION

Seed dressing, foliar-applied insecticides and host plant resistance provide protection against RWA though new biotypes may overcome genetic resistance in wheat varieties. Insecticide sprays are less environmentally friendly and may contribute excessively to input costs of the farmer. The aim of our experiment is to determine efficacy of host plant resistance in commercial wheat varieties compared to chemical control and also analyze cost implications and profitability of chemical RWA control measures in commercial wheat.

MATERIALS AND METHODS

Field trials using a split-split plot design with four replications were planted at ARC-SGI (Bethlehem) and Seotlong (Qwa-qwa) in 2008. Comparisons between application cost, efficacy and profitability of host plant resistance, seed dressing (Imidacloprid) and foliar insecticides (Demeton-S-Methyl/Parathion or Chlorpyrifos) applied singularly or in combination to Matlabas, Scheepers 69 (susceptible check), SST 399 and PAN 3144 (resistant check) were made. An adapted commercial precision planter with an in-row spacing of 5cm, between-row spacing of 45cm and fertilizer placement sufficient for 30kg ha⁻¹ was used and soil moisture during planting was adequate in 2008. Seed dressing consisted of Gaucho 350FS applied at 400ml of Imidacloprid with 800ml of water to 100kg of seed. The foliar insecticides Demeton-S-Methyl (500ml/ha) + Parathion (650ml/ha) and Chlorpyrifos (850ml/ha) were applied with a knapsack sprayer delivering 100l/ha between growth stages 12 to 13. Percentage infested tillers in plots were determined between growth stage 12 to 13 before application of foliar insecticide treatments by using the recommended scouting technique for RWA. Application cost (seed, pesticide, application and risk), cultivar yield and quality were used to calculate profitability of all treatments in comparison with the untreated check for each cultivar. Data was analyzed by ANOVA using GENSTATS 8.1 for Windows (F probabilities of 0.05, 0.01 and 0.001).

RESULTS AND DISCUSSION

Seed dressing combined with insecticides increased yield significantly above the untreated check and frequently resulted in a positive growth response. In 2008 main effect of Treatments (Insecticides) was significant at Seotlong (F.pr <0.05) confirming that reduced RWA infestation from Imidacloprid treatment combined with insecticides enables wheat varieties to achieve yields closer to the genetic potential for the specific variety. Hectolitre mass of Scheepers 69 (susceptible check) was significantly increased at ARC-SGI (F.pr <0.001) and Seotlong (F.pr <0.001) by Imidacloprid and Chlorpyrifos and Demeton-s-methyl/Parathion. Though percentage RWA infestation at ARC-SGI was less than at Seotlong in 2008, marginal rainfall on shallower sandy-loam soil resulted in a mean yield of 1.85 tons ha⁻¹ at ARC-SGI compared to 2.41 tons ha⁻¹ at Seotlong where higher rainfall during the late wheat season on deep sandy soil increased yield.

CONCLUSIONS

With the production conditions of 2008 insecticide treatments were generally more profitable in high-yielding environments such as Seotlong as all five treatments increased profitability on three of the four wheat varieties. This trend strongly indicates that insecticides become increasingly important as the yield potential of a specific production area or field approaches optimal yielding conditions.

Keywords: Wheat, Russian Wheat Aphid, Chemical Control

LOW TEMPERATURE SHIPPING AND COLD CHAIN MANAGEMENT OF 'FUERTE' AVOCADOS: AN OPPORTUNITY TO REDUCE SHIPPING COSTS

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INTRODUCTION

The South African avocado industry is largely export orientated, depending heavily on the European markets, with 'Fuerte' making up 25% of exports. A temperature of 5.5°C and expensive controlled and modified atmosphere treatments are currently used to delay ripening; however, fruit still appear on the European market showing signs of softening and physiological disorders. Previous work by Bower & Magwaza (2004) showed that it is possible to ship greenskins at 2°C, and has also been repeatedly shown to result in improved fruit quality (Van Rooyen, 2006). The extent to which cold chain breaks affect quality, and whether 1-MCP counters this, is unknown in greenskins, as is the combination with low temperature. The objective of the study was to determine the potential for shipping 'Fuerte' avocados at 2°C, and to determine the effects of cold chain breaks on fruit quality.

MATERIALS AND METHODS

'Fuerte' avocado fruit were subjected to treatments of temperature (2°C and 5.5°C), 1-MCP (treated and untreated), waxing (waxed and non-waxed) and cold chain breaks (no break, 24 hour delay, break at 5, 10 and 20 days). The 40 treatment combinations were placed into simulated shipping for 28 days. Data were collected for 10 fruit (replications) for each treatment combination and analysed with respect to fruit softness, weight, water content, CO₂ levels, days-to-ripening, external quality and internal quality. A factorial design was used for the statistical analysis.

RESULTS AND DISCUSSION

The storage temperature of 2°C provided good internal quality as well as reduced weight loss (mainly water loss) and fruit softening. The 2°C storage temperature did cause a notably higher occurrence of external chilling injury than 5.5°C. The cold chain breaks showed no definitive results, but further physiological analysis of the tissue samples should highlight the effects of cold chain breaks on fruit quality.

CONCLUSIONS

The results indicate that a 2°C storage temperature can improve the internal quality. Being a greenskin, the external chilling injury which occurred as a result of 2°C storage is unacceptable and may require other mitigating treatments to negate the external chilling injury. This suggests that 1-MCP may still be required for greenskins, whereas the external injury in non-greenskins such as 'Hass' would be immaterial.

REFERENCES

- BOWER, J. P., MAGWAZA, L.S. 2004. Effect of coatings and packaging on external and internal quality with emphasis on cold injury. *S. Afr. Avocado Grower's Assoc. Yrbk.* 27, 51-55.
- VAN ROOYEN, Z., 2006. Factors affecting mesocarp discoloration severity in 'Pinkerton' avocados. Ph.D. Thesis, University of KwaZulu-Natal, Pietermaritzburg, South Africa.

Keywords: low temperature shipping, 1-MCP, cold chain breaks

CAN HYDROPRIMING IMPROVE GERMINATION SPEED, VIGOUR AND EMERGENCE OF MAIZE LANDRACES UNDER WATER STRESS?

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INTRODUCTION

Maize landraces are crop genetic resources that have evolved through natural and farmer selection. Earlier work showed that landraces may have the same viability but not vigour as hybrids. Hydropriming has recently been used to enhance seed vigour in several other crops. The aim of this study was to evaluate whether hydropriming can improve vigour characteristics and seedling emergence of a local maize landrace compared to commercial hybrids under water stress.

MATERIALS AND METHODS

The study was conducted at the University of KwaZulu-Natal, Pietermaritzburg. Seeds from a local landrace were produced and characterized according to kernel colour, white (Land A) and purple (Land B), and compared to two hybrids, SC701 and SR52, which are popular amongst local farmers. Three replications of 25 seeds from each variety were soaked in water for 0 hours (unprimed or control), 12 hours and 24 hours, and germinated between moistened double layered paper towels in a germination chamber at 25°C for 8 days. Parameters measured included final germination, mean germination time (MGT) and germination velocity index (GVI). Seedling emergence was performed in seedling trays, using three replications of 10 seeds from each variety and treatment, using pine bark wetted to 25% or 75% of field capacity (FC), for 21 days in a temperature-controlled glasshouse (25°C day; 15°C night; 60% RH). Parameters measured included final emergence, mean emergence time (MET), root and shoot lengths, and leaf area. Samples of unprimed and primed seeds were analysed for soluble sugars using isocratic High-Performance Liquid Chromatography (HPLC). Data was analysed using GenStat® (Version 11) ANOVA and LSD (5%) to separate means.

RESULTS

Hydropriming did not improve final germination. Hybrids performed better than landraces when seeds were not primed. Priming landraces for 12 and 24 hours reduced MGT by 9% and 7%, respectively, compared to 5% in hybrids for both 12 and 24 hours priming. GVI of landraces was improved by 40% following 12 hours of priming. GVI of hybrids was 11% and 7% slower than landraces after priming seeds for 12 and 24 hours, respectively. There was a highly significant interaction ($P < 0.001$) between variety and priming for germination traits associated with vigour, namely root length, shoot length and fresh mass. For all varieties, priming seeds for 24 hours improved emergence at 25% FC, whereas priming for 12 hours improved emergence at 75% FC, albeit not significantly ($P > 0.05$). There was a highly significant interaction ($P < 0.001$) between priming and FC for MET. Priming seeds for 24 hours reduced MET for all varieties. Priming seeds for 12 and 24 hours increased leaf area by 33.8% and 29%, respectively. There was no correlation between the pool of soluble sugars and other measured parameters in response to priming, implying that benefits realised from priming were not related to availability of soluble sugars.

CONCLUSION

Hydropriming seeds for 12 and 24 hours, respectively, improved GVI, reduced MGT and improved emergence and MET of maize landraces under water stress. Performance of hybrid seeds remains superior to that of landraces even after seed treatment to improve germination and vigour. The positive response of landraces to seed treatment, and improved performance under water stress conditions, suggest that there is a need to identify genes for vigour in the landrace maize.

Keywords: Emergence, Germination, Hydropriming, Landraces, Water stress

COMPARATIVE PERFORMANCE OF TOMATO CULTIVARS IN A CLOSED SOILLESS HYDROPONIC PRODUCTION SYSTEM VERSUS AN OPEN BAG SYSTEM

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INTRODUCTION

Most tomato cultivars grown in South Africa are imported varieties. Therefore, knowledge for optimal cultivation of specific tomato cultivars under various growing conditions still needs to be determined. However, many growers in and around South Africa have become interested in growing tomato in soilless systems due to improved yield and quality obtainable under these conditions (Maboko *et al.*, 2009). The objective of the study was to compare the performance of four tomato cultivars in two different production systems, i.e., the open-bag hydroponic system and the closed hydroponic (gravel film technique) system.

MATERIAL AND METHODS

Two hydroponic systems were used, i.e., an open-bag and a closed system (gravel-film technique) under a 40% shadenet structure. Four cultivars were evaluated in each production system, namely 'FiveOFive', 'Malory', 'Miramar' and 'FA593'. Both experiments were laid out as randomized complete block designs with four replicates. Data were collected from 10 plants per treatment (4 m²) and the performance of the cultivars was evaluated using total, marketable and unmarketable yield, as well as physiological disorders.

RESULTS AND DISCUSSION

Plants grown in the open-bag system developed faster than plants grown in the closed system. 'Miramar' and 'FiveOFive' produced the highest marketable yield when grown in the closed system, while the marketable yield of 'FA593' was similar to these two cultivars in the open bag system. In both production systems, 'FA593', followed by 'Malory', had the lowest number of marketable fruit compared to the other two cultivars. The lower marketable yield of 'FA593' and 'Malory' can be attributed to the higher number of cracked fruit due to larger fruit size.

CONCLUSIONS

The results indicate that the closed cultivation system can improve the number of marketable fruit, as well as total and marketable yield of tomato compared to the open bag cultivation system. 'Miramar' and 'FiveOFive' were the most promising cultivars in both systems with regard to yield and quality.

REFERENCES

MABOKO, M.M., DU PLOOY, C.P. & BERTLING, I., 2009. Comparative performance of tomato cultivars in soilless vs. in-soil production systems. *Acta Hort.* 843, 319-326.

Keywords: Closed system, fruit cracking, open bag system, marketable yield

INFLUENCE OF SEED PRIMING ON GERMINATION OF WILD CUCUMBER (*Cucumis myriocarpus*)

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INTRODUCTION

Seeds of wild cucumber (*Cucumis myriocarpus*) germinate poorly due to an auto-allelochemical referred to as cucurbitacin A (Mafeo & Mashela, 2009). Consequently, this chemical must be leached by means of rain or irrigation water in order to enhance germination. The plant is being evaluated as an alternative crop since its leaves are widely used as greens, while extracts from its fruits have various medicinal and nematocidal properties (Mashela, 2002). An investigation was conducted to determine the germination of *C. myriocarpus* seeds in response to seed priming in stagnant and running water.

MATERIALS AND METHODS

Treatments included an untreated control (T0) and priming of *C. myriocarpus* seeds in stagnant (T1) and in running tapwater (T2) for 24 hours. Primed seeds were placed in Petri dishes on moistened filter paper. The three treatments were arranged in a completely randomized design with 5 replicates per treatment, in growth chambers at 27°C and 80% RH. The filter papers were moistened daily at 17h00 using 2 ml distilled water, with germinated seeds being removed and recorded from each Petri dish daily for 10 days. The trial was terminated at 10 days once all T2 seeds had germinated.

RESULTS AND DISCUSSION

Relative to untreated controls, priming in stagnant and running water improved cumulative germination by 48% and 83%, respectively. In T2, where auto-allelochemicals were leached out of the priming environment, germination rate was improved - with four peaks. In T1 and controls, the germination rate lagged behind T2 and had only two peaks. The presence of germination peaks suggests that germination in this species is staggered. As shown by the four peaks in T2, when the allelochemicals are leached the germination rate increases but the staggering is retained. This staggering probably serves as a survival strategy, ensuring that seeds do not germinate all at once when exposed to harsh environmental conditions.

CONCLUSION

Germination in *C. myriocarpus*, regardless of leaching of allelochemicals, is staggered as a survival strategy. The mechanism involved is not yet established. However, suppression of germination by Cucurbitacin A appears to be a common phenomenon on various seeds (Mafeo and Mashela, 2009). Future research will be focusing on the influence of cucurbitacin A on the activities of gibberillic acid on seed germination.

REFERENCES

- MAFEO, T.P. & MASHELA, P.W., 2009. Responses of Germination in Tomato, Watermelon and Butternut Squash to a *Cucumis* Bio-nematicide. *J. Agric. Sci.* (In Press).
Mashela, P.W., 2002. Ground wild cucumber fruits suppress densities of *Meloidogyne incognita* in tomato crop. *Nematropica* 32, 13 - 19.

ACKNOWLEDGEMENTS

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Keywords: Allelochemicals, *Cucumis myriocarpus*, germination

THE EFFECT OF IRON SUPPLEMENTS ON THE POSTHARVEST CHILLING INJURY DISORDER OF AVOCADO FRUIT

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INTRODUCTION

This presentation deals with recent research aimed at reducing chilling injury in South African avocado fruit. Previous surveys and trials have indicated that susceptibility to chilling injury may be associated with reduced fruit iron concentration (Magwaza *et al.*, 2008). To substantiate these results, further trials were performed during 2007/08 season.

MATERIALS AND METHODS

During the 2007/08 season, two experiments were executed. In the first, 90 grams of DDPA (Fe chelate) was top-dressed onto a 'Hass' orchard in the Kiepersol area. In the second trial, 60 grams DDPA split into 6 monthly dosages of 10 grams each, and applied by fertigation onto a 'Pinkerton' orchard in the Schagen area, starting from Sep. 2007 to Feb. 2008. Each treatment was replicated five times and each replicate consisted of seven trees. Fruit sampling for mineral analysis took place on a monthly basis from Dec. 2007 to Sep. 2008. Sampling for storage purposes in both trials was done on a bi-weekly basis from May to Sep. 2008. In the 'Hass' trial, a total of 15 fruit per replicate was harvested on each date of which five fruit were used for maturity and mineral content analysis and 10 were stored at phytosanitary temperatures (2°C for 28 days). In the case of 'Pinkerton', 67 fruit per replicate were sampled of which 60 were assigned to three postharvest storage temperatures (2, 4, and 6°C) and seven used for maturity and mineral analysis.

RESULTS AND DISCUSSION

The results indicated that, on certain dates and at specific storage temperatures, the mean chilling injury scores were lower in fruit from orchards that received Fe supplements. However, in both cultivars, neither the flesh nor the skin iron content was increased by the iron treatments. Interestingly, the iron applications reduced the nitrogen content of the fruit at both experimental sites. This led to significant reductions in grey pulp, a nitrogen dependent internal physiological disorder of avocado fruit. On the other hand, the orchards became more susceptible to orchard freeze damage due the lower nitrogen status of the trees.

CONCLUSIONS

The Fe applications applied in the current study was found to influence the development of three physiological disorders of avocado fruit. Interesting observations were also made regarding the interaction between Fe supplementation and N uptake. However, taking all the above results into account, we conclude that, in contrast with elements such as nitrogen and calcium, it is not justified to attempt to modulate the fruit pulp Fe content in an attempt to improve the postharvest storage potential of the fruit.

REFERENCES

MAGWAZA, L.S., LEMMER, D., NTANDANE, J. & KRUGER, F.J., 2008. Effect of N and Fe fertilizer treatments on the incidence of chilling injury in 'Fuerte' and 'Hass' avocados. *S. Afri. Avocado Growers' Assoc. Yrbk.* 3, 6-8.

ACKNOWLEDGEMENTS

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

Keywords: Avocado, chilling injury, iron supplements, postharvest disorder

ESTIMATING WATER USE OF 'VALENCIA' ORANGE TREES UNDER DRIP IRRIGATION USING SAP FLOW MEASUREMENTS

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INTRODUCTION

Precise water use estimation of irrigated fruit trees is important for irrigation planning and scheduling for sound management of already strained water resources. Sap flow measurements have been considered useful and accurate for directly estimating transpiration (i.e. water-use) of fruit trees.

MATERIALS AND METHODS

Transpiration of 'Valencia' orange trees was estimated from sap flow measurements conducted on four trees using the Heat Ratio Method. Measured transpiration was correlated against Penman-Monteith reference evapotranspiration (ET_0) calculated using weather variables measured by an on-site automatic weather station. Soil water contents (using ECH2O probes and time domain reflectometry), soil temperatures (copper constantan thermocouples) and soil solution electrical conductivities (EC meter and electrodes) were also measured. Changes in tree and orchard canopy structure (i.e. tree size and shape) and optical properties (i.e. leaf area index and photosynthetically active radiation interception) were quantified over time. Irrigation applications (timing and amounts) were determined using wetting front detectors, soil water sensors and in-line irrigation monitoring.

RESULTS AND DISCUSSION

Observed sap flow rates in the trees appeared to be more strongly correlated with seasonal changes in evaporative demand than tree growth, due to the evergreen nature of these trees which experience flushes of growth. However, variation in daily citrus tree transpiration did not appear to be solely determined by atmospheric demand, as increases in ET_0 between July and early November were not met by a similar increases in water use, and during this period there were declines in the calculated crop factor. However, when atmospheric demand subsequently declined between March and July similar declines in transpiration rates were observed.

CONCLUSIONS

Under seasonally low evaporative conditions citrus responds to atmospheric demand but when atmospheric demand becomes too high the roots cannot supply enough water to meet these demands.

Keywords: fruit tree water use, sap flow, heat pulse velocity, evapotranspiration

EFFICACY OF INSECTICIDES AGAINST THE POTATO TUBER MOTH (*Phthorimaea operculella*)

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INTRODUCTION

The potato tuber moth is a non-indigenous pest that originated in South America and has been present in South Africa for more than a century (Visser 2009). It occurs wherever potatoes are cultivated, but is especially destructive under dry conditions in the warmer seasons. Potato farmers report contradictory “results” after using certain insecticides, and during some years the moth is a more severe problem than in previous years. Therefore, a study was initiated to test the efficacy of insecticides registered in against potato tuber moth field populations, compared to a known susceptible population.

MATERIALS AND METHODS

Fourteen tuber moth populations were collected across and reared in an insectarium at the ARC-Roodeplaat for 2 – 3 generations. A detached-leaf bioassay technique was used to determine the survival of first instar larvae on treated leaves. The study involved three phases, i.e. a) using diagnostic dosages, b) using cumulative half dosages, and c) comparing results with a susceptible reference population.

RESULTS AND DISCUSSION

All of the insecticides were equally effective against potato tuber moth at field recommended dosages, since they all caused 100% mortality of larvae after feeding on treated leaves for 9–12 days. Similar results were obtained for cumulative half dosages. When insecticides were used at 10% dosage the potato tuber moth populations showed limited mortality, which was similar to mortalities obtained with the control (no insecticide) and reference populations.

CONCLUSIONS

The conclusion is that none of the insecticides currently registered against the potato tuber moth has lost their efficacy relating to tuber moth control when evaluating several populations collected across the country. Possible explanations for tuber moth “outbreaks” or unexplained poor control during some years will be discussed.

Keywords: bioassay technique, insecticides, potato tuber moth, infestation

EVALUATION AND SELECTION OF 20 SORGHUM [*Sorghum bicolor* (L.) MOENCH] GENOTYPES FOR DROUGHT TOLERANCE: RESPONSE OF GRAIN YIELD, HARVEST INDEX AND 1000 SEED MASS TO DROUGHT STRESS

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INTRODUCTION

Sorghum bicolor (L.) is one of the major staple food cereal crops in Asia and Africa (Asante, 1995). Drought stress is one of the major environmental constraints for sorghum production throughout the world. To improve sorghum productivity in drought prone areas, plant response mechanisms should be well understood. The study was conducted to determine the effects of moisture stress on grain yield (GYLD), harvest index (HI) and 1000 seed mass (TSM).

MATERIALS AND METHODS

Twenty sorghum genotypes were planted under dryland and irrigated conditions at density of 56 000 plants ha⁻¹ on sandy clay loam soil in Potchefstroom and sandy soil in Taung. The experiment was laid out in a randomised complete block design replicated three times. Drought stress was induced by withholding irrigation from five leaf stage to maturity to mimic naturally dryland farming conditions. Ten plants from 1.8 m² area of the two middle rows were harvested per plot at maturity and weighed. Heads were threshed and grains weighed to determine GYLD and TSM. Data analysis and correlation matrix were performed using GenStat statistical program.

RESULTS

Genotypes under irrigated conditions showed significant variations with regard to HI, GYLD and TSM in both localities. Only HI in both localities, and GYLD in Taung showed no significant ($p < 0.05$) variations among genotypes under dryland conditions. Combined analysis of variance results showed remarkable effects of drought on HI and GYLD in Potchefstroom, and on GYLD and TSM in Taung. Drought susceptible index results showed significant variations ($p < 0.05$) among genotypes with regard to HI, GYLD and TSM in both localities. GYLD significantly correlated ($p < 0.05$) with HI and TSM under dryland and irrigated conditions in both localities.

DISCUSSION AND CONCLUSIONS

HI and TSM should be considered in selection criteria because they significantly correlated with GYLD. Although drought susceptible index could separate tolerant genotypes from susceptible ones, it is not reliable criterion since it only considers genotypes exhibiting smaller yield reduction. Drought-tolerant genotypes should be chosen based on absolute yield under stress rather than yield reduction margin. Genotypes with high yielding and drought-tolerant potential should be selected.

LITERATURE CITED

ASANTE, S.A., 1995. Sorghum quality and utilization. *African Crop Sci. J.* 3(2), 231-40.

ACKNOWLEDGEMENT

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Keywords: Drought stress, drought tolerant, stress susceptibility index, yield potential

YIELD AND QUALITY RESPONSES OF TOMATO CULTIVARS UNDER ORGANIC FERTILIZATION USING FULLY DECOMPOSED CATTLE MANURE

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INTRODUCTION

Tomato (*Lycopersicon esculentum* L.) is the most important vegetable crop world-wide (Villareal, 1979). However, its maximum yield is not yet realized due to limited information to meet its nutritional needs (Ayoola and Adeniyani, 2006). The objective of the study was to determine the effect of different levels of cattle manure on yield and quality responses of selected tomato cultivars.

MATERIALS AND METHODS

Two independent field experiments were conducted at the University of Limpopo experimental farm (Syferkuil) under irrigation during 2007 and 2008. The soil of the farm is sandy loam of Hutton form, with the pH of 6.0-6.2. Prior to the trials soil analyses showed 1.15% N, 0.83% P, 6.3% K, 45.1% Ca, and 45.1 % Mg. The experiments were laid out in a split plot design with three replications. Three indeterminate (Money Maker, Ox-Heart and Sweetie) and two determinate (Roma and Floradade) tomato cultivars were used as main plot treatments and six different levels of cattle manure in gram per plant (0, 10, 20, 30, 40 and 50) as subplot treatments. Fruit yield was measured in gram per plant and converted into kilograms per hectare at the end of harvests. Fruit size was measured in millimeters from six random fruit samples using hand held fruit caliper during the first harvest. Other agronomic traits including plant height, numbers of fruits per plant, total soluble solids were also recorded. Data were subjected to analysis of variance (ANOVA) using Agrobase (2005).

RESULTS AND DISCUSSION

Results indicated that there were significant interactions ($P < 0.01$) between indeterminate tomato cultivars and levels of manure applied for fruit yield and size in both experiments. Yields for the indeterminate varieties ranged from 7311 to 42052 kg ha⁻¹ in experiment I and 8447 to 38864 kg ha⁻¹ in experiment II. The fruit yield of determinate varieties varied from 7928 to 34705 kg ha⁻¹ in experiment I and 3169 to 29840 kg ha⁻¹ in experiment II. The fruit size varied from 28 to 83 mm during experiment I and 25 to 90 mm during experiment II for the indeterminate varieties. Whereas fruit size of determinate varieties ranged from 50 to 72 mm during experiment I and 27 to 74 mm during experiment II. The best level of manure for maximum fruit yield and greater size was achieved at 40 g plant⁻¹ using indeterminate cultivar Money Maker and determinate cultivar Roma.

CONCLUSION

The study concluded that cattle manure at a rate of 40 g/plant could greatly enhance tomato yield for farmers in Limpopo province or other similar environments.

REFERENCES

- Agrobase. 2005. Agrobase generation II user's manual. Agronomix software, Manitoba, Canada.
- Ayoola, O.T. and O.N. Adeniyani. 2006. Influence of poultry manure and NPK on yield and yield components of crop under different cropping system in South West of Nigeria. African Journal of Biotechnology 5 (15): 1386-1392.
- Villareal, R. L. 1979. Tomato production in the tropics problems and progress. p. 23-27. in: R. Cowell, ed. Proceedings of the First International Symposium on Tropical Tomato. AVRDC, Shanhua, Taiwan.

Keywords: Limpopo, *Lycopersicon esculentum*, Tomato, Fruit size

THE EFFECT OF RUNOFF STRIP WIDTH OF IN-FIELD RAINWATER HARVESTING ON MAIZE PRODUCTION UNDER VARYING SOIL WATER REGIMES

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Contribution of in-field rainwater harvesting (IRWH) to water use efficiency has been profound, especially in the drier areas of the Free State Province. However, increased rainfall variability and failure continues to undermine the IRWH field water storage potential. In areas with access to irrigation water, the prospects of integrating micro-flood irrigation with IRWH technologies could be a positive development towards optimizing both precipitation and irrigation water use efficiency among resource poor communities. Along with this initiative the adaptation of the basin and runoff strip width became the major focus of this work. Runoff widths of 1 m, 2 m, and 3 m were tested against rain-fed, supplemental (133 mm) and full (333 mm) irrigation applications on four blocks at Paradys Experimental Farm of the University of the Free State.

To develop a comprehensive field water balance for the variables of interests, weekly soil water content measurements were taken by a neutron water meter at central positions of the runoff and basin strips at depths intervals of 250 mm, 450 mm and 650 mm before and after wetting. The basin area of the IRWH system was used as the furrow to distribute the irrigation water. Water application depths of 80 mm per 30 m length basin strip worked well in both supplemental, and full irrigation regimes. On site weather station provided the relevant data to partition evaporation and transpiration as required by the Tanner & Sinclair (1983) procedure and to complete the field water budget.

Results showed that the relationship between evaporation and transpiration depends on runoff strip width and irrigation. Evaporation increased proportionally with the width of runoff strips, while transpiration increased with water availability (irrigation) but decreased significantly with increased width of runoff strips. Grain yields related well with transpired water presenting the rain-fed, supplemental and full irrigation with average grain yields of 3001, 8754 and 5333 kg ha⁻¹, respectively. The highest yields are associated with the 1 m runoff strips. Corresponding yield and water use efficiencies pin points to the comparative advantage of using the basin strip as a storage area for both harvested runoff and stream inflow during rainfall and irrigation events, respectively.

Keywords: Water harvesting, runoff strip width, evaporation, transpiration, maize yield, water use efficiency

RESPONSE OF *Amaranthus tricolor*, *Cleome gynandra* AND *Brassica rapa* TO FERTILIZER APPLICATION

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INTRODUCTION

Amaranthus tricolor, *Cleome gynandra* and *Brassica rapa* have been essential sources of food for years, providing vital nutrients and vitamins in South African rural communities where vitamin A deficiency is a major challenge. The cultivation of vitamin A rich vegetables can thus address vitamin A deficiencies in diets, as well as alleviating malnutrition and poverty in disadvantaged households in rural communities. There is inadequate information on the nutritional requirements and the nutritional value of this indigenous vegetable (Palada & Chang, 2003).

MATERIALS AND METHODS

Amaranthus tricolor and *Cleome gynandra* trials were conducted during the 2008 summer season, and *Brassica rapa* during the 2009 winter season at the ARC-Roodeplaat Research Station. The trials were laid out in a complete randomized block design, with three replicates. Soil nutrient status before applying fertilizers was 27 mg P kg⁻¹; 64 mg K kg; 210 mg Ca kg⁻¹; 93 mg Mg kg⁻¹. The fertilizer treatments applied based on soil analysis were: T1= No fertilizer applied; T2=100: 20:150 kg N:P:K ha⁻¹; T3= 0: 20:150 kg N: P: K ha⁻¹; T4=100:20:0 kg N: P: K ha⁻¹ and T 5= 50:10: 75 kg N: P: K ha⁻¹. Seedlings of *A. tricolor*, *C. gynandra* and *B. rapa* were transplanted at a spacing of 35 X 20, 30 X 15 and 40 X 40cm, respectively. Harvesting was done every two weeks to determine the yield.

RESULTS AND DISCUSSION

The application of the complete and half N-P-K fertilizer combination (=100: 20:150 kg N:P:K ha⁻¹ and T 5= 50:10: 75 kg N: P: K ha⁻¹) resulted in high yield. Eliminating nitrogen (T3= 0: 20:150 kg N: P: K ha⁻¹) reduced the yield significantly at p=0.05, whereas potassium elimination (T4=100:20:0 kg N: P: K ha⁻¹) did not show any negative effect on the yield. Clear differences between the fertilizer treatments were observed in the field. Plants were small and the leaves were pale green and tapered where no fertilizer was applied (T1=No fertilizer applied) and when nitrogen was eliminated (T3= 0: 20:150 kg N: P: K ha⁻¹).

CONCLUSIONS

A. tricolor, *C. gynandra* and *B. rapa* have shown a positive reaction to fertilizer application (mainly nitrogen). Potassium exclusion, however, did not have any negative effects on the yield. A follow up trial will be conducted to validate the effect of fertilizer application on growth, yield and nutritional value of *A. tricolor*, *C. gynandra* and *B. rapa*.

REFERENCE

PALADA, M C and CHANG, L C, 2003. Suggested cultural practices for vegetable Amaranth. International guide Co-operator's Guide. AVRDC Publisher.

ACKNOWLEDGEMENT

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Keywords: Amaranthus, Cleome, Brassica, yield, fertilization

SEED PERFORMANCE AND WATER STRESS TOLERANCE OF LOCAL BAMBARA GROUNDNUT GERMPLASM

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INTRODUCTION

Bambara groundnut [*Vigna subterranea* (L.) Verdc.] is a member of the Fabaceae family. It is an indigenous tropical African Crop. Other South African names for it include jugo bean (English), *dopboontjie* (Afrikaans), *ditlao* or *ditloo* (Ndebele), *ditloo-marapo* (Pedi), *hlanga* (Shangaan), *tzidzimba* or *nduhu-mvenda* (Venda), *izindlubu* (Zulu) and *indlubu* (Xhosa). In spite of its nutritional and agronomic value, bambara groundnut has not been widely studied, and its role in food security in South Africa has declined to the level where it is no longer a common crop. The objective of this preliminary study was to determine seed performance and water stress tolerance in two landraces of bambara from KwaZulu-Natal under controlled environment conditions, before field studies are performed.

MATERIALS AND METHODS

Seeds of two landraces (light-brown and speckled seed coats, respectively) were harvested from a subsistence farm in the KwaZulu-Natal midlands (Tugela Ferry) and subjected to viability (tetrazolium chloride), vigour (conductivity and seedling growth rate) and germination tests to determine seed quality using four replications of 50 seeds. A pot trial was used to determine seedling emergence, plant growth and yield under two temperature (27/22 °C and 20/15 °C, day/night, 60% RH) and three irrigation regimes [200 ml H₂O per 500 g of soil on the first day of the week only (Low) or on the first and third days of the week only (Medium) or on the first, third and fifth days of the week only (High)]. Leaf proline content was used to determine plant response to stress at 50% flowering. The pot trial was replicated four times and the sampling units for plant growth determination were maintained during laboratory determinations.

RESULTS

There was no significant difference between landraces with respect to viability and total germination. Light-brown seeds reached T₅₀ two days earlier than speckled seeds, suggesting a greater germination capacity for the former. Light brown seeds also showed a significantly ($P < 0.05$) better seedling dry mass and fewer abnormal seedlings compared with the speckled seeds. These findings were in agreement with the results of a conductivity test, which showed a significantly ($P < 0.01$) greater leakage of soluble substances from speckled seeds compared with light brown seeds. Growing plants under high temperature conditions significantly ($P < 0.01$) improved emergence, growth (height and leaf area) and time to 50% flowering for both landraces, but light brown seeds were associated with earlier emergence. Low water treatment reduced plant growth under high temperature regimes. Under the low temperature regime, high water treatment significantly reduced plant growth. There was a significant positive correlation between proline accumulation and both water and temperature stress. Biomass and economic yield data were not determined at the time of writing, but will be ready within two months for presentation early in January 2010.

CONCLUSIONS

Seed performance in bambara groundnut may be associated with seed colour. Low temperatures reduce seedling emergence and plant growth, but the crop can withstand low water availability better under high temperature regimes.

Keywords: Germination, seed, temperature, water stress

WATER USE EFFICIENCY OF FOUR AFRICAN LEAFY VEGETABLES

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INTRODUCTION

African Leafy Vegetables (ALV's) are important new crops with a potential to broaden food base in South Africa. An understanding of their water use is essential for evaluating their potential to grow in areas where water is a limiting factor. The objective of this study was to investigate the water use efficiency of Chinese cabbage, amaranthus, corchorus and cowpea.

MATERIALS AND METHODS

Water use efficiency trial was carried out in 2007 and 2008 growing seasons at the ARC-Roodeplaat ARC-VOPI, 40 km North East of Pretoria. The trial was conducted under a rain shelter that has a total experimental area of 288 m². Four irrigation water treatments with three replications were laid in a randomized complete block design. The treatments applied were irrigation to field capacity (FC), described as 100FC, 75% of the water applied to refill to FC (75FC), 50% of the water applied to refill to FC (50FC) and 25% of the water applied to refill to FC (25FC). Plant samples were collected every 10 – 14 days and partitioned into leaf, stem, root, and flower to determine the growth of the plant. Data were subjected to analysis of variance using General linear model procedure of SAS version 8.0 (SAS Institute Inc. 1999).

RESULTS

Chinese cabbage and amaranth showed a yield reduction of 16-35% when receiving 25-50% of 100FC, whereas cowpea showed a yield reduction of 40-50%. Corchorus receiving 25-50% showed a yield reduction of 25-29%. In all experiments, higher water productivity (WP) was obtained in crops receiving 25FC treatment, as compared to crops receiving 100FC irrigation treatment. All crops receiving less irrigation treatment (25FC) resulted in lower yields, as compared to the well irrigated crops (100FC), implying that increasing soil water content could lead to increased yields. Higher WP, however, was obtained with the dry irrigation treatments (25FC), as compared to the full irrigation treatments (100FC), indicating that optimum yield of the four crops could be attained in areas where water is a limiting factor if proper crop and deficit irrigation management is practiced.

CONCLUSION

The yield differences of amaranths, cowpea and corchorus obtained from the different irrigation treatments applied were negligible, and this could be an indication of their tolerance to water stress. The WP's obtained from this preliminary experiment is optimal with the low irrigation treatments (25FC); however, further investigation is needed in order to use these results in the recommendation of guidelines of cropping systems at national level.

ACKNOWLEDGEMENT

Water Research Commission for funding.

REFERENCES:

SAS Institute Inc. (1999) User's guide, version 8.0 (5th Edn, Vol 2). Cary, NC, USA

Keywords: Water use, water productivity, food crops, African leafy vegetables, yield, evapotranspiration

EVALUATION OF NITROGEN LEVELS AND PLANTING DATES ON COTTON CULTIVARS (*Gossypium* spp.) IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

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INTRODUCTION

A study was conducted at Addo and Cradock for three consecutive seasons between 2004/2005 and 2006/2007. Cotton was introduced to this province as one of the cash crop to try and help in improving rural livelihood. The main objective was to determine nutrient uptake of cotton plants and their response to different nitrogen fertilizer levels on seed cotton yield and fibre quality.

MATERIALS AND METHODS

Three different nitrogen levels (80, 120 & 160 kg N/ha) and a control (0 kg N/ha) together with four different cotton cultivars (NuOPAL, Delta OPAL, Delta OPAL RR, DP404B) were evaluated on a split plot design. The nitrogen fertilizer treatments were applied as split applications at 4, 8 and 12 weeks after planting with supplemental sprinkler irrigation. Main effects were nitrogen application and sub effects were cultivars.

RESULTS AND DISCUSSION

Significant differences were found in the yields of different cultivars and planting dates at different nitrogen fertilization levels. Highest yields that ranged from 4.1 to 5.3 kg/ha seed cotton were obtained at Addo from the early planting across the treatments as compared to late planting. The untreated control gave the lowest yield in both localities with the two planting dates. At 80 and 120 kg/ha N of nitrogen levels NuOPAL gave the high yields of 4325 and 4143 kg/ha on early planting at Addo, respectively. Where 160 kg/ha N was applied, highest yield of 5312 kg/ha seed cotton were obtained by NuOPAL at Addo with early planting. Even though there were no significant differences between treatments interaction, highest yields were observed from 80 kg/ha to 120 kg/ha N level at early planting across cultivars at Addo, whereas at late planting yields were very low across N-treatment and cultivars.

At Cradock, yields were generally low across all treatments, at early October planting NuOPAL gave better yields of between 2999 and 1989 kg/ha seed cotton at 120 kgN/ha and 160kgN/ha respectively, as compared to other cultivars. NuOPAL gave the highest yield and yield characteristics than the DeltaOPAL, DP404B and DeltaOPAL RR cultivars in both localities. It has also been shown from fibre quality analysis results that fibre properties were within the norms of good fibre quality.

CONCLUSION

The results have shown that cotton can grow well in some areas of the Eastern Cape only when planted from early to middle October. It had been noted that cotton planted during late October are prone to early cold or frost, insects and pests damaged at the end of the season thereby reducing yields. Good yields obtained at 80 and 120 kg N/ha are a clear indication that, these nitrogen levels could be optimum and the cost could be reasonable for the farmers and this will be beneficial in terms of saving on inputs. NuOPAL is the best cultivars for the area owing to its better yield and tolerance of the above mentioned yield reducing factors.

Keywords: Nitrogen fertilization, cotton cultivars, planting dates

PRECISION MANURE MANAGEMENT ACROSS SITE-SPECIFIC MANAGEMENT ZONES: SURFACE SOIL AND ENVIRONMENT QUALITY

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RATIONALE

Maintenance and improvement of soil quality across spatially variable soils in continuous cropping systems is critical to sustaining agricultural productivity and environmental quality.

INTRODUCTION

Precision manure management is a relatively new concept that combines the best manure management practices with precision agricultural techniques, such as site-specific management zones (MZs). Site-specific management zones are subregions of a field that express a homogeneous combination of yield limiting factors (Doerge, 1999). Animal manure is a useful resource that could be recycled beneficially for crop production and soil quality improvement. Surface and ground water contamination caused by P runoff and NO₃-N leaching from manure has been the driving force behind the implementation of best manure management practices. Eroded soils containing high levels of P from manure into surface water can cause eutrophication in aquatic ecosystems. The objectives of the study were (i) to evaluate the effects of variable rate application (VRA) of manure on selected topsoil quality parameters across site-specific management zones (MZs) under irrigated conditions, and (ii) to evaluate the VRA of manure using the N leaching and P runoff environmental risk assessment indices to understand its impact on environmental quality.

MATERIALS AND METHODS

Study sites were located in northeastern Colorado, USA and have been under continuous and furrow irrigated maize. Experimental strips, 4.5 m wide and 540 m long, spanned across all MZs with dairy manure treatments nested within MZs in the field.

RESULTS, DISCUSSION AND CONCLUSION

Our results indicate that manure application significantly ($P \leq 0.05$) increased organic matter (OM), water holding capacity (WHC), and EC while bulk density (BD) was decreased on low and medium MZs. Manure treatments had no significant impact on OM and BD of the high zone. Duiker (2001) reported that approximately 44 Mg ha⁻¹ of manure is required to maintain soil OM levels, and higher manure rates are necessary to increase soil OM content. While Duiker (2001) made observations under uniform fields, accounting for spatial variability in our study has proved different on low and medium MZs but not on the high MZs. The N leaching and P runoff indices indicated medium and manageable environmental hazard associated with VRA of manure across MZs. Overall this study indicates that VRA of manure across MZs has potential to improve or maintain soil quality parameters over time without impairing the environment.

Keywords: Environmental quality, soil quality, water quality, precision agriculture, management zones

COMPARING TOXICITIES OF CUCUMIN BIO-NEMATICIDE AND SYNTHETIC NEMATICIDES

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INTRODUCTION

Extracts of wild cucumber (*Cucumis myriocarpus*) fruits consistently suppressed numbers of the root-knot (*Meloidogyne incognita*) in vegetables such as tomatoes, butternuts and pepper. The bionematicide is widely used in nature farming in Limpopo Province. The material also suppress numbers of the citrus nematodes. The active ingredient in this bio-nematicide had been identified as cucurbitacin A, which is chemically referred to as cucumin. Relative acute toxicity is measured in terms of LD50 for the Lethal Dosage required to kill 50% of a test organism. The higher the LD50, the less acutely toxic the product is. After determining the toxicity of cucumin, a desktop study was conducted to determine the relative toxicity of this material to standard synthetic nematicides.

MATERIALS AND METHODS

The study was conducted at the University of Limpopo, Agrofood Technology Station Laboratory. The LD50 of cucumin was compared with the LD50 of three Carbamates, three Organophosphates and one bio-nematicide, which are widely used as nematicides in suppression of plant parasitic nematodes. Comparisons were made by dividing the LD50 of selected nematicides by that of Cucumin.

RESULTS AND DISCUSSION

On average, Cucumin was 11.5 (range 1.8 – 22) more toxic than the Carbamates, 47.7 (range 4 – 123) more toxic than the Organophosphates, and 384 more toxic than Crop Guard. This observation, confirms assertions that cucumin might be the most toxic chemical. The efficacy, toxicity and lifespan of a nematicide depend on the soil type. Cucumin breaks into two compounds which were also shown to have high bioactivity. More work still needs to be done to provide information about the end product of this highly toxic bio-nematicide in the environment.

These variables have not been determined for cucumin as a bio-nematicide.

CONCLUSION

Currently, various studies are underway to determine the efficacy, toxicity and lifespan of cucumin as a bio-nematicide under various soil conditions.

ACKNOWLEDGEMENTS

The authors are grateful to Tshumisano for provision of funding.

Keywords: Bio-nematicide, Cucumin, *Cucumis myriocarpus*

EFFECT OF SPACING, TRANSPLANTING TIME AND HARVESTING METHODS ON AMARANTHS (*Amaranthus cruentus*) PRODUCTION

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INTRODUCTION

Vegetable amaranths (*Amaranthus cruentus*) is one of the popular indigenous vegetables in the Republic of South Africa. It is an annual, fast growing plant, and is a rich source of calcium, iron, and vitamins A and C. Compared to exotic vegetables, amaranths have received minimal research and development attention that limited its potential as a food crop. The aim of this study was to determine the optimum spacing, transplanting time and harvesting methods of amaranths.

MATERIALS AND METHODS

Two experiments were carried out at ARC - Roodeplaat, VOPI, Pretoria, in summer 2008: effect of spacing and harvesting methods, and optimum transplanting time of amaranths. The experimental design for the optimum spacing and harvesting methods was in a randomized complete block design, with six different spacings and two harvesting methods, replicated three times. The spacings were 10 x 20 cm (50 plants m⁻²) (S1), 20 x 20 cm (25 plants m⁻²) (S2), 10 x 50 cm (20 plants m⁻²) (S3), 20 x 50 cm (10 plants m⁻²) (S4), 10 x 75 cm (13 plants m⁻²) (S5) and 20 x 75 cm (S6) (6 plants m⁻²). The harvesting methods evaluated were tipping (H1) and cutting to 30 cm height (H2) and the optimum transplanting time (Tp) was determined by using 4 transplanting dates (Tp1, Tp2, Tp3, and Tp4). All these treatments included tipped (removing the growth shoot before planting) (Tp1T, Tp2T, Tp3T, Tp4T) and not tipped (Tp1NT, Tp2NT, Tp3NT, Tp4NT). The experiments were repeated from October 2009 to December 2009.

RESULTS AND DISCUSSION

The first year results showed that the highest yield was obtained by the wider spacing and there was no significant difference between the two harvesting methods. The highest total fresh mass and good quality amaranths yield was obtained from Tp2 and Tp3. The yield potential of amaranths was higher at early transplanting than later transplanting and higher at closer spacings than at the wider spacings. The combined results for both years will be presented.

CONCLUSIONS

From the first year's results it was concluded that the yield of amaranths can be significantly increased by transplanting the seedlings when they are 21 to 28 days old at a spacing of 20 x 20 cm (25 plants m⁻²), which is commonly used by farmers. The harvesting method did not show any significant difference between the treatments.

ACKNOWLEDGEMENT

The authors would like to acknowledge the Department of Science and Technology (DST) for funding the project.

Keywords: Amaranths, Indigenous vegetables, seedlings, food crops

RAINFALL RISK ANALYSIS FOR RAINFED AGRICULTURE IN THE LIMPOPO BASIN

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Improvement of household food security in the Limpopo Basin has been elusive due to a combination of factors related to information and market constraints, but also farmers risk aversion (to crop improvement investments) induced by the high variability of rainfall during the growing season. Droughts and mid-season dry spells are now a common characteristic of the semi-arid Limpopo Basin. The purpose of this study was to characterize the range of rainfall environments experienced by smallholder farmers in the Limpopo Basin. The study also examined how smallholder farmers in semi-arid Insiza district of Zimbabwe determine their planting dates under highly variable rainfall regimes. Generally the second half of the growing season receives more rainfall than the first half in the Limpopo Basin. However, rainfall is more variable during the January-March period than the October-December part of the season. Growing seasons start earlier and end later in the Mozambique part of the basin. The Limpopo Basin is prone to two and three week dry spells with chances of 14 day spells higher (50%) than the 21 day spells (19%). The chances of 14 and 21 day dry spells increase drastically during the second half of the growing season. The 1980-1990 was one of the driest decades in the Limpopo Basin and droughts have a return period of two years. In-season rainfall varied significantly over short distances during the 2007/08 and 2008/09 seasons in Insiza district. The start of the rains did not necessarily determine the planting date as there are other factors such as the availability of agriculture inputs that influenced the time of planting in Insiza district. Smallholder farmers do not manage their cropping based on the temporal and spatial variability of rainfall during the season. Seasonal forecasting information should reach smallholder farmers in the Limpopo Basin to aid in decision making on the cropping program. There is scope in promoting rainwater harvesting technologies, use of soil fertility amendments and good management in order to reduce risk in the smallholder cropping systems in the basin.

Keywords: Limpopo basin, rainfed agriculture, risk, dry spell

THE EFFECT OF SUBSTRATE pH VALUE ON MYCELIUM GROWTH SPEED OF MUSHROOM STRAINS: *Pleurotus ostreatus*, *Auricularia polytricha*, *Lentinula edodes* AND *Ganoderma lucidum*

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INTRODUCTION

Early cultivation of mushrooms was on tree logs. However, the wood log production cycle is lengthy (6-12 months from inoculation to fruiting) and unsustainable. Grasses have been developed to be used as logs (plastic cultured substrates) for a fast and sustainable production method. The production on grass substrate, unlike wood logs, requires knowledge of the specific pH at which the mycelium multiplies optimally. This knowledge will assist in selection of the materials to be used as substrate for spawn production.

METHODS AND MATERIALS

The study was conducted at JUNCAO Research Institute, Fujian Province of People's Republic of China. The substrate was *Miscanthus floridulus* powder (80%) and wheat bran (20%) with 57% water. The pH of the substrate was adjusted to various pH values ranging from 3 to 11, using HCl and NaOH, and then topped up to the height of 15cm in a glass test tube. The substrate was sterilized using an autoclave at 1.47×10^5 Pa for 2 hours and thereafter inoculated with mushroom strains and incubated at 25°C for 14 days. The 9 treatments (pH 3, 4, 5, 6, 7, 8, 9, 10 and 11) were replicated 4 times (four test tubes/replicate). The growth was monitored by measuring the mycelium accumulation on the outside of the test tube using a ruler on the 7th and 14th day after inoculation.

RESULTS AND DISCUSSION

A peak in mycelium growth was observed at pH range 6 - 9 and a decline in growth occurred at pH 10 and 11 for *Auricularia polytricha*. *Lentinula edodes* (shiitake) mycelium growth was favoured by acidic conditions (optimum pH 4), with a drastic decline in mycelium growth when pH reached neutral and growth autolyzed at pH 10 and 11. The same results were observed by Hasegawa *et al.* (2005) with the optimum mycelial growth being reached at pH 3.5. *Pleurotus ostreatus* reached optimum growth at pH 8. The optimum mycelium growth for *Ganoderma lucidum* was achieved between pH values of 6 and 7.

CONCLUSIONS

The growth of mushroom mycelium is dependant on the pH value of the substrate, with each of the examined species having a unique optimum pH.

REFERENCES

HASSEGAWA, R.H., KASUYA, M.C.M. & VANETTI, M.C.D., 2005. Growth and antibacterial activity of *Lentinula edodes* in liquid media supplemented with agricultural wastes. *Electron. J. Biotechn.* **8** (2) 1-6.

Keywords: pH, mycelial growth, mushroom strains, substrate

WEED EMERGENCE PATTERNS IN SOYBEAN AS AFFECTED BY MANAGEMENT PRACTICES

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INTRODUCTION

Management strategies for weed species could be improved by understanding the weed species emergence pattern. The challenge for farmers and weed managers is that weed species rarely emerge at the same time.

MATERIALS AND METHODS

A study was conducted in 2006, 2007 and 2008 in a no-tillage field at the Department of Agronomy Ashland Bottoms research farm, near Manhattan, Kansas State, USA. A 12-m x 12-m area defined a weed patch for each species. Seed bank samples were taken randomly before plots were established. Average number of seeds for each weed species was determined to document initial seed bank population. Four treatments imposed were no-crop (soybean removed), soybean with no-residual herbicide, soybean with half-rate residual herbicide and soybean with full-rate residual herbicide. These were replicated four times within each patch for a total of 16 experimental plots arranged in a completely randomized design. Soybeans were no-till planted at 300 000 seeds ha⁻¹ in 0.76-m rows throughout the field. The labeled rate residual herbicide treatments were S-metolachlor (2.13 kg ha⁻¹) for shattercane (*Sorghum bicolor* L. Moench), metribuzin at 0.84 kg ha⁻¹ for prickly sida (*Sida spinosa* L.) and sulfentrazone (0.046 kg ha⁻¹) for ivyleaf morningglory (*Ipomoea hederacea*). Weed seedlings were counted and removed from the emergence quadrat every three to four days.

RESULTS AND DISCUSSION

All species began emergence in mid-May in all years, coinciding with soybean planting. *Sorghum bicolor* L. Moench had extended emergence in 2006; while in 2007 it had two primary flushes of emergence, and only one flush of emergence in 2008. *Sida spinosa* L. and *Ipomoea hederacea* had one flush of emergence in 2006; however, these species had two flushes of emergence in 2007. Variability in precipitation plays a significant role in the emergence patterns of these weeds species. For all species, bare-soil treatment had the highest cumulative emergence, followed by no-herbicide treatment and the residual herbicide treatments had least emergence in both years.

CONCLUSIONS

Environmental factors play an important role in the emergence patterns of weeds. Leaving fields bare promote weed emergence. Applying residual herbicides delay weed emergence giving the crop a competitive advantage.

ACKNOWLEDGEMENT

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Keywords: Management Practices, weed patch, weed emergence pattern

TOTAL PHENOLICS AND ANTIOXIDANT ACTIVITY OF BLACK TEA AS A FUNCTION OF BREWING TEMPERATURE AND TIME

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INTRODUCTION

Potential health benefits of tea, together with its popularity as a beverage, have prompted numerous investigations of the chemical constituents of tea and their antimutagenic (Halder *et al.*, 2005), anticarcinogenic and antioxidant (Han, 1997; Sarkar *et al.*, 2001) properties.

MATERIALS AND METHODS

Black tea obtained from Mukumbani Tea Estate was brewed using a water bath at 30°C, 60°C or 90°C for either 3 or 10 minutes. The Folin Ciocalteau method (Waterman & Mole, 1994) was used to determine total phenols in the black tea extract. Antioxidant activity was determined using the Trolox Equivalent Antioxidant Capacity (TEAC) assay (Awika & Rooney, 2004). The Vanillin HCL method (Prince *et al.*, 1978) was used to determine tannins. There were three replicates, with each measurement made in duplicate. Data was subjected to analysis of variance (using SAS, 2003) General Linear Model procedure, and the Duncan Least Significant Difference test was used to identify differences among the means.

RESULTS AND DISCUSSION

Total polyphenols, antioxidant activity and tannin content decreased with decreasing temperature and time. At 90°C for 3 minutes 7.68 mg/100g total polyphenol, 3.85 µmol/g of antioxidants and 2.81 mg/100g of tannin were extracted. This decreased to 5.50 mg/100mg total polyphenols, 1.31 µmol/g of antioxidants and 0.72 mg/100mg of tannin at 30°C for 10 minutes.

CONCLUSION

Black tea brewed at 90°C for 3 minutes contains higher levels of polyphenol and optimum total antioxidant activity. The use of lukewarm water to brew black tea must be discouraged.

REFERENCES

- AWIKA, J.M. & ROONEY, L.W., 2004. Sorghum photochemical and their stability in sunflower oil and emulsion. *Food Chem.* 64, 323-329.
- HALDER, B., PRAMANICK, S., MUKHOPADHYOY, S. & GIRI, A.K., 2005. Inhibition of benzo[a]pyrene induced mutagenicity and genotoxicity multiple test systems. *Food Chem. Toxicol.* 43, 591-597.
- HAN, C., 1997. Screening of Anticarcinogenic ingredients in Tea polyphenols. *Cancer Lett.* 114, 153-158.
- PRINCE, M.L., VAN SCOYOC, S. & BUTLER, L.G., 1978. A critical evaluation of the vanillin reaction as an assay for tannin in sorghum grain. *J.Agr. Food Chem.* 26, 1214-1218.
- SARKAR, A. & BHADURI, A., 2001. Black tea is powerful Chemopreventor of reactive oxygen and nitrogen species: comparison with its individual Catechin constituents and Green tea. *Biochem. Bioph. Res. Co.* 284(1), 173-178.
- WATERMAN, P.G. & MOLE, S., 1994. Analysis of Plant Metabolites. Alden Press Limited, Oxford. p. 1-16, 66-103.

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Keywords: Total phenols, Antioxidant activity

YIELD OF IRRIGATED WINTER AND SUMMER GRAIN CROPS AS AFFECTED BY CROP ROTATION

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INTRODUCTION

Yield improvement through crop rotation under dry-land conditions on the Highveld has been proven through research. Benefits of sound crop rotation systems are the improvement of profits and the reduction of production risk. The rate of cropping under irrigation is doubled to two crops every 12 months, which might make rotation even more important than under dry-land. This experiment was initiated to determine the importance of crop rotation under irrigation on a sandy soil at Vaalharts where two crops are grown annually.

MATERIALS AND METHODS

A field trial under flood irrigation with the following crop rotation systems was conducted over a period of 4.5 years on the Vaalharts experimental farm at Jan Kempdorp: 1. Canola – maize; 2. Wheat – maize; 3. Barley – maize; 4. Canola – groundnut; 5. Wheat – groundnut; 6. Barley – groundnut; 7. Canola - maize - wheat – maize; 8. Canola - groundnut - wheat – maize; 9. Canola - groundnut - wheat – groundnut; 10. Canola - soybean - wheat – groundnut. A complete randomised block design with four replicates were used, the results analysed through an analysis of variance with significance at $p = 0.05$. Agronomical practices were according to best practice recommendations.

RESULTS AND DISCUSSION

Cropping system had a significant effect on the yield ($p = 0.05$) of maize (mean yield 10 102 kg ha⁻¹). The yield of maize in the canola-maize one-year system was 18 % lower, and that of maize following canola in the in the canola - maize - wheat - maize system, 12 % lower than that of maize in the canola-groundnut-wheat-maize system. The yield of maize in the one-year wheat-maize system was 9 % lower than that of maize in the two-year systems where canola and groundnuts were also part of the cropping sequence. Groundnut yield (mean 3 991 kg ha⁻¹) was affected by crop rotation system. As in the case of maize, groundnuts grown in the most crop diverse rotation system had the highest yield. The yield of groundnut following canola was 14 % and 9 % lower than the yield of groundnut preceded by wheat and barley, respectively. The yield of canola was dominated by a seasonal effect but also influenced by an interaction between seasons and cropping systems. The annual canola yield among crop systems varied from 872 to 3 142 kg ha⁻¹. Barley, with a mean yield of 6 311 kg ha⁻¹ was not affected by crop rotation, but by seasons only. Wheat (mean yield 5 983 kg ha⁻¹) was affected by a crop system x season interaction.

CONCLUSIONS

Crop rotation under irrigation affected the grain yield of (in declining order of sensitivity) maize, groundnut, wheat, canola. Barley was not affected by crop rotation.

ACKNOWLEDGEMENTS

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Keywords: Barley, canola, crop rotation, groundnut, maize, wheat

GROWTH AND YIELD RESPONSE OF CASSAVA, *Manihot esculenta* CRANTZ TO ORGANIC AND INORGANIC FERTILIZER

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INTRODUCTION

Cassava is not a well-known crop in South Africa, although it is a staple food of immense importance throughout Africa. Cassava is cultivated as subsistence crop on a small scale by peasant farmers, in Northern KwaZulu-Natal, Eastern parts of Mpumalanga and Limpopo Province with elevation less than 800m and annual rainfall of 500 mm. Most South Africans has limited land for cultivation and most soils are depleted of nutrient elements resulting in low cassava yields. To prevent nutrient depletion of the soil from cassava production, about 60 kg N, 10-20 kg P and 50 kg K₂O ha⁻¹ are recommended if the expected yield is 15 t ha⁻¹, providing all stems and leaves are returned to the soil. If it is removed, at least twice these amounts of fertilizer are needed. Inorganic fertilizer can be used to replenish soil nutrients, but small holders cannot afford these due to high cost associated with it. Alternatively, farmers use organic resources such as N-fixing legumes and animal manures.

MATERIALS AND METHODS

The trial was established during 2007/2008 growing season. The design was a randomized complete block design with four replicates. Treatments were four cassava cultivars (Line 2, 82, 15 and 19), and five organic/inorganic fertilizer applications consisting of Kraal manure, Chicken manure, Kraal manure + 30 kg N ha⁻¹, Chicken manure + 30 kg N ha⁻¹, and 30 kg N ha⁻¹. The amount of manure to be applied was determined based on the value of its N-content, thus to meet minimum N-level and was applied at 5 t ha⁻¹. Parameters measured included plant height, biomass, and fresh root weight. The results were analyzed using Genstats and means were separated using least significant different (LSD) of Turkey. The trial was semi irrigated mostly during critical times i.e. during very hot summer.

RESULTS AND DISCUSSION

Growth response was significantly different between organic/inorganic fertilizers while cassava cultivars did not vary. The highest average plant height was recorded with 30 kg N ha⁻¹, which was 4.9% higher than the average obtained with organic/inorganic fertilizers. Biomass varied significantly between organic/inorganic fertilizers and cassava cultivars. Best biomass yield was observed where cassava cultivars were treated with chicken manure + 30 kg N ha⁻¹ and Chicken manure alone. This resulted in 64 900 kg ha⁻¹ and 63 558 kg ha⁻¹ biomass with chicken manure and chicken manure + 30 kg ha⁻¹ N treatment respectively in cassava line 15. Cultivar x Organic N fertilizer interaction was significant for biomass. Fresh roots varied between cassava cultivars and organic/inorganic N fertilizer at P_≤0.05. Kraal manure resulted in the lowest fresh root yield across cultivars at an average of 21 283 kg ha⁻¹. The highest fresh root yields were obtained where kraal manure + 30 kg N ha⁻¹ and chicken manure were applied. Highest fresh root yield of 42 217 kg ha⁻¹ was obtained by line 15 with chicken manure alone. Addition of N to kraal manure and chicken manure seems to improve cultivar yields, evident in line 15, where yields were above the South African cassava standard yield of 35 t ha⁻¹. Generally, harvest indexes of cassava cultivars were above acceptable level of 50%. Harvest Indexes significantly differed between organic/N fertilizer and cultivars. The highest harvest index of 65% was observed in line 15 with chicken manure.

CONCLUSIONS

Cassava cultivars had a significant response in growth, biomass, and fresh root yield to organic/inorganic fertilizers, mostly with chicken manure plus inorganic N added treatments. Lines 15 was observed to the best cultivar for use in the study areas.

Keywords: Cassava cultivars, yield response, inorganic fertilizer

TOMATO SEEDLING HEALTH AND DEVELOPMENT AS INFLUENCED BY TRICHODERMA AND MYCORRHIZA APPLICATION

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INTRODUCTION

The symbiosis between Trichoderma and Mycorrhiza is widely reported in literature (Raupach & Kloepper, 1998; Meyer & Roberts, 2002). It is believed that these two important biological control agents work in tandem. It is also well known that most of their functions are similar while there are even reports of the negative effect of Mycorrhiza on Trichoderma colonization, and vice versa. Many practitioners make use of both fungi; however, the time of application could have a significant impact on the effectiveness thereof. The aim of this research was to investigate the interactive effects of Trichoderma and Mycorrhiza on seedling health and development in tomato (*Lycopersicon esculentum* L. Cultivar Nemo-Netta).

MATERIALS AND METHODS

A factorial experiment (3X3) involving combination of Trichoderma (T) and Mycorrhiza (M) with regard to their application time (0: untreated; 1: during sowing; 2: two weeks after sowing) giving nine treatments (TOM0, TOM1, TOM2, T1M0, T1M1, T1M2, T2M0, T2M1 and T2M2). The trial consisted of a completely randomized design with 12 plants per treatment. Tomato "Nemo-Netta" was used as a test crop and allowed to grow for four weeks in pvc pipes filled with sand and coir mixture. Data collection consisted of growth parameters (leaf area index, plant height, root length, stem diameter, dry root to shoot ratio), leaf chemical analysis and chlorophyll content determination using a fluorometer. ANOVA tests were performed and treatments means were compared using Fisher's least significant differences (LSD) test (P 0.05).

RESULTS AND DISCUSSION

Applying Trichoderma and Mycorrhiza during sowing (T1M1) gave the overall best results with regard to plant growth parameters. The control (TOM0) showed the least beneficial results in terms on all the parameters studied. Applying Trichoderma either alone or in combination, regardless of the application time, had a marked effect on seedling development. This was not entirely so for Mycorrhiza, when applied alone at later stage (TOM2), though the results were not significantly (P 0.05) different from TOM0.

CONCLUSION

These preliminary findings suggested that Mycorrhiza and Trichoderma do have a synergistic effect on seedling development in tomato.

REFERENCES

- RAUPACH, G.S. & KLOEPPER, J.W., 1998. Mixtures of plant growth-promoting rhizobacteria enhance biological control of multiple cucumber pathogens. *Phytopathology* 88, 1158-1164
- MEYER, S.L.F. & ROBERTS, D.P., 2002. Combinations of biocontrol agents for management of plant-parasitic nematodes and soilborne plant-pathogenic fungi. *J. Nematol.* 34, 1-8

Keywords: tomato, trichoderma, mycorrhiza

THE EFFECT OF A RESIDUE LAYER ON THE ENERGY BALANCE OF SUGARCANE: A REVIEW OF MICROMETEOROLOGICAL METHODS

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Harvesting sugarcane green and using crop residues as a mulch layer for the subsequent ratoon (instead of burning residues) is a desirable alternative production system. Knowledge of how residue layers affect microclimate, the surface energy balance, growth and sugarcane water use is limited. Surface energy balance fluxes namely net irradiance (R_n), sensible heat (H), soil heat (G) and latent energy (λE) are used for calculating evaporation. We review methods for partitioning energy fluxes in irrigated sugarcane with and without a residue layer.

The Bowen ratio energy balance (BREB) method uses air temperature (T_a) and water vapour pressure (e) at two heights and direct measurement of R_n and G with λE and H obtained from the shortened energy balance ($R_n = \lambda E + H + G$) as a residual and Bowen ratio ($\beta = H/\lambda E$). BREB has been used successfully in sugarcane (Inman-Bamber and McGlinchey, 2003) although accurate measurements of e are difficult and extensive fetch is required. Eddy covariance (EC) measures high-frequency vertical wind speeds, T_a and e from which H and λE are determined. EC measurements are accurate, relatively complex and expensive (Drexler *et al.*, 2004). The scintillation method measures visible or infrared radiation intensity fluctuations. Path-averaged measurements of H are obtained over distances (50 m to kilometers) with λE calculated as a residual (Drexler *et al.*, 2004). Surface renewal (SR) determines H from high-frequency T_a fluctuations using fine-wire thermocouples with λE calculated as a residual. The SR method is simple, robust and relatively inexpensive, but requires calibration (Mengistu and Savage, 2009).

Based on comparison of the various methods, SR was chosen to measure energy partitioning in sugarcane at Komatipoort. Initial findings indicate that λE of sugarcane with no residue layer exceeds that of a crop with residue layer. The information will assist in understanding the modification by a residue layer of microclimate and crop processes.

REFERENCES

- DREXLER, J.Z., SNYDER, R.L., SPANO, D. & PAW U, K.T., 2004. A review of models and micrometeorological methods used to estimate wetland evapotranspiration. *Hydrol. Process.* 18, 2071-2101.
- INMAN-BAMBER, N.G. & McGLINCHEY, M.G., 2003. Crop coefficients and water use estimates for sugarcane based on long-term Bowen ratio energy balance measurements. *Field Crops Res.* 83, 125-138.
- MENGISTU, M.G. & SAVAGE, M.J., 2009. Surface renewal method for estimating sensible heat. *Water SA*. Accepted.

Keywords: Bowen ratio, eddy covariance, energy balance, green cane harvesting, scintillation, surface renewal

AVENUES FOR IMPROVING PROFITABILITY IN THE 'BEAUMONT' MACADAMIA CULTIVAR

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INTRODUCTION

In 2007, increasing volumes in the global macadamia industry reduced kernel prices to levels last recorded in 1999. With world production expected to triple in the next ten years, only the best producers will remain competitive. The fact that whole kernel prices were the least influenced in 2007 indicates a preference for unbroken kernel. This is problematic, considering that the "Beaumont" cultivar (representing close to 60% of all planted trees) is known to produce low quantities of whole kernels and is also susceptible to kernel discolouration, which further lowers the price. Most critical is the fact that 'Beaumont' nuts do not abscise, resulting in late harvesting and shortened shelf life. In the absence of better cultivars, a concerted effort is required to improve the quality of 'Beaumont' kernel.

MATERIALS AND METHODS

Shelf life survey: This survey examined data from previous post-harvest trials, to determine shelf life for kernel of varying origin and subjected to various post-harvest treatments.

Kernel breakage: Nuts harvested from the tree were subjected to various post-harvest handling treatments with a potential to cause breakage, including dropping of nut onto hard surfaces, drying rate and the use of various commercial dehuskers and crackers.

Discolouration trials: A survey was conducted over three seasons on farms in different climatic areas to determine whether growing conditions contribute to discolouration. Nuts were sampled at regular intervals from selected trees and evaluated for discolouration, with this data being correlated with climate data.

Harvesting trials: 2-Chloroethyl phosphonic acid (Ethephon) was tested as a nut abscission agent. Various rates and times of application were examined, with the percentage abscission being recorded for each treatment.

RESULTS AND DISCUSSION

Shelf life survey: The primary finding was that kernel harvested early in the season has the longest shelf life. Whole kernels have considerably longer shelf life than kernel pieces, and water sorting reduces shelf life for all types of kernel.

Kernel breakage: Rough handling of nuts on farm had minimal effect on kernel breakage, as did the use of correctly set dehuskers. Drying rate affected whole kernel, with faster drying giving more whole kernel. In terms of cracking, both cultivar and the type of cracker affected whole kernel. For 'Beaumont', the Shaw-type cracker gave the most whole kernel.

Discolouration trials: Discolouration is probably due to leaching of water soluble phenols from the shell to the kernel. It is more prevalent early in the season and in years of low rainfall – particularly low rainfall in the months during which kernel maturation occurs.

Harvesting trials: Ethephon was shown to be an efficient abscission agent, with up to 80% nut drop being achieved. The product is more effective in the late season, but at 1000ppm satisfactory abscission can be attained early in the harvest season.

CONCLUSIONS

To remain competitive SA macadamia growers need to optimise quality. Ethephon applications allow the abscission of 'Beaumont' nuts when discolouration is minimal, and with correct post-harvest handling, breakage can be minimised.

Keywords: macadamia, discolouration, post-harvest, quality, profitability, breakage

SUPPRESSION OF *Meloidogyne incognita* RACE 2 ON WATERMELON USING *Cucumis africanus* AND *Cucumis myriocarpus* SEEDLING ROOTSTOCKS

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INTRODUCTION

Worldwide, various technologies such as ground leaching and nematode-resistant cultivars are being developed to reduce reliance on halogenated nematicide technologies that have been associated with global warming (Mashela, 2002). The development and use of nematode-resistant seedling rootstocks for watermelon (*Citrullus lanatus*) production is one such promising technology in the management of the southern root-knot nematode (*Meloidogyne incognita*). The objective of this study was to determine the host-status and host-sensitivity of two *Cucumis* species to *M. incognita* race 2.

MATERIALS AND METHODS

Greenhouse studies were separately conducted to test the host-status and host-sensitivity of *Cucumis africanus* and *C. myriocarpus* to *M. incognita* race 2. Treatments, viz. 0, 500, 1000, 1500 and 2000 juveniles and eggs, were arranged in a randomized complete block design with 10 replicates per treatment. Pots containing three-week old seedlings of *C. africanus* and *C. myriocarpus* were each infested by dispensing eggs and juveniles using a 20 ml plastic syringe. At harvest, 56 days after inoculation, plant length, shoot weight, stem diameter and nematode numbers were collected as data and analysed using ANOVA through SAS software.

RESULTS AND DISCUSSION

At all four inoculation levels, the reproductive factors (final nematode population/initial nematode population) of *M. incognita* race 2 on *C. africanus* and *C. myriocarpus* were less than one, which suggested that the nematode failed to reproduce on the two species. Nematode infection had no effect on the measured growth parameters of *C. africanus* and *C. myriocarpus*. Given the lack of nematode reproduction or reduction in plant growth, both *Cucumis* species tested can be viewed as being resistant to this nematode species.

CONCLUSION

The two *M. incognita*-resistant seedling plant species have the potential for use as resistant rootstocks for watermelon production in soil infested with the root-knot nematode. However, further studies are necessary to ensure that the active ingredient preventing nematode infestation in these rootstocks, namely cucurbitacin, is not transferable to watermelon fruits under field conditions.

REFERENCES

MASHELA, P.W., 2002. Ground wild cucumber fruits suppress densities of *Meloidogyne incognita* in tomato crop. *Nematropica* 32,13 - 19.

ACKNOWLEDGEMENTS

Grateful thanks are extended to the National Research Foundation for providing funds.

Keywords: Cucumis africanus, Cucumis myriocarpus, Meloidogyne incognita, resistant rootstocks, reproductive factor

ALLELOPATHIC EFFECTS OF *Amaranthus*

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INTRODUCTION

Allelopathy has been described as the inhibition of one plant by another via the release of metabolic by-products into the environment. It is regarded as a survival mechanism used by plants for interference with the growth of other plants. With increasing interest and consumption of African leafy vegetables as a result of poverty and other factors, these crops are promoted more and more. In a crop rotation production system, *Amaranthus* may pose serious problems for the follow-up crops if allelopathic effects do exist. The project investigated the allelopathic effects of different *Amaranthus* species on different vegetable crops and weed species.

MATERIALS AND METHODS

A field experiment, pot trial and seed germination trial were conducted at the ARC-Roodeplaat VOPI. The field trial was conducted by planting *Amaranthus* at two different spacings. The recommended spacing of 20 cm in row and 25 cm between rows as well as a wider spacing of 20 cm in row and 50 cm between rows were used. The trial was conducted as a Randomised Complete Block Design (RCBD) with four replicates with plot sizes of 3m x 3m. The *Amaranthus* plants were allowed to reach maturity and were ploughed back into the soil before spinach, tomato, cabbage and green pepper seedlings were planted on the same area. Tomatoes and green peppers were planted in five rows with four plants per row, yielding 6 data plants. Cabbage and spinach were planted in five rows with seven plants per row yielding fifteen data plants. In the pot trial the allelopathic effect of different *Amaranthus* species and different plant parts of *Amaranthus* was assessed. A RCBD design with three replicates and five treatments was used. *Amaranthus* seedlings were allowed to reach maturity in the pots after which different plant parts of *Amaranthus* were incorporated into the soil to determine the effects of the different plant parts on tomato seedlings. The seed germination trial investigated the effects of a crude *Amaranthus* extract at 50 mg/ml and 25 mg/ml on the germination of seeds of two vegetable crops and three weed species. A RCBD design with three replicates and fifteen treatments per replicate was used.

RESULTS AND DISCUSSION

Initial results revealed that the *Amaranthus* extracts inhibited seed germination of vegetable and weed seeds. No differences were observed between the extracts of different plant parts of *Amaranthus*. The results for the field and pot trials are in the process of being analysed.

CONCLUSIONS

Allelopathic effects on both vegetable and weed seeds have been observed in the seed germination trial. If the results from the field and pot trials would support those findings, management of *Amaranthus* production needs to consider the potential effects which allelochemicals may have on vegetable production on the same soils.

ACKNOWLEDGEMENTS

Funding from the Gauteng Department of Agriculture and Rural development.

Keywords: Allelopathy, *Amaranthus*, vegetables

A VARIETY SELECTION DECISION SUPPORT SYSTEM FOR SUGARCANE BASED ON GENOTYPE-BY-ENVIRONMENT ANALYSES

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INTRODUCTION

Improvements in plant breeding procedures, combined with strategies to release niche specific varieties have contributed to increased variety numbers in the South African sugarcane industry, often complicating variety selection for growers. The objective of this study was to develop a decision support system (DSS) based on industry legalities, varietal characteristics, and structured genotype-by-environment (G x E) analyses, to assist users with variety selection decisions.

MATERIALS AND METHODS

Long-term data extracted from the variety trial database of the South African Sugarcane Research Institute (SASRI) were categorized according to different agro-climatic regions, harvest ages (12, 18, 24-month) and harvest seasons (early, mid, late season harvests). Restricted maximum likelihood (REML) analyses were conducted regionally to determine varietal adaptability to different harvest ages and seasons. Varietal adaptability to different yield potential conditions was determined by regressing variety mean yields against trial mean yields, and varietal adaptability was interpreted from the slope of the regression curves. All analyses were translated into “yes/no” decision matrix in a relational database, which was linked to a web interface. The system allows users to specify regional, harvest age, season, water regime, pest and disease, and yield potential characteristics of their production environment, selects appropriate varieties that conform to specified criteria, and eliminates non-compliers in a stepwise approach. The system was validated against expert opinion (Extension specialists).

RESULTS AND DISCUSSION

Highly significant ($p < 0.001$) variety x age and variety x season interactions were observed in all regions, which allowed appropriate characterisation of varieties. Regression analyses demonstrated varied stability of varieties across regions depending on the environmental yield potential. A total of 76 different production scenarios were tested, and on average the DSS selected a greater number ($p < 0.01$) of varieties compared to experts, with 73% of the DSS selections corresponding exactly to expert opinion. When averaged across regions, the success (% of DSS selections accepted by experts) of the system was estimated to be 84%. The factors investigated in this study were considered as priorities in a logical hierarchy influencing sugarcane production in the industry. However, further refinement of the system will include analysis of environmental covariates and their inclusion into the DSS.

CONCLUSIONS

The study has shown that statistical analyses of priority factors affecting productivity can be employed to broadly characterise varieties, and such characterisations can be adapted successfully into a selection tool that conforms to advice from field experts. Further inclusion of actual trial yield data into the system will allow users to view and compare variety performance at a local level to further assist with variety selection.

Keywords: Sugarcane, Variety, Genotype-by-environment, Decision support system

EFFECTS OF SILICON ON QUALITY AND MALONDIALDEHYDE CONTENT OF CUT ROSE (*Rosa x Hybrida* L.) CV. HOT LADY UNDER SALT STRESS

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INTRODUCTION

Silicon (Si) has been demonstrated to be beneficial for the growth of plants, particularly gramineous plants, and also to alleviate both biotic and abiotic plant stresses.

MATERIALS AND METHODS

A greenhouse experiment was conducted to investigate the effect of different levels of silicon (Si) when applied over a six month period to the hydroponically grown cut rose (*Rosa x hybrida* L.) 'Hot Lady' under two levels of salt stress. In particular, four concentrations (0, 50, 100, and 150 ppm) of Si were combined with either a 0 mM or 25 mM NaCl (EC \approx 3.8 mS cm⁻¹) level in the nutrient solution supplied to the plants.

RESULTS AND DISCUSSION

Application of 50 and 100 ppm Si partially maintained membrane permeability or fully restored it to the level of the control. Maximum chlorophyll content was recorded at 50 ppm Si. The addition of 50 ppm Si increased the number of flowers under both the salt stressed and unstressed conditions. However, no significant differences were found in flower number between 50 and 100 ppm Si treatments when accompanied by NaCl stress. Plants treated with NaCl alone showed a reduction in leaf area, while plants treated with NaCl together with either 50 or 100 ppm Si were similar to those in the control and unstressed treatments.

CONCLUSIONS

In this study, inclusion of silicon in the nutrient solution proved to have beneficial effects on growth and quality of hydroponically-produced roses. We found that a higher quality and yield could be obtained when silicon was applied to the nutrient solution in 50 and 100 ppm as Si. However, potassium silicate in high concentrations was found to be problematic as it caused pH fluctuations in the nutrient solution, affecting plant growth and quality.

REFERENCES

DATNOFF, L.E., SNYDER, G.H. & KORNDÖRFER, G.H., 2001. Silicon in Agriculture. Elsevier, Amsterdam.

SAVVAS, D., GIOTIS, D., CHATZIEUSTRATIOU, E., BAKEA, M. & PATAKIOUTAS, G., 2009. Silicon supply in soilless cultivations of zucchini alleviates stress induced by salinity and powdery mildew infections. *Environ. Exp. Bot.* 65, 11-17.

Keywords: Silicon, hydroponics, mineral nutrition, floriculture

INTERACTION BETWEEN AVOCADO FRUIT MATURITY, 1-METHYLCYCLOPROPENE APPLICATION RATE, STORAGE TEMPERATURE AND STORAGE PERIOD ON THE QUALITY OF 'FUERTE' AND 'HASS' AVOCADO FRUIT

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INTRODUCTION

South Africa was the first avocado-producing country to successfully commercialize 1-methylcyclopropene (1-MCP; SmartFreshSM). During the last decade, the initial set of laboratory trials was followed by static container trials and commercialization. The patent holder (Rohm & Haas, USA) annually commissions a set of relevant trials aimed at continuously upgrading the technology. Results of a study conducted during 2009 aimed at characterizing the interaction between 1-MCP application rates and storage temperature settings will be presented.

MATERIALS AND METHODS

'Fuerte' and 'Hass' fruit, count 18, were obtained from a local pack house during the onset, the middle and the end of the packing season. During these three periods maturity levels for 'Fuerte' were 75, 68 and 66% moisture content respectively and for 'Hass' 72, 69 and 67% respectively. Fruit were treated with 0, 200, 300 and 500 ppb SmartFreshSM and stored for a 40 day period with early season fruit at 6° and 8°C, mid-season fruit at 5° and 7°C and late season fruit at 4° and 6°C. In each case one box of count 18 fruit was ripened on day 20, 25, 30, 35 and 40 at 19°C. Ripening period, physiological disorders and fungal infections were recorded.

RESULTS AND DISCUSSION

For both 'Fuerte' and 'Hass', at all storage temperatures and maturities, ripening followed similar patterns. SmartFreshSM displayed an increase in mean days to ripen (DTR) as the concentration increased on days 20, 25 and 30. The effect of SmartFreshSM became weaker on days 35 and 40. A slight decrease in mean DTR also occurred as the storage period was increased. For 'Fuerte' the incidence of grey pulp increased as the season progressed, while only a slight increase was observed for the control 'Hass' fruit stored at lower temperature regimes for 35 and 40 days. SmartFreshSM and storage temperature did not affect incidence of fungal diseases, but there were trends between the different maturity levels (time of season).

CONCLUSION

Ripening of 'Hass' and 'Fuerte' avocado fruit was influenced by SmartFreshSM concentration and storage period, but not by maturity or the time of the season. Physiological disorders and diseases were, on the other hand, not significantly influenced by SmartFreshSM concentrations or storage temperatures, but by the time of the season.

ACKNOWLEDGEMENTS

Funding by Rhom & Haas is hereby acknowledged.

Keywords: avocado, SmartFreshSM, storage temperatures, storage period, maturity level, ripening

TUFA, A NEW GROUNDNUT CULTIVAR IN SOUTH AFRICA

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INTRODUCTION

Groundnut production in South Africa has declined over the past few years. During the 1973/74 production season the kernel yield exceeded 380 00 tons as compared to yields of less than 100 000 tons during the past five years. The implications for this dramatic decrease in production are the decline in the export of groundnuts, which earned prima prices for producers and foreign income for the country. This opened the opportunity for the introduction of a new high yielding groundnut cultivar. Tufa has a distinctive upright growth habit and is easily recognizable in the field. This cultivar shows great potential for filling the gap within the groundnut industry for the eating as well as exporting markets.

MATERIALS AND METHODS

Over the past three growing seasons, starting in 2006, groundnut cultivar trials were conducted over twelve localities across the major groundnut production areas of South Africa. Fourteen cultivars and lines were tested. Each year up to 17 trials were divided into three groups; irrigated/sprayed (7), irrigated/not sprayed (3) and dry land trials (7). The irrigated/sprayed and dry land trials were given preventative applications of fungicides for foliar diseases where the irrigated/not sprayed trials weren't given the preventative applications of fungicides. Standard agricultural practices were used for cultivation. The trials were harvested and yield- and grading qualities were recorded. Data acquired were statistically analyzed to acquire data of relevance within the probability of 95%.

RESULTS AND DISCUSSION

Results showed that Tufa is a high yielding cultivar with a wide range of suitability able to thrive in the diverse climatic conditions encountered within the groundnut production area. Groundnut production under dry land is bound to vary considerably over seasons and localities. The erratic nature of the rainfall necessitates a cultivar well adapted to erratic climatic behavior. Statistical analysis of the yield stability for the 14 lines and cultivars tested, showed a high probability of yield stability for Tufa over the past three years. Recent interactions with the export market has shown a favorable interest in Tufa for the confectionary market as the kernels of Tufa displays a uniformity for even coating of the kernels. Tufa not only displayed a drought tolerance but also a tolerance to leaf diseases providing a positive outcome in the profit margin of the cultivar.

CONCLUSIONS

Based on acquired data it can be said that Tufa will impact the groundnut industry positively in South Africa. Having a higher yielding cultivar will raise the margin of profit for the producer as well as the industry strengthening the agricultural economy within South Africa.

REFERENCES

Dreyer J, Salomon L (2007) Groundnut cultivar evaluation report. www.arc.agric.za
Dreyer J, Salomon L (2008) Groundnut cultivar evaluation report. www.arc.agric.za
Dreyer J, Salomon L (2009) Groundnut cultivar evaluation report. www.arc.agric.za
Quality and economic synopsis of fourteen groundnut cultivars and lines tested in 2008/09. www.arc.agric.za

ACKNOWLEDGEMENTS

Acknowledgement towards OPOT and the ARC for funding the national groundnut cultivar trials.

Keywords: Tufa, Groundnut

SENSIBLE HEAT FLUX AND EVAPORATION USING ITERATION

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INTRODUCTION

Surface renewal (SR), temperature variance (TV) and Monin-Obukhov similarity theory (MOST) methods require complex iterative procedures for estimating sensible heat flux (H) and evaporation. Also, for example, the Penman-Monteith grass-reference evaporation method requires the saturation water vapour pressure vs temperature slope at canopy temperature and specific latent energy of vaporisation requires the wet bulb, both unknown temperatures. A simple spreadsheet-based iterative method is used for flux estimation for these cases.

MATERIALS AND METHODS

Data from field experiments at Bellevue, near Pietermaritzburg, KwaZulu-Natal and data collected above Midmar Dam, near Howick, KwaZulu-Natal were used. Unshielded and naturally-ventilated fine-wire thermocouples above the canopy and water surface respectively were used to measure high frequency air temperature from which H and evaporation were estimated by iteration using SR, TV and MOST methods, the latter using surface-layer scintillometer data from the Bellevue site. Spreadsheet iterations were limited to 25 and compared with 100 using a maximum change of 0.001. In the case of a daily model for open-water evaporation, the model implementation required an iterative procedure for estimating wet bulb temperature from air temperature and water vapour pressure. Apart from the MOST iterative procedure, implementation was applied in a single spreadsheet cell. Procedures for unstable and stable conditions were applied to a single cell using conditional statements.

RESULTS AND DISCUSSION

The SR and TV spreadsheet iterative methods yielded accurate estimations for 25 iterations. The iterative procedure for MOST estimations of H , momentum flux and evaporation was more complex, requiring more than one spreadsheet cell. Procedures for estimating grass-reference temperature from weather station data sometimes yielded inconsistent (negative) temperatures.

CONCLUSIONS

An accurate spreadsheet-based iterative procedure was implemented for SR, TV and MOST estimations of H and evaporation. The procedure was applied using SR, TV and surface-layer scintillometer data from various surfaces including open-water, used to estimate wet bulb temperature and also grass-reference temperature and grass-reference evaporation. The spreadsheet procedure conveniently allows simultaneous visual inspection of input data, graphical display(s) and the iterative results.

ACKNOWLEDGEMENTS

We thank the Water Research Commission for funding and acknowledge assistance in the field from many UKZN staff and students and CSIR staff.

Keywords: Energy balance, iterative procedure, MOST, Penman-Monteith, surface renewal, temperature variance

EFFECTS OF PHOSPHATE LEVELS ON ROSE GERANIUMS (*Pelargonium graveolens*) PRODUCTION

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INTRODUCTION

Rose geranium (*Pelargonium graveolens*) is an aromatic plant that has gained a magnitude of usage in South Africa's agricultural industry as one of the most important essential oil crops. Apart, from being indigenous to South Africa, rose geranium is widely cultivated world wide. Although there is still some conflicting information available on the factors that affect yield of rose geranium, recent trials have shown that yield is highly dependent on management of fertilization, moisture and climate (Agriculture, forestry & fisheries, 2009). Phosphorus plays an important role in plants and its effects has therefore being studied in most crops. The effect of P on rose geranium cultivated under soilless conditions has not received this level of attention and need to be investigated further.

MATERIALS AND METHODS

This research trial was conducted in a fibre glass greenhouse at the University of Free State experimental farm, (Bloemfontein). The experiment was carried out during autumn and winter seasons (2009). Each treatment had five replications and was assigned in a completely randomized block design (CRBD). Plants were grown on a 5 L pots filled with sterile pool silica filter sand obtained from Hyper Pool Equipment. A space of 15 cm between plants and 50 cm between rows was used. A 'drain to waste' fertigation system was used to fertigate all experimental plots and these plots received four irrigation cycles per day, scheduled at 08:00, 11:30, 14:00 and 18:00. P-levels evaluated were 0.1, 0.8, 1.50 and 2.20 meq P L⁻¹. Micronutrients were applied as follows; Libfer (13% Iron-EDTA) was applied at 1.12 ppm; boric acid was applied at 0.21 ppm; ammonium molybdate was applied at 0.05 ppm; manganese sulphate was applied at 0.55 ppm; copper sulphate was applied at 0.03 ppm and zinc sulphate was applied at 0.20 ppm (Combrink, 2005). The pH of the nutrient solution was maintained at 6.98 while the nutrient solution EC was kept at 1.60 m S cm⁻¹.

RESULTS AND DISCUSSION

Most of the evaluated crop yield parameters were not affected by P-levels. However, P-levels had an effect on the oil yield, oil quality, foliar minerals and crude protein content. Oil yield was increased with 2.20 meq P L⁻¹ yielding approximately 115.17 kg ha⁻¹ compared to the 43.85 kg ha⁻¹ obtained with 0.1 meq P L⁻¹. Linalool and geraniol responded well to a P-level of 2.20 meq P L⁻¹, while citronellol responded well to the 0.1 meq P L⁻¹. Citronellyl formate and guaia-69-diene responded positively to the 1.50 meq P L⁻¹, and the citronellol:geraniol ratio responded well to 1.50 meq P L⁻¹. Calcium and Al were not affected by any of the P-levels evaluated on this study. However rose geranium had a significant high level of foliar Mg, K, N and total N at 1.50 meq P L⁻¹ and also crude proteins levels were significantly higher at this level. Lastly, the uptake of S was reduced at pro-liferated P-level, than N, K and Mg; hence S was higher at a lower P- level (0.8 meq P L⁻¹)

CONCLUSIONS

The results obtained from this study clearly showed that P can be used to enhance the quality of essential oils of rose geraniums grown under soilless conditions.

REFERENCES

- Agriculture, forestry & fisheries, 2009. Essential oil crops: *Production guidelines for rose geranium*. Department of Agriculture: Directorate: Plant Production, Private Bag X144, Pretoria, 0001, South Africa.
Combrink, n.j.j., 2005. Nutrient solutions and Greenhouse management. Combrink Familietrust, Cape Town, RSA.
LIS-BALCHIN, M., 1996. Geranium oil. *Inter. J. Aroma* (7) 3, 18-20

ACKNOWLEDGEMENTS

National Research Foundation, Central University of Technology, Free State, and University of the Free State.

Keywords: Oil quality, P-levels

DEVELOPMENT OF A STANDARD SET OF MICROSATELLITE MARKERS FOR THE IDENTIFICATION OF GUAVA CULTIVARS AND SELECTIONS

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INTRODUCTION

Guava varieties are multiplied through vegetative propagation, which requires routine verification of the clonal material. To avoid misidentification and to protect the Plant Breeders' Rights, an efficient identification tool is required. Microsatellites, or simple sequence repeats (SSRs), are a resourceful tool available for fingerprinting due to their ubiquitous distribution along the eukaryotic genome, high level of polymorphism, co-dominant inheritance and robustness (Powell *et al.*, 1996). A number of SSR markers for *Psidium guajava* L. were developed by Risterucci *et al.* (2005) for cultivar identification, linkage mapping and potential inter-specific genetic studies. A sub-set of these markers was tested in this study.

MATERIALS AND METHODS

Leaves were collected from selected plants in the nursery and orchard. The DNA was extracted according to a modified CTAB DNA extraction procedure (Risterucci *et al.*, 2005). PCR amplification using SSR primer pairs was carried out, whereafter amplification products were resolved and scored on a 2% agarose gel. The parameters used to evaluate the information rendered included the number of alleles per locus and observed heterozygosity.

RESULTS AND DISCUSSION

A total of 45 guava selections and cultivars were analyzed with ten SSR primer pairs that rendered reproducible polymorphisms. These informative SSR primer pairs were selected from a larger set of SSRs after evaluation of a smaller sub-sample of guava cultivars. Most guava selections could be identified using a set of 3-4 SSR primer pairs.

CONCLUSION

SSR markers could be successfully used in the identification of guava selections and cultivars. Polymorphisms revealed in this preliminary study will further be used in genetic mapping, marker-assisted selection and germplasm characterization.

REFERENCES

- POWELL, W., MACHRAY, G.C. & PROVAN, J., 1996. Polymorphism revealed by simple sequence repeats. *Trends Plant Sci.* 1, 215-222.
RISTERUCCI, A.M., DUVAL, M.F., ROHDE, W. & BILLOTTE, N., 2005. Isolation and characterization of microsatellite loci from *Psidium guajava* L. *Mol. Ecol. Notes* 5, 745-748.

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Keywords: Microsatellite, markers, guava

MONITORING OF RANGELAND QUALITY BY MEANS OF LOW ALTITUDE REMOTE SENSING

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INTRODUCTION

As stated by Mackay and Zietsman (1996), remote sensing is a potential aid for identification and monitoring of changes in vegetation, measurement of biotic productivity and identification of land use patterns in rangelands, and thus has the potential to reduce the time and to improve the cost efficiency of managing rangeland resources.

MATERIALS AND METHODS

A combination of two Sony Cyber-shot DSC-P73/P93 digital cameras mounted into a wooden frame was used as the sensor. This sensor allowed taking four band data [Red (R), Green (G), Blue (B), and Near-infrared (N-IR)]. An Infrared (IR) cut-filter was removed from only one digital camera in order to increase N-IR sensitivity. An IR pass filter (720nm) was attached to the lens. Stereo Photography with these digital cameras allowed taking four band data. In this study a Robinson R22, two seater helicopter was used as the aerial platform for obtaining the colour infrared imagery. The obtained imagery was used for the classification of vegetation. The maximum likelihood, a supervised classification method of TNTmips was used for image analysis.

RESULTS AND DISCUSSION

The objective was to determine if grouping of vegetation (into trees, shrubs and grasses) could be done with acceptable accuracy using the CIR imagery obtained by the combination of two Sony cameras. The percentage of overall accuracy in the Error Matrix analysis was used for assessing the image classification accuracy. The mean overall accuracy of the CIR imagery was 92.34%, which suggests that by using the CIR imagery obtained at a low altitude, using the inexpensive sensor (combination of the two Sony cameras) natural vegetation can be grouped into trees, shrubs and grasses with 92% certainty.

CONCLUSIONS

The inexpensive remote sensing methodology demonstrated a potential as an effective tool for classification of natural vegetation. This opens another door in the monitoring of rangeland quality especially when it comes to bush encroachment which has been widely reported as a threat to savannah regions.

REFERENCES

Mackay, C.H. & Zietsman, H.L., 1996. Assessing and monitoring rangeland condition in extensive pastoral regions using satellite remote sensing and GIS techniques: an application to the Ceres Karoo region of South Africa. *African Journal of Range and Forage Science* 13(3), 100-112.

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University of Limpopo and National Research Foundation.

Keywords: Infrared imagery, rangeland, remote sensing

SOIL CHEMICAL CHARACTERIZATION IN CONTRASTING CROPPING SYSTEMS UNDER LAND REFORM PROGRAMME IN ZIMBABWE

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INTRODUCTION

In the year 2000 the government of Zimbabwe embarked on the fast track land reform programme (FTLRP). These new systems have seen agricultural production declining by 20% (Moyo *et al.*, 2001).

MATERIALS AND METHODS

The research was carried out in Manicaland Province, in the Eastern Border Highlands of Zimbabwe. The crop production systems under study are communal farming systems (Dora farming area), A2 (Mutare farming area) and A1 (Odzi farming area) which are all in, Manicaland Province of Zimbabwe. The study was carried out from 2005 to 2009. Twenty samples were randomly collected for 0-30 cm and 30-60cm depths from each farming system. The soils were analyzed for Ca, Mg, K, Zn, pH and OM. The analyses of the mentioned nutrients were done using standard procedures as described by AOAC (1990). Data were analysed by SAS statistical package. The data was inferred using $P < 0.05$.

RESULTS

Calcium, Magnesium and Potassium

Calcium and Magnesium are significantly different ($P < 0.05$) at both for 0-30cm and 30-60cm depths. Therefore the results show that as soil depth increases there is a significant increase in the available exchangeable cations. A2 system had the highest Ca and K content and A1 had the highest Mg levels at 0-30cm depth. At 30 -60 cm Ca, Mg and K was highest in communal, followed by A1 and A2 respectively.

CONCLUSIONS

The results clearly show that these crop production systems have serious fertility problems, which need addressing.

REFERENCES

AOAC (*Association of Official Analytical Chemists*), 1990. Official methods of analysis. 15th Edition. AOAC Inc., Arlington. Virginia. USA
MOYO, S., SUKHUMI, C., CHIDAWANYIKA, C., AND BINSWANGER, H., 2004. Agricultural growth and land reform in Zimbabwe: Assessment and recovery options.

ACKNOWLEDGMENTS

The authors would like to thank the Faculty of Agriculture and Natural Resources of Africa University for funding this research. The farmers from the three production systems are also thanked for allowing us to do sampling at their farms as well as providing us with yield data for their crops for the past seven years.

Keywords: A1, A2, communal, production systems, soil nutrients

THE EFFECT OF METHYL JASMONATE AND SALICYLIC ACID ON CHILLING INJURY OF 'EUREKA' LEMONS

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INTRODUCTION

Lemons are susceptible to chilling injury when exposed to temperatures below -0.5°C. South Africa produces and exports lemons to countries around the world. The industry continues to lose large amounts of fruit during postharvest storage due to chilling injury. Exposing lemons to low temperature (-0.5°C) for a certain period is an obligatory quarantine treatment for disinfestations of Mediterranean fruit fly. However, fruit do not tolerate such temperatures and develop chilling injury, an unsolved problem in the citrus industry. Salicylic acid and methyl jasmonate treatments were tested for their ability to reduce chilling injury in lemons.

MATERIALS AND METHODS

'Eureka' lemons were sterilized, air-dried and dipped in 1, 10 or 50µM of methyl jasmonate or 1, 2 or 2.5mM of salicylic acid for 30s, waxed with Avoshine® and stored at -0.5°C for 0, 7, 14, 21, 28, 35, or 42 days, before being transferred to ambient temperature for 7 days. Measurements of fruit weight, ethylene and CO₂ production and electrolyte leakage of the rind were taken and total antioxidant capacity/activity, total phenolics and soluble sugars of the rind were analysed.

RESULTS AND DISCUSSION

Fruit did not develop visual symptoms of chilling injury despite the extended cold storage period. No significant differences were found between treatments and cold storage time with respect to electrolyte leakage, ethylene evolution and respiration. Treatment with 10µM methyl jasmonate or 2mM salicylic acid significantly ($P < 0.05$) reduced fruit mass loss and slowed reduction of total antioxidants during cold storage.

CONCLUSION

Methyl jasmonate and salicylic acid dips could possibly be used to enhance the resistance of fruit to chilling injury during cold storage. Both compounds probably act through the maintenance of antioxidant levels.

Keywords: chilling injury, methyl jasmonate, salicylic acid, anti-oxidants

MODELLING CROP GROWTH AND CROP WATER RELATIONS IN SOUTH AFRICA: PAST ACHIEVEMENTS AND LESSONS FOR THE FUTURE

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Mathematical simulation of crop growth and water relations has become indispensable to agricultural science and practice. A critical assessment of how modelling contributed to the development of crop science and to the management of crop production and natural resources in South Africa (SA) over the past 25 years could give new perspectives on the benefits derived from modelling, the appropriateness of approaches employed and the best way forward.

The initial objectives of the major SA modelling initiatives (ACRU, BEWAB, CANEGRO, CERES, PUTU, SAPWAT, SWB) dictated the approaches that were followed and determined the impacts thereof. Significant advances were made with regard to improved understanding of crop growth and water use and adapting models for local conditions such as for example dryland grain crop production under very low rainfall. Modelling provided invaluable support for strategic investigations into the impacts of climate change, land use and water use. Many of the models succeeded in providing much needed information to improve tactical and operational management of irrigated and dryland agriculture. Some models have been (and are being) used operationally to forecast crops (maize, wheat and sugar) and to monitor droughts in natural vegetation, adding value to the respective industries.

Modelling has formed, in some cases, an integral part of tertiary education in crop science and hydrology. This should be strengthened to build more capacity to address the ever-increasing complexity of challenges in agriculture.

The review identified factors that are crucial for modelling to maintain effective impacts on the science and practice of crop production and natural resource use. These were excellent scientific leadership, long term funding, effective collaboration between local and with international groups, expertise on local agronomy and good quality experimental data for model testing and adaptation. Future modelling efforts should explore opportunities to integrate information obtained from technologies such as remote sensing and genomics.

Keywords: crop model, irrigation, water balance, management, hydrology, simulation

TECHNOLOGY APPLICATION CASE STUDY: USING 3DMAPPER™ FOR SOIL SURVEY ANALYSIS NEAR BREYTON IN MPUMALANGA

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INTRODUCTION

Soil distribution is related to the factors of soil formation and the specific interaction thereof. On a hillslope scale, topography plays a major role as both climate and biology are homogeneous. Site specific topography therefore determines soil profile development and as a result also soil form. Soil distribution patterns in the landscape are defined as toposequences. Understanding the combination of terrain morphological units as well as slope gradient and shape, greatly facilitate advancement in soil surveys. Tacit knowledge of these aspects built up during soil surveys is difficult to analyze, yet very useful in predicting the distribution of soils in the landscape. The implication is that because soil is not distributed randomly in the landscape it is possible to predict soil type distribution with a degree of accuracy.

METHODOLOGY

3dMapper™ a terrain analysis program, is designed to analyze and evaluate slope characteristics of landscapes to do predictive soil mapping (PSM). The program uses an aerial image, georeferenced over a wire frame digital elevation model (DEM) of a landscape, depicting actual surface topography. Soil polygons names and point observation data can be added as layers over the landscape model. 3dMapper™ was used to develop an understanding of the relationship between soil associations and topographical features and then to predict the distribution of soil associations in the landscape in the Breyton area Mpumalanga. The ultimate objective of this technology application study was thus to produce the required soil maps, using predictive mapping techniques based on terrain analysis.

RESULTS

Data of an existing detailed soil survey (150 m grid) were used to verify predicted soil distribution patterns. The soil field survey data was imported into 3DMapper™ as shape files and analyzed using available model options. The surveyed area is dominated by the occurrence of plinthic soils followed by hydromorphic and oxidic soils. The position of the plinthic soils in the landscape studied correlated well with plan curvature while hydromorphic soil positions correlated with slope gradient. Positions of oxidic soils correlated with terrain morphological units in high landscape positions.

CONCLUSIONS

3DMapper™ software is useful in providing an understanding of the distribution of soil associations in landscapes. Tacit knowledge was enhanced to the extent that in conjunction with 3DMapper™, the accuracy of soil border delineation was improved.

Keywords: predictive, soil, mapping

EMMER AS A SOURCE OF IMPROVED WATER USE EFFICIENCY FOR WHEAT

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INTRODUCTION

Like many crops, bread wheat (*Triticum aestivum*), suffers from a lack of genetic diversity which makes it difficult to breed for improved traits such as disease resistance and water use efficiency. The progenitors of modern wheat are a potential source of increased genetic diversity. A preliminary field experiment indicated that emmer (*Triticum dicoccum*) had higher water use efficiency than modern bread wheat, spelt (*Triticum spelta*) and einkorn (*Triticum monococcum*). The experiment described in this paper, was designed to further evaluate emmer under droughted and irrigated conditions.

MATERIALS AND METHODS

A factorial experiment was established in a glasshouse to investigate the growth, development and water use efficiency (WUE) of einkorn, emmer, spelt and bread wheat under irrigated (to 80% field capacity) and droughted (50% field capacity) conditions. Plants were grown in 1m long PVC columns. The experiment was a split-plot design with irrigation on the main plot. There were four replicate blocks, with four columns per species within each block. Water use was monitored weekly using a theta probe to measure soil moisture content within five soil profile layers. WUE was measured using three different techniques: regression of biomass production against water use, instantaneous transpiration efficiency (ITE, calculated as net photosynthesis rate divided by transpiration rate) and the carbon isotope discrimination technique, using the flag leaf.

RESULTS AND DISCUSSION

There were no significant differences in ITE, but emmer (3.03) and spelt (3.05) recorded higher values than einkorn (2.39) and wheat (2.41). Carbon isotope discrimination ($\Delta^{13}\text{C}$) showed that emmer and spelt both had $\Delta^{13}\text{C}$ values of 17.8, einkorn 19.6 and wheat 19.5 ($P < 0.001$). As there is a negative relationship between $\Delta^{13}\text{C}$ and transpiration efficiency, this indicates that, during the growth of the flag leaf, emmer and spelt used water more efficiently than einkorn and wheat. Regression analysis showed that, over the life of the crops, emmer had a WUE of 2.4 g l⁻¹ compared to 1.6 g l⁻¹ for spelt, 1.4 g l⁻¹ for einkorn and 1.0 g l⁻¹ for wheat ($P < 0.001$). This work confirms findings from the preliminary field experiment and also supports previous studies by Al-Hakimi *et al.* (1998) and Peleg *et al.* (2005).

CONCLUSIONS

The three methods of assessing WUE confirmed that emmer had greater WUE than modern wheat and, over the life of the crops, WUE was significantly greater than spelt and einkorn. Further work will investigate whether the traits underlying higher WUE in emmer can be introgressed into modern bread wheat.

REFERENCES

- AL-HAKIMI, A. 1998. Primitive tetraploid wheat species to improve drought tolerance in during wheat. 305-312. In: A.A. Jaradat (ed.) *Triticeae III. Proceedings of the Third International Triticeae Symposium*, 4-8 May 1997, Aleppo, Syria.
- Peleg Z., Fahima, T., Abbo, S., Krugman, T., Nevo, E., Yakir, D. and Saranga, Y. 2005. Genetic diversity for drought resistance in wild emmer wheat and its ecogeographical associations. *Plant Cell Environ.*, 28, 176-191.

Keywords: Emmer, water use efficiency, wheat

NITROGEN BASED SLUDGE LAND APPLICATION IN AGRONOMIC CROPS: AGRONOMIC AND ENVIRONMENTAL IMPLICATIONS

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INTRODUCTION

Beneficial agricultural use of treated municipal sludge is a well known practice around the world. Nevertheless, only 28% of the sludge produced in South Africa is beneficially utilized on agricultural lands. A lack of local knowledge about the benefits and disadvantages of sludge has contributed to the low utilisation. The South African Sludge Guidelines used to allow an annual upper application limit of 8 t ha⁻¹, but was recently increased to 10 t ha⁻¹. This report recommends local field scale studies to verify the guideline. The overall objective of this study was to investigate the dynamic nature of sludge loading for optimal crop production and to assess the potential environmental impacts through nitrate leaching and P accumulation in the soil profile.

MATERIALS AND METHODS

Field experiments were conducted on a clay loam soil planted to dryland maize (*Zea mays* L.) and irrigated maize-oat (*Avena sativa* L.) rotation at the East Rand Water Care Works (ERWAT), Johannesburg, Gauteng, South Africa. Plots of 25 m² were arranged in a randomized complete block design comprising four replications of five treatments. An 8 t ha⁻¹ sludge control treatment was compared with 0, 4, and 16 t ha⁻¹ yr⁻¹ rates and an inorganic fertilizer (NPK 2:3:2, KCl, and LAN). The sludge used in this study was anaerobically digested and paddy-dried having acceptable quality for agricultural use. During the study, both sludge and inorganic fertilizer were broadcast and immediately incorporated into the soil.

RESULTS AND DISCUSSION

Doubling the old annual 8 t ha⁻¹ sludge norm significantly ($P \leq 0.05$) increased grain and forage yield of both dryland maize and the irrigated maize-oat rotation. Export of N in forage was approximately double that exported in the grain above. Nitrogen exported in forage from the irrigated rotation was at least three times higher than that from similar sludge loading rates under dryland maize production. Mass balance calculations involving N applied, N exported in product and change in soil N storage revealed substantial losses from the system, particularly under irrigated conditions. Soil solution samples collected from 0.3 and 0.6 m deep wetting front detectors under the irrigated maize-oat rotation indicated a low risk of groundwater pollution through nitrate leaching. The risk of leaching was higher with the use of inorganic fertilisers. Sludge applied according to crop N demand would result in total and Bray-1P accumulation in the soil profile and could pose a threat to surface water pollution with time.

CONCLUSION

Ideally the upper sludge limit to satisfy crop N demand should be dynamic because it depends on the sludge N content, the intensity of cropping, and the availability of water. Ultimately, maximum sludge loading will depend on the accumulation of P and the risk this poses for pollution.

ACKNOWLEDGMENTS

Funding from WRC, ERWAT, and SASOL is gratefully acknowledged

Keywords: Sludge, Nitrogen, Phosphorus, Leaching, Maize, Oats

CATECHIN AND EPICATECHIN PHENOLICS IN 'HASS' AVOCADO TISSUES

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BACKGROUND

Various researchers have reported that fruit exocarp and seed have greater amounts of free phenols than of bound ones. The moieties conjugate via the hydroxyl groups of the phenolics, thereby reducing their ability to function as strong antioxidants. As silicon has been found to interact in the phenolic pathway, potassium silicate treatments could be used to either release free phenols from the conjugates or increase the phenol concentration in fruit tissue, resulting in increased antioxidant activity of such tissue. The objective of this research was to study the pre-harvest production and distribution of the major avocado phenolics, catechin and epicatechin (free and bound forms), in fruit tissues. Understanding the production and distribution of these two phenols, and the effect of a postharvest application of silicon on the concentration of these phenols and/or their forms, will aid in improving fruit quality.

MATERIALS AND METHODS

Mature postharvest fruit (32% oil g/g dry weight) were treated by dipping them into solutions with different concentrations of potassium silicate (0, 5, 13, 25 x 10³ppm) for 40 min, storing them at 5.5°C for 28 days and thereafter allowing them to soften at room temperature. Total phenolics were determined spectrophotometrically while the concentration of individual phenols was determined by HPLC. Lipid peroxidation was determined spectrophotometrically, while electrolyte leakage and catalase activity were analyzed according to Tesfay *et al.* (in press). Catalase expression was visualized using a Western blot and statistical evaluation of data was performed using GenStat 11th edition.

RESULTS AND DISCUSSION

Phenolics are not evenly distributed in fruit. The accumulation of soluble phenolic compounds is generally greater in external tissues of fleshy fruit than in internal tissues. It was, hence, not surprising to find a significantly lower phenolic concentration in mesocarp than in exocarp tissue. Fruit quality was improved by Si treatment, probably due to reduced electrolyte leakage and lipid peroxidation, and as a result of increased catalase expression and a 10-20% increase in catalase activity.

CONCLUSION

Results confirm the potential of potassium silicate to significantly improve postharvest fruit quality through an increased antioxidant pool in fruit, and particularly by increasing free phenols and catalase expression in mesocarp tissue.

REFERENCES

TESFAY, S.Z., BERTLING, I. & BOWER, J.P., (in press). Levels of anti-oxidants in various tissues during maturation of 'Hass' avocado (*Persea americana* Mill.). *J. Hortic. Sci. Biotech.*

Keywords: epicatechin, catechin

RAINFALL-RUNOFF RELATIONSHIPS AS INFLUENCED BY RUNOFF TO BASIN AREA RATIOS AND MULCHING RATES IN BAINSVLEI KENILWORTH ECOTOPE

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INTRODUCTION

Infield rain water harvesting (IRWH) techniques was mainly test on a clay soils at a fixed runoff (2m) to basin area (1m) ratio. Rainfall-runoff relationships are fundamental to the hydrology within the soil-plant-atmospheric systems of the IRWH. A study was conducted on Bainsvlei soil forms (2m deep sandy loam soils) at Kenilworth experimental farm of the University of the Free State during 2008/09. The aim of the study was to assess the rainfall-runoff relationships for the infield rain water harvesting techniques in Bainsvlei Kenilworth ecotope.

MATERIALS AND METHODS

The plot set-up was performed according to different runoff strip lengths (RSL). Mulching rate (MR) application studies were done on each RSL treatments. There were four different runoff strip length (RSL) treatments and also five mulch application rates (MR). The soil of the site is reddish brown in colour with the fine sandy loam texture (*Amalia family*).

The rainfall intercepted by the crop canopy was calculated as a function of leaf area index. The rainfall amount collected per rain storm was analyzed using a step wise multiple regressions to formulate an equation. This was then compared with area under the rainfall intensity curve (AUC) method which calculates amount of runoff from rainfall intensities greater than 6 mm/h.

RESLUTS AND DISCUSSIONS

The general trend is that the canopy rainfall interception increased exponentially with maize growth stages across all treatments. The longer runoff strip lengths showed higher rainfall interception throughout the growing period. From the relationship analysis of the canopy rainfall interception and runoff however, the study disapprove the hypothesis that assumed runoff would be affected by the growing stages. Equation from the stepwise regression for the runoff from the rain storm event gave coefficient of determination (r^2) of 0.61 at P=0.001 significant level. During the season maximum runoff depth (7.9mm) and highest runoff ratio (0.43) were recorded on a bare (MR0%) and narrow runoff strip length of 1 meter (RSL-1). The simulated runoff data by using AUC method for the bare treatment for each runoff strip length treatments compared with the observed runoff values during the respective storm events to evaluate the performance of the model.

CONCLUSIONS

It is concluded that the regression model simulated the runoff amount during the rain storm events reasonably well. The AUC method can be also used with reasonable confidence after evaluating to simulate the runoff from rainfall intensity during the rainstorms on bare maize plots.

Keywords: Rainfall-runoff relationship, runoff strip length, mulching rate

THE INFLUENCE OF PLANTING DENSITY ON GRAIN YIELD AND QUALITY OF SPRING WHEAT CULTIVARS UNDER IRRIGATION

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INTRODUCTION

No-till planters, when used to establish wheat under irrigation differ from normal planters (170 mm) in that the row widths used are much wider (250 mm). Wider rows increase inter-plant competition at the same seeding rate and the question whether seeding rates must be adapted, was posed. This study was conducted to determine the influence of seeding rate on grain yield and quality of different spring wheat cultivars when planted in wide rows in the cooler irrigation region of South Africa.

MATERIAL AND METHODS

Two factorial field trials (2007-2008) with split-plot arrangements were established in farmers' fields under irrigation (centre pivot) close to Hopetown, adjacent to the Gariiep River. A no-till planter was used to establish eight spring wheat cultivars at 175-300 target plants m⁻² in four replications. The row width was set at 250 mm and the crop was fertilised with standard fertiliser at planting and supplementary N by fertigation providing totals of 180 kg N ha⁻¹ and 40 kg P ha⁻¹. Pest and weed control was done by the farmer with the rest of the field. Yield of each plot was determined after harvesting 5 x 1.5 m yield plots with a plot harvester. Protein and hectolitre mass (HLM) were determined by the Grain Quality laboratory at ARC-SGI.

RESULTS AND DISCUSSION

The 2007 and 2008 seasons were excellent with high yields and low CV's. In 2007, no significant yield differences could be ascribed to planting density (PD) or cultivars (CUL), with no interaction between these two factors. During the 2008 season, a significant PD x CUL interaction indicated that cultivars differed in response to planting density. While the yield of some cultivars did not respond to increasing planting density, the yield of others was significantly increased up to an optimum level after which it decreased. Quality parameters like grain protein and HLM were not significantly influenced by planting density in either season.

CONCLUSION

These results show that cultivars can differ in response between seasons and that cultivar specific planting density recommendations may be necessary. Planting densities should remain fairly high and plant populations of 200-250 plants m⁻² should be aimed for (despite the use of wide rows) to achieve optimum yield potential.

ACKNOWLEDGEMENTS

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Keywords: spring wheat, no-till planting, row width, planting density

DOES BT MAIZE HAVE AN EFFECT ON ARTHROPOD BIODIVERSITY IN MAIZE FIELDS?

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INTRODUCTION

South Africa is ranked number eight in the world with regard to total genetically modified (GM) crop area with 1.8 million hectares planted in 2008 (James, 2008). Assessment of the impact of GM Bt maize on the environment is hampered by the lack of even the most basic checklist of species present in maize ecosystems. The aims of this study were to determine arthropod diversity on maize and to compare diversity between Bt and non-Bt maize.

MATERIALS AND METHODS

Collections of arthropods were done during the 2007/2008 and 2008/2009 growing seasons on Bt and non-Bt maize plants at Vaalharts in the Northern-Cape province and in Venda in the Limpopo province. Twenty plants, each of Bt and non-Bt maize, were randomly selected from fields at each sampling. Each plant was bagged and all arthropods removed later. Arthropods were classified to morpho-species level as well as into functional groups that will assist in assessment of the potential exposure of species to Bt toxin in GM maize. Data on species abundance and diversity was analyzed by means of the Shannon and Margalef diversity indices.

RESULTS AND DISCUSSION

A total of 2566 arthropods were collected from these plants that consist out of 126 morpho-species and 18 orders. The diversity indices indicated that there were no significant differences between species richness and diversity for Bt and non-Bt maize. Although there was a trend of higher numbers of individuals per plant on Bt maize than non-Bt maize, the numbers did not differ significantly. There was no significant difference between the mean numbers of Lepidoptera larvae that occurred on Bt and non-Bt maize plants. Seventy-five morpho-species were collected on maize in the Venda area of which 29.3% also occurred at Vaalharts.

CONCLUSIONS

Arthropod biodiversity in maize is high and no difference between Bt and non-Bt maize was detected. The biodiversity information generated through this project will be used in future development of post-release monitoring activities on GM maize, in accordance with the GMO act.

REFERENCES

JAMES, C. 2008. Global Status of Commercialized Biotech/GM Crops: 2008 The First Thirteen Years, 1996 to 2008. *ISAAA Briefs* 39: Executive Summary.

ACKNOWLEDGEMENTS

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Keywords: Biodiversity, GM maize

GENETIC ANALYSIS OF DOUGH MIXING STRENGTH AND BREAD-MAKING PROPERTIES OF THE HARD RED SPRING WHEAT BREEDING LINES MN98550 AND MN99394

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INTRODUCTION

The development of wheat varieties with high yield and acceptable grain quality traits is a major focus for many breeding programs worldwide. However, full-scale end-use quality evaluation is not routinely performed on breeding material, because the process is time-consuming, laborious, and costly, but could be facilitated through the use of genetic and molecular biological selection procedures. In this study, we identified chromosome regions influencing dough-mixing strength and bread-making properties of hard red wheat breeding lines adapted to the Upper Midwest region of the U.S.

MATERIALS AND METHODS

Plant Materials: A mapping population of 139 recombinant inbred lines (RILs, F_{6:8}) was developed from the MN98550 x MN99394 cross. Parents, RILs, and three check varieties were grown in yield plots in a randomized complete block design.

Quality Analyses: Dough mixing strength was evaluated using a computer-based 35-g mixograph according to AACC Method 54-40A (AACC 2000). Properties included mixograph pattern (MIXOPA), midline peak time (MPT), midline peak integral (MPI), midline peak value (MPV), and midline peak width (MPW). Bread-making properties were evaluated using 25-g flour samples (AACC Method 10-10B). Bake mixing time (BMT), loaf volume (LV), bake water absorption (BWA), and bread crumb properties were evaluated. ANOVA was performed using GLM PROC of SAS 9.1 (SAS Institute, Cary, NC). Broad-sense heritability estimates were obtained for all traits.

Marker Assay and QTL Analysis: A genetic linkage map was constructed with 531 SSR and DArT marker loci that spanned a distance of 2,505 cM over the whole genome of wheat. QTL analyses were performed using composite-interval mapping in WinQTL Cartographer v. 2.5 (Wang et al. 2005). A QTL was declared when the LOD score was greater than a threshold level of 2.5.

RESULTS AND DISCUSSION

Because the RILs were highly homogeneous (F_{6:8}), heritability estimates were high (0.79 - 0.94) for all dough mixing strength and bread-making properties with the exception of crumb properties. Strong correlations were observed among MPT, MPI, and BMT ($r > 0.93$ at $P < 0.001$) and among MPV, MPW and BWA ($r > 0.72$ at $P < 0.001$), indicating that those properties share some genes in common.

QTL analysis identified forty-three QTL over 13 wheat chromosomes controlling 10 dough mixing strength and bread-making properties. The high-molecular weight glutenin genes *Glu-B1* and *Glu-D1* were major QTL clusters on chromosomes 1B and 1D that influenced all five mixograph traits, BMT and LV, whereas BWA was mainly influenced by 1B. A third QTL cluster on 6D influenced four mixograph and bake mixing time related properties (MIXOPA, MPT, MPI, BMT). Additional minor QTL clusters on chromosomes 1B and 7D influenced mixing time related properties (MPT and MPI). A QTL cluster on 1A influenced MPV and MPW.

REFERENCES

- AACC. 2000. Approved Methods of the American Association of Cereal Chemists, 10th Ed. The Association: St. Paul, MN.
- Wang, S., Basten, C.J., Zeng, Z.B. 2005. Windows QTL Cartographer 2.5. North Carolina State University, Raleigh

Keywords: Wheat, Dough mixing strength, Bread-making, Quantitative trait locus

ESTIMATING LEACHING LOSSES FROM MOBILE AND IMMOBILE SOIL WATER NITRATE CONCENTRATIONS

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INTRODUCTION

Nitrate (NO_3^-) leaching losses from cropping systems can lead to a deterioration in water quality and represent an economic loss to farmers. Quantifying NO_3^- losses in deep drainage is difficult due to uncertainties associated with estimating drainage fluxes and NO_3^- concentrations in the leachate. Active and passive soil water samplers can be used to determine solute concentrations but give limited information on water fluxes. Mechanistic models are also used to estimate leaching, but often require complex calibration with measured data to ensure accuracy.

MATERIALS AND METHODS

Measured data from a drainage lysimeter trial under irrigation in which soil profile nitrate (NO_3^-) concentrations were monitored using active (ceramic suction cups sampled at ~ 60 - 70 kPa) and passive (wetting front detectors sampled at ~ 3 kPa) samplers were compared to NO_3^- concentrations in immobile and mobile soil water phases simulated with the SWB-Sci model. SWB-Sci includes a cascading soil water and solute balance model, which provides mobile and immobile NO_3^- concentrations via a simple solute mixing fraction approach.

RESULTS AND DISCUSSION

As hypothesized, suction cup concentrations aligned closely with simulated immobile soil water NO_3^- concentrations, while wetting front detector concentrations aligned closely with simulated mobile soil water phase concentrations. These findings indicate that NO_3^- leaching can be estimated by (1) using a mechanistic crop growth model such as SWB-Sci to simulate NO_3^- leaching after it has been tested and calibrated using data from wetting front detectors and/or suction cups, or (2) multiplying measured NO_3^- concentrations with water fluxes obtained from a soil water balance model to estimate leaching. For approach (2), suction cup concentrations can be used during 'slow' drainage events and wetting front detector concentrations during 'fast' drainage events, as indicated by the model.

CONCLUSIONS

These results demonstrate that monitoring and modelling can be used together to improve estimates of NO_3^- leaching losses. More research on a wide range of cropping systems is needed to test and develop this approach further.

ACKNOWLEDGEMENTS

The authors acknowledge the Water Research Commission, National Research Foundation and CRC for Irrigation Futures for supporting this research.

Keywords: Nitrogen, nitrate, leaching, monitoring, modelling, SWB-Sci

THE NATURE OF AEOLIAN DEPOSITS IN THE SOUTH WESTERN FREESTATE

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INTRODUCTION

There is a scarcity of water in South Africa. Understanding the hydraulic properties of soils can optimize irrigation and drainage. A soil survey was conducted in the south-western Free State to identify soils suitable for a large (2000 ha) irrigation scheme. The hydraulic properties of the dominant soils were determined. The extrapolation of the data depends on subsoil textures which cannot be presented by surface soil maps. The aim was to characterize the nature of the subsoil of the larger soil body to infer the deposition conditions and processes to support the nature of soil behaviour under irrigation.

METHODOLOGY AND SITE DESCRIPTION

Aeolian sands cover a significant portion of the south western Free State. The aeolian sand soil body studied is isolated by dolerite ridges and a salt pan. It occurs on the footslope (4) and valley bottom (5) of the landscape. The micro topography is small linear dunes. Data was extracted from the soil map of a soil survey done in 1961 (Division of Chemical Services, 1961-1970). Graphs were drawn to find the presence of the clay soil bodies within the bigger soil body.

RESULTS

The textures of the soils vary between sand and clay. The soil bodies with higher clay content are more concentrated in the lower lying areas although some occur on the upper TMU4. More sandy and more clayey soil bodies are enveloped in the subsoil of the larger soil body. Observations both sides of the soil boundaries show that the boundaries of the soil bodies are not necessarily vertical and can be erratic or gradually sloping.

CONCLUSION

Wind deposits from the north western direction were the dominant force in the formation of this soil body. Although the sand was deposited over a large area, it must have formed dunes to some extent. Clay was washed in from the southern dolerite ridge and mixed with sand by bioturbation. The alluvial clay contributions from the dolerite ridges were deposited in inter-dune localities. During the formation of the bigger soil body the dunes were relatively stable and grew mainly vertically. This implies that preference deposition of sand was controlled and not randomized. The control mechanism could have been vegetation. The current vegetation distribution supports this theory as the dunes are covered with long grass which may intercept sand more effectively than the inter-dune areas covered with short shrub veld. The climate probably did not vary much during the depositional phase.

REFERENCE

Division of Chemical Services, 1961-1970. Bodem opname, Van der Kloof besproeiingsprojek (Lückhoff), Departement van Landbou-tegniese Dienste (currently ARC-Institute Soil Climate and Water), Pretoria.

Keywords: sand dunes, clay bodies, hydraulic soil properties, irrigation scheme

LABORATORY AND RAPID FIELD PROCEDURE TO CALIBRATE EC-10 AND EC-20 CAPACITANCE SENSORS IN COIR

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The use of capacitance water sensors for the scheduling of irrigation for hydroponic tomato and cucumber crops grown in coir was investigated. Laboratory experiments in a climate controlled chamber were conducted to accurately calibrate ECH₂O capacitance sensors, models EC-10 and EC-20, in coir with an improved calibration procedure. Water content predictions by the coir-specific calibration and manufacturer's calibration equations were compared to actual water content measured from mass loss of the coir sample. The manufacturer's calibration equation indicated a poor accuracy of prediction, which mostly underestimated the volumetric water content, compared to the near perfect prediction of the coir-specific calibration of individual sensors. A rapid calibration procedure for EC-10 and EC-20 sensors was proposed to reduce the calibration time of the sensors and promote their commercial use for irrigation management in coir. The accuracy of prediction by the rapid calibration procedure for the plant available water content range was high for both EC-10 and EC-20 sensors and allowed for the compensation for variation between sensors.

Keywords: Capacitance sensors, coir, water content

A CLIMATIC SOYBEAN RUST FORECAST MODEL

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INTRODUCTION

Soybean rust (SBR) caused by the fungus *Phakopsora pachyrhizi* Syd., has been reported on commercial soybean plants every year since its arrival in South Africa (SA) in 2001. Extensive research had been done on the epidemiology and fungicide application requirements in SA, however, no work on the long term climatic vulnerability of soybean production areas to SBR is available. This means soybean producers do not know whether SBR is a threat in their area.

MATERIALS AND METHODS

An algorithm based on first principles collected from literature was developed, which estimated the likelihood of a SBR outbreak based on temperature and rainfall (Nunkumar, 2006). The algorithm was applied to two years of weather data from the Department of Agriculture based at Cedara and compared to records of SBR disease outbreaks (du Preez, 2005) collected through previous research conducted at Cedara. The algorithm was verified using independent weather and SBR outbreak data from Greytown.

RESULTS AND DISCUSSION

Application of the algorithm at Cedara revealed that the algorithm accurately predicted the outbreak of SBR within 14 days of its appearance in the field. When applied at Greytown, the algorithm again accurately predicted the outbreak of SBR across all six seasons of data. The algorithm was applied to a 50 year historical weather data base and the results mapped (Schulze and Horan, 2009; Schulze *et al.*, 2009). These maps allow soybean producers to see the long term climatic vulnerability of SBR infection in their specific area.

CONCLUSIONS

This research has resulted in an algorithm which seems to accurately predict an outbreak of SBR based on temperature and rainfall data. The application of the algorithm will allow soybean producers to better understand the climatic vulnerability of their area to SBR infection. This information can help producers to make better informed decisions regarding SBR control, either through selecting cultivars which mature during low risk periods or through timing of fungicide applications.

REFERENCES

- Du Preez, E. 2005. *Chemical control of soybean rust (Phakopsora pachyrhizi) of soybeans*. Unpublished MSc dissertation. University of KwaZulu-Natal. Pietermaritzburg, South Africa.
- Nunkumar, A. 2006. *Studies on Phakopsora pachyrhizi, the causal organism of soybean rust*. Unpublished MSc dissertation. University of KwaZulu-Natal., Pietermaritzburg, South Africa.
- Schulze, R.E. and Horan, M.J.C. 2009. Methods 1: Delineation of South Africa, Lesotho and Swailand into quinary basins. In: Tadross, M. and Schulze, R.E. (Eds). *Regional aspects of climate change and the secondary impacts on water resources*. WRC Report 1562/1/09, Section 5. Water Research Commission, Pretoria, South Africa.
- Schulze, R.E., Horan, M.J.C., Kunz, R.P., Lumsden, T.G. and Knoesen, D.M. 2009. Methods 2: Development of southern African quinary catchments database. In: Tadross, M. and Schulze, R.E. (Eds). *Regional aspects of climate change and the secondary impacts on water resources*. Water Research Commission, Pretoria, South Africa, WRC Report 1562/1/09, Section 6.

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Keywords: Algorithm, climatic vulnerability, modelling, soybean rust

SOIL MAPPING IN AFRICA AT THE CROSSROADS: WORK TO MAKE UP LOST GROUND

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Soil studies in Africa have always made a substantial contribution to the development of concepts concerning soil classification, soil genesis and soil survey techniques. Several milestones mark the progress of soil survey in Africa:

- In 1897-1900 the first soil survey was done in Madagascar
- 1923 first soil map of Africa at scale 1:25 M
- 1930-1945 several reconnaissance surveys
- 1950s the second renaissance of pedology
- 1954 5th Intern. Congress of Soil Science in Congo
- 1964 Soil Map of Africa at scale 1:5 M (CCTA)
- 1970-80s FAO-Unesco Soil Mapping programme
- 1995-.... SOTER (Soil and Terrain databases)
- 2008-.... Africa Soil Information Service (AfSIS)

The evolution of soil information took several steps:

- Soil maps and databases have evolved quite rapidly during the last 2 decades
- Some 20 years ago, most soil data were produced as:
 - paper soil maps, accompanied by
 - paper reports, with thick annexes
 - a paper soil profile of
 - morphological descriptions and
 - laboratory data

Nowadays soil information is most likely to come stored in a Geographic Information System. There was a evolution of Soil Scientists. Investments in pedological research shrunk and emphasis shifted to applications.

Soil survey and primary data collection is in a crisis. Soil surveys are seen as costly and not really necessary with the result that insufficient government funds are made available. There is an over-reliance on satellite/distant observation data. By the end of the 20th century many national soil survey centres closed down or were privatised. Systematic soil mapping is abandoned. Innovative techniques and useful outputs are the solution! Soil surveys are replaced by digital soil mapping. A case where the survey continued will be presented. In Rwanda, the soil survey started in 1981 and was finalised in 1994 on scale 1:50 000. Contrary to general belief several African countries are covered by soil maps. Nineteen countries have small scale maps, 13 have medium scale maps and 7 have some areas covered by large scale soil maps.

Keywords: GIS, soil mapping

EXPRESSION OF THE MON810 BT EVENT IN VARIOUS GENETIC BACKGROUNDS OF MAIZE

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INTRODUCTION

This study was prompted by field observations from a strip trial where a maize hybrid deploying a stack of the Mon810 and Roundup Ready (RR) events appeared to have suffered higher infestation levels of the African stem borer, *Busseola fusca* (Fuller) than a related Bt-hybrid without the herbicide gene. Similar observations were not made during previous testing of a considerable number of experimental hybrids from various seed companies containing both genes. The question arose whether the expression of the Bt-event could be modified by the RR event in a particular genetic background.

MATERIALS AND METHODS

The Mon810 and RR events (not stacked) were compared to Mon810 stacked with RR Ready as well as to a susceptible standard. Each of these trait versions were presented in three genetic groupings (12 hybrids in total). These were tested in two field trails conducted at Potchefstroom (artificial infestation) and Vaalharts (natural infestation) during 2008/09, using randomized block designs with six replicates per entry. Variables measured were larval survival, larval mass gain, leaf feeding damage, internal stem damage, incidence and levels of ear damage, plant height reduction and grain yield loss. Data were subjected to factorial analysis using genetic groupings as factor 1 and trait versions as factor 2.

RESULTS AND DISCUSSION

In the Potchefstroom trial significant differences were observed between genetic groupings for both larval mass and larval survival during the vegetative stages of plant development. Larval mass was significantly greater for the stack than for Bt in two genetic groupings whereas RR did not differ from the susceptible standard. The result was, however, not reflected in data obtained at harvest. All variables measured provided the classic result expected from effective Bt-mediated control, with the susceptible standards and RR hybrids being significantly affected by infestation and no effects observed for either the Bt hybrids or stacks. In the Vaalharts trial the incidence of damaged ears was significantly higher for the stack than for Bt in one genetic grouping. This result also reflected in levels of ear damage. Significant differences in genetic groupings were recorded for four of six variables measured.

CONCLUSIONS

It appeared as if the expression of the Mon 810 Bt event is affected by variance in genetic background and that this may culminate in reduced efficacy of this gene in the presence of the RR gene. A particular genetic background to be avoided in the combined deployment of Mon810/RR was, however, not identified, calling for the evaluation of a wider range of hybrids.

Keywords: Busseola fusca, Bt maize

ESTIMATING THE SPATIAL DISTRIBUTION OF PROFILE AVAILABLE WATER CAPACITY AND SOIL WETNESS IN A COMMERCIAL CROP LAND USING THE EM38

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INTRODUCTION

There is a huge demand for spatial information on crop fields and there is a willingness to pay up to R160 ha⁻¹ for grid sampling and chemical maps related to soil fertility. Electromagnetic induction (EMI) technology, such as the EM31 and EM38, measures the electrical conductivity of soils and when calibrated it can make an immense contribution towards improving our understanding of the spatial distribution of soil chemical properties. Several researchers have shown the cost-benefit advantage of using these instruments as an alternative to conventional grid sampling and spatial analysis of salinity in crop lands. Despite this obvious advantage the instruments are not widely used in South Africa. This paper explores the ability of the EM38 to indirectly measure soil properties such as clay and soil wetness in order to characterise these properties spatially in the crop field.

MATERIALS AND METHODS

A 55 ha crop field under in-field rainwater harvesting (IRWH) at Paradys Experimental Farm of the University of the Free State in Bloemfontein was used to conduct the experiment. The EM38 was drawn in a sled behind a quad bike at a speed of approximately 5 km h⁻¹ on 2 Julie 2007 on every second runoff strip of the IRWH system (i.e. 6 m strips), both in the horizontal (EM_h) and vertical (EM_v) coil orientation. The instrument measures apparent soil electrical conductivity in millisiemens per meter (mS m⁻¹) every 20 cm as it is drawn over the field. All measurements were geo-referenced and the data processed with Surfer software package. A detail soil survey was conducted on the 55 ha crop field using a mobile hydraulic auger. Samples were divided into 300 mm intervals and a soil particle analysis was made using the standard pipette method. Seventy five neutron excess tubes were installed on a grid basis over the field and volumetric water content was measured in 300 mm intervals up to 900 mm depth.

RESULTS AND DISCUSSION

There was no apparent visual relationship between soil forms and EC classes derived from the vertical or horizontal coil orientation EM readings. Significant relationships between EC measurements and clay plus silt content were obtained, which made it possible to estimate the spatial distribution thereof. These relationships were further used to estimate the profile available water capacity and its distribution over the crop field. A good relationship ($r^2 = 0.7$) between EM readings and soil water content for the total profile was obtained. This made it possible to estimate soil wetness from the recorded EM readings over the entire field.

CONCLUSIONS

Information of this kind is of great importance for the Precision Agriculture sector of South Africa, especially in the semi-arid areas where many of the management decisions are based on soil wetness and PAWC. The EM technology opens a window of opportunity to improve management decisions on: where to plant?, when to plant?, what seeding rates to be used?, what fertilizer rates?

Keywords: Soil variability, EM38, soil wetness, profile available water capacity

INTEGRATING BIOLOGICAL MANAGEMENT PRACTICES INTO POME FRUIT PRODUCTION SYSTEMS

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INTRODUCTION

Increased environmental concerns among SA fruit producers have stimulated an interest in the use of biological soil amendments in standard agricultural management systems over the past decade. The role of biodiversity in sustaining crop production and soil fertility, and the associated role of soil microbial functions, has been elucidated (Griffiths *et al.*, 2001; Abbott & Murphy, 2003). Since microbial activity is generally carbon-limited in agricultural soil, management practices that provide a range of organic compounds on a regular basis will maintain an active and diverse microbial population (Magdoff & Weil, 2004). The effect of continued applications of organic material, various microbial inoculants and biostimulants on tree performance was investigated.

MATERIALS AND METHODS

A field trial was conducted in the Vyeboom region, Western Cape, in an 'Early Bon Chretien' pear orchard on BP1 rootstock suffering from poor root development in the initial years after planting. Biological treatments applied included straw mulch, compost, compost extract, seaweed extracts, humates, Biostart® (*Bacillus* inoculant mixture), effective microorganisms (EM) and poultry manure. Soil microbial properties were measured by making use of soil enzyme activity assays, conventional microbial plate counts and community level physiological profiles (Biolog).

RESULTS AND DISCUSSION

Regular application of compost extract, in addition to annual compost applications, over a period of five growing seasons significantly improved cumulative yield over two seasons, from 29 ton.ha⁻¹ (control) to 44 ton.ha⁻¹. Furthermore, shoot growth and trunk circumference were significantly increased from the first growing season. It is suggested that monthly compost extract applications result in maximum efficiency of nutrient utilisation through synchronisation of nutrient release with plant demand. No simple relationship was apparent between yield and the soil microbial parameters measured in this study.

CONCLUSION

Results using compost and compost extract seem promising. However, more research is needed on compost extract quality and the mechanisms of action involved in a field environment before commercial application can be fully recommended.

REFERENCES

- ABBOTT, L.K. & MURPHY, D.V., 2003. Soil Biological Fertility - A key to sustainable land use in agriculture. Kluwer Academic Publishers, Dordrecht.
- GRIFFITHS, B.S., BONKOWSKI, M., ROY, J. & RITZ, K., 2001. Functional stability, substrate utilisation and biological indicators of soils following environmental impacts. *Appl. Soil Ecol.* 16, 49-61.
- MAGDOFF, F. & WEIL, R.R., 2004. Soil organic matter management strategies. pp. 45-66. *In: Magdoff, F., & Weil, R.R. (Eds.). Soil organic matter in sustainable agriculture.* CRC Press: Boca Raton, Florida.

Keywords: compost, compost extract, pear, *Bacillus*, humate, seaweed

PREDICTING STREAMFLOW FROM THE SOIL MAP IN THE WEATHERLEY CATCHMENT

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INTRODUCTION

There is an interactive relationship between soil and hydrology. Water plays a primary role in the genesis of most soil properties and soil governs hydrological processes. In this study relationship was examined to develop a hydrological streamflow prediction model, not to introduce “yet another model” to the already overpopulated hydrological modelling world, but to accentuate the role of soils in hydrology and the need for incorporation of relevant soil data into hydrological models.

METHODOLOGY

The soil map of the Weatherley research catchment was converted into a hydrological response map, distinguishing between three hydrological soil types: recharge, interflow and responsive soils. The coverage and distribution pattern of various soil types served as basis for dividing the catchment into five hillslopes with different hydrological behaviour. Model inputs are conceptual flow models of the hillslopes (based on interpretation of soil properties), daily rainfall and monthly average ET. Daily peak and baseflow volumes were calculated for individual hillslopes over four years, lumped together and correlated with measured streamflow.

RESULTS

Cumulative streamflow were calculated with an accuracy of more than 85% compared to measured cumulative streamflow. Daily streamflow predictions were slightly underestimated in the beginning of the selected periods, but overestimated in the end. R^2 values of daily calculations range between 0.43 and 0.87 for the different seasons depending on the rainfall pattern.

CONCLUSIONS

The hydrological model predicted streamflow well for the Weatherley catchment emphasizing the role of soil in hydrology and the importance of soil in hydrological models.

Keywords: Hillslope hydrology, hydrograph, interflow soils, recharge soils, responsive soils

SOIL EROSION ON A TOPO-SEQUENCE IN MAPHUTSENG, LESOTHO

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INTRODUCTION

Soil erosion has for a long time been acknowledged as one of Lesotho's biggest problems, as it threatens and actively diminishes the little arable land that the country has. Although soil properties naturally have a large effect on the extent and spatial distribution of soil erosion, very little research has been carried out in Lesotho on soil erodibility. In this study the spatial distribution of gullies on a topo-sequence in the Maphutseng valley was investigated in relation to the soil. Different soil properties were also tested in the laboratory to try and find an easily identifiable soil property which could be used to delineate areas particularly sensitive to erosion.

MATERIALS AND METHODS

Aerial photographs (1957 and 2004), satellite images, geological and topographic maps and Google Earth images were used in a GIS format to map the extent of gullies, soils, topography, geology, hydrology and vegetation of a topo-sequence in the Maphutseng valley. Sixty-two profile pits were classified on this topo-sequence, from which seventeen modal profiles were sampled for laboratory analyses, along with six control samples (three from basalt derived soils and three from mudstone). The laboratory analyses done on these samples included: particle size analysis, total C and N, pH, titratable acidity, NH₄OAc extractable cations, saturated paste cations, EC, free Fe, Al and Mn, water stable aggregates, infiltration indices and water dispersible silt and clay. The gully extent of three other sub-catchments in the valley was also mapped to explore the uniformity of gully development in the valley.

RESULTS AND DISCUSSION

The four sub-catchments have vastly different gully densities, which range between 3.5 and 9.3 km/km². In the main gully different areas also showed different degrees of gully development. The lowest gully density is found on the sandstone derived soils (1.4 km/km²), with the highest gully density on the duplex soils (13.3 km/km²). The gully extension between 1957 and 2004 has also differed in different areas. For the duplex area it was 6.4 km/km², whereas for the rest of the catchment the gully length actually decreased by 0.6 km/km². This shows that although the gully erosion cycle has ceased in most of the catchment, it still continues on the duplex soil area.

The laboratory analysis shows that the water dispersible clay percentage is significantly higher (at $p \leq 0.01$) in the duplex soils than in all the other soils. The occurrence of piping in this area strengthens the argument that the non-uniformity of gully stability in the catchment is because of the difference in the soils' dispersibility. Soil colour had the best correlation ($R = 0.7$) with the percentage water dispersible clay.

CONCLUSIONS

Gully extension varies substantially between different catchments. The difference in gully density and extension is attributed to the difference in the percentage of water dispersible clay, associated with duplex soils. Soil colour seems to be an easily determined parameter which can be used in the field to determine potential soil erodibility.

Keywords: Gully erosion, Lesotho, Water dispersible clay, GIS

PRIORITISING CATCHMENTS FOR INVASIVE ALIEN PLANT CONTROL

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INTRODUCTION

The dilemma facing South Africa is that more than 400 invasive alien plant species have been identified throughout 80% of the country, and due to limited resources not all species can be controlled in all areas simultaneously. There is, therefore, a need to prioritise a subset of these species for immediate attention. In addition, there is a need to prioritise geographical areas where control measures will be implemented first.

MATERIALS AND METHODS

Appropriate criteria for the ranking of invasive alien species, and for the ranking of areas; were selected through expert workshops and using the Analytical Hierarchy Process (AHP). These criteria were used to complete pair-wise comparisons of species and areas. A biome approach was adopted, as the relative importance of invasive alien plants, and of their impacts, differs significantly by biome. The approach was first applied at a primary catchment scale for the whole RSA and then at a quaternary scale for the Western Cape Province. Finally, data on the budget allocations for projects in the Working for Water programme were compared to the priorities identified in these studies.

RESULTS AND DISCUSSION

The results indicate that the current expenditure by the Working for Water programme is often in line with the priorities identified in the studies at the primary catchment scale, but there is room for improvement at the quaternary catchment scale.

CONCLUSIONS

The results are as good as the underlying spatial datasets but as new or revised datasets become available, they can easily be accommodated by the hierarchy model, and criteria and sub-criteria can be added or removed.

REFERENCES

Van Wilgen, B.W., Forsyth, G.G., and le Maitre, D.C. (2008). The prioritisation of species and primary catchments for the purposes of guiding invasive alien plant control operations in the terrestrial biomes of South Africa. CSIR report no. CSIR/NRE/ECO/ER/2008/0070/C.
Forsyth, G.G., le Maitre, D.C., and van Wilgen, B.W. (2009). Prioritising quaternary catchments for invasive alien plant control within the Fynbos and Karoo biomes of the Western Cape Province. CSIR report no. CSIR/NRE/ECO/ER/2009/0094/B.

Keywords: Invasive alien plants, prioritisation, catchment

ASSESSING SOIL ORGANIC CARBON (SOC) CHANGES BY MEANS OF THE HOT WATER EXTRACTABLE CARBON (HWEC) FRACTION

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INTRODUCTION

Soil organic carbon (SOC) plays a key role in soil health but changes are slow and difficult to detect. Soil organic carbon can be grouped into two major pools – the labile carbon pool and the non-labile carbon or stable (inert) pool. The stable SOC is largely bound to the clay particles. The labile fraction is responsive to soil management practices and has thus been identified as an indicator for the evaluation of the quantity of SOC independently from the site conditions. However, an appropriate practical analysis method that can give reliable results is still lacking. The hot water extractable carbon fraction was evaluated to determine its ability to reliably quantify the labile carbon pool, and to determine its ability to detect any short-term changes in soil organic carbon (SOC) as a result of changes in management practices.

MATERIAL AND METHODS

The Hot Water Extractable Carbon (HWEC)-method of Schulz (1990) uses distilled water at 100 degrees Celsius as an extractant. A set of standard samples from long-term experiments in Germany (Static Fertilisation Experiment from 1902, Bad Lauchstaedt) and South Africa (BT1 from 1939, Mount Edgecombe), both with a well-known differentiation in SOC, has been exchanged between the two countries. Total Soil Organic Carbon (SOC) and HWEC were analysed to establish the successfulness of the method for South African Soils and to determine the relationship between these two carbon parameters and with clay content. The effect of management practices on the HWEC fraction was assessed by using soils from selected sites of the Sugar Belt in South Africa with a differentiation in SOC due to management (trashed, burned, and not cultivated or virgin).

RESULTS

The relationships derived between SOC and HWEC were comparable to the German results (Schulz 1997) for soils with between 10 and 40% clay. In these instances when the HWEC results were multiplied by a factor of 15, the HWEC method gives a good estimate for the labile carbon portion in soils. The virgin soils had an average of 923 mg/kg HWEC which were 87% higher than that from burned fields. However total SOC content of the virgin soils was just 19% higher compared to that from burned soils. The HWEC values of the trashed soils were on average 66 % higher than those of the burned soils and the total SOC content was 52% higher. This lead to the assumption of a different stabilization rate of the carbon in the trashed soils probably due to the relatively high C/N ratio of trash (dead sugarcane leaves).

CONCLUSION

The HWEC method showed reproducible results and the analyzed values were plausible. The correlations with clay and SOC confirmed that the HWEC fraction is closely related to labile carbon and thus reflects carbon changes as affected by land management. The next step will be to determine the importance and meaningfulness of HWEC fraction as soil health indicator.

Literature

Schulz E. (1990): Die heißwasserextrahierbare C-Fraktion als Kenngröße zur Einschätzung des Versorgungszustandes der Böden mit organischer Substanz (OS) (The hot water extractable C-fraction as indicator for the status of soil organic matter. Tag. Ber. Akad. Landwirtsch.-Wiss., Berlin 295, 269-275

Schulz E. (1997). Charakterisierung der organischen Bodensubstanz (OBS) nach dem Grad ihrer Umsetzbarkeit und ihre Bedeutung für Transformationsprozesse für Nähr- und Schadstoffe (Characterization of soil organic matter according to its degradability and its significance to transformation processes of nutrients and pollutants. Arch. Acker-Pfl. Boden., 41, 465-484

Keywords: soil sustainability, soil carbon fractions, labile carbon, hot water extractable carbon, soil health indicator

INFLUENCE OF RAINFALL INTENSITY PATTERNS ON INFILTRATION AND RUNOFF UNDER IN-FIELD RAINWATER HARVESTING

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INTRODUCTION

In determining the potential of rainwater harvesting systems, determining the amount water harvested is a formidable challenge. This challenge is further magnified when experiments must be done waiting for the erratic rainfall prevailing in arid and semi-arid areas. A mobile rainfall simulator is used to overcome this challenge and simulate rain events of variable intensity patterns. The aim of this study was to investigate how well natural rainfall can be simulated, to explore the penetration depth of infiltrating water and to investigate the effect of rainfall intensity pattern on runoff amounts.

MATERIALS AND METHODS

The experiments were done on Tukulu and Bainsvlei soil forms under in-field rainwater harvesting (IRWH). The Hofrey rainfall simulator of the University of the Free State was used to simulate rainfall events, in which the set up also enabled the measurement of runoff generated. Three different rainfall intensity patterns were used as treatments, viz. normal shaped, right-skewed, and constant application. The rainfall events were made to be of the same duration and amount to enable objective comparison. Soil capacitance (DFM) probes were used to monitor the progress of wetting front during infiltration.

RESULTS AND DISCUSSION

The result showed that the mobile rainfall simulator can provide storm events representative of the natural ones. Regression between the intended and actual intensities yielded an r^2 and d -index of 0.97 and a slope of 0.87. The results also revealed that the infiltration front affected only the top 200 mm of the horizon, irrespective of the textural difference of the two soils. The statistical analysis done on the amount of runoff generated reveals that intensity pattern has significant effect on the Tukulu soil, but not on the Bainsvlei soil.

CONCLUSIONS

The finding that the wetting front didn't progress beyond 200 mm indicates that infiltration will be affected by the top horizons. Hence, given the five South African soil taxonomy's diagnostic surface horizon, this finding sheds light into categorizing the infiltration of soils accordingly. The results from rainfall simulation showed that Hofrey can solve the problem of waiting for erratic rainfall and enable easier determination of runoff potential. Further, intensity patterns can play a role in the amount of runoff on the Paradys-Tukulu ecotope. Thus a parameter representative of the intensity patterns needs to be included when predicting the runoff potential on Tukulu soils.

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Keywords: water harvesting, rainfall intensity, runoff, infiltration, soil water