

GLANDULAR AND NON-GLANDULAR TRICHOME DENSITY OF ROSE-SCENTED GERANIUM (PELARGONIUM SPP.) AS INFLUENCED BY SOURCE OF NITROGEN

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The objective of this experiment was to study the variation in glandular and non-glandular trichome density of rose-scented geranium as influenced by two sources of N, comprising conventional or organic fertiliser at 100, 200 and 300 kg ha⁻¹ N year⁻¹ and a control (zero kg ha⁻¹ N year⁻¹). Leaf samples were collected from three different positions on the stem (bottom, middle and top) and used to identify the influence of N source and amount on the density of essential oil glands, using a scanning electron microscope. In all the treatments, the adaxial leaf surfaces had higher numbers of glandular and non-glandular trichomes as compared to the abaxial leaf surfaces. The density of both trichome types was significantly affected by leaf position, with the highest density on the top, young leaves. Application of N significantly increased the density of both trichome types as compared to the control. Using organic fertilizer at the rate of 100 kg ha⁻¹ N year⁻¹ significantly increased the density of both trichome types on the adaxial and abaxial leaf surfaces as compared to conventional N and the control. It was followed by conventional N at the rate of 100 kg ha⁻¹ N year⁻¹, while increasing N levels of both sources further had no significant effect on trichome density. This study concludes that application of N (especially organic N at a rate of 100 kg ha⁻¹ N year⁻¹) significantly increased the density of the essential oil glands. Previous studies showed a strong positive linear relationship ($R^2 = 0.85\%$) between the density of glandular trichomes and oil content of the plant. Therefore, higher numbers of essential oil glands could relate to higher essential oil yield.

Keywords: Conventional N, essential oil, organic N, trichome density

MAIZE GRAIN YIELD AND CHANGE IN SOIL MICROBIAL BIOMASS CARBON FOLLOWING APPLICATION OF INDUSTRIALLY MANUFACTURED BIOLOGICAL AMENDMENTS

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Attempts at promoting increased food production through improved soil fertility management in South Africa have been boosted with the development and marketing of industrially manufactured biological amendments (IMBAs). Manufacturers claimed the products have the potential of improving soil fertility and hence increase crop productivity when used either as boosters or total replacement to mineral fertilizers based on the manufacturers' recommendation. Hence, this study was initiated during 2006/07-production season to quantify and compare the effect of selected products on maize yield and changes in soil microbial biomass carbon under different field conditions. Nine selected products and NPK fertilizer were used as recommended for maize at four trial sites (Potchefstroom, Bothaville, Ottosdal and Bethlehem). An unamended control plot was included in the treatments. The trial was laid out as a randomised complete block (RCB) design with four replicates. Soil sampling for microbial biomass C study was taken 1-month after treatment application at 4-weekly interval until harvest when grain yield was determined.

Results of the study gave an average grain yield 2.6, 2.4, 2.3 and 3.1 t ha⁻¹ across treatments at Potchefstroom, Bethlehem, Bothaville and Ottosdal, respectively. Plots treated with the growth booster Molcast gave a higher yield increase than NPK plots at Potchefstroom and Ottosdal while few of the substances used as total replacement resulted in a marginal increase in grain yields. At Potchefstroom, plots treated with Molcast, Promis and K-humate resulted in a 12.7, 1.4 and 0.7 % grain yield increase, respectively. Similar results were observed at Bethlehem whereas at Bothaville it was the opposite. At Ottosdal, grain yields from all IMBAs treated plots were higher than NPK except for Growman. The highest yield increase of 40.3 % was obtained at Ottosdal in Molcast treated plots. Expectedly, all IMBAs treated plots had a higher content of soil microbial biomass C than NPK plots. Total replacement of inorganic fertilizer by IMBA induced biomass C mineralisation that was apparently more consistent in light-textured soils of Bothaville and Ottosdal. The highest microbial biomass C content of 0.72, 0.145, 0.385 and 0.180 mg C g⁻¹ soil was measured at different sampling dates in K-humate, Montys, Crop care and Lanbac treated plots at Potchefstroom, Bethlehem, Bothaville, respectively. The correlation coefficients between soil microbial biomass C and maize grain yield obtained at all trial sites following application of IMBAs were generally low and not significant. Molcast and Montys seem quite promising products in terms of increasing crop yield and soil microbial biomass C content as well as consistency of efficiency across all trial sites.

Keywords: Crop productivity, grain yield, growth booster, humate, soil fertility

YIELD COMPONENTS AND GRAIN YIELD OF MAIZE AS AFFECTED BY SOIL NUTRIENT STATUS IN A LONG-TERM TRIAL

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A better understanding of the impact of nutrition on yield components presents opportunities for effective manipulation of the yield. The study was carried out in order to quantify the yield components of maize. During the 2004/2005 season, cobs of two mature maize plants per plot were sampled from selected soil nutrition treatments of the Long-term Trial, Hatfield Experimental Farm, University of Pretoria. The components determined were number of kernel rows per cob, kernel number per row, potential kernel number per cob, mass per kernel, kernel mass per cob and grain yield. Row number per cob was not affected by soil nutrient status. The treatment with adequate macronutrients and organic manure applied (WNPKM) had the highest kernel number per row and consequently, the highest number of kernels per cob with the NPK treatment not significantly different. Potassium deficient treatments (NP and P) had the lowest kernel number per row and kernel number per cob, about 50% lower than the WNPKM treatment. WNPKM had the highest mass per kernel of 35 g/100 kernels followed by NPK with 32 g/100 kernels, while treatments NP and P had the lowest mass per kernel at 23 g/100 kernels and 19 g/100 kernels respectively. Treatments P (30 g), NP (32.5 g) and the unfertilized control (50 g) produced the lowest kernel yield per cob. WNPKM (240 g) and NPK (190 g) produced the highest yields. WNPKM (9,1 ton ha⁻¹) and NPK (7,6 ton ha⁻¹) produced the highest grain yield while NP (0,6 ton ha⁻¹) and P (0,4 ton ha⁻¹) produced the least grain yield. Nutrient stress decreased kernel number and kernel mass, which are the major determinants of grain yield.

Keywords: Nutrient stress, kernel number, kernel mass

CONSERVATION AGRICULTURE: A PRO-ACTIVE STRATEGY TO MITIGATE GLOBAL WARMING AND CLIMATE CHANGE

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Global warming is fast becoming a major international environmental problem. Already in 1997 the Kyoto Protocol was accepted to reduce greenhouse gas (GHG) emissions. It is projected that with an increase in average air temperature, sea levels will rise while the habitat boundaries for many plants and animals will change with disastrous consequences for survival. Resource-poor farmers in rural areas will be hardest hit by the effects of climate change because of their limited options to evade risk. Agricultural activities contribute directly to GHG emissions such as CO₂, CH₄ and N oxides that cause global warming which leads to climate change. It is postulated that the implementation of conservation agriculture (CA) practices can act as a potential sink to counterbalance GHG emissions. In the Qunu district of the Eastern Cape Province of South Africa, CA practices (minimum tillage, crop residue retention, crop rotation and intercropping) are being demonstrated at a commercial scale. Maize and soybean are planted in rotation, and maize and *Lablab purpureus* (*Dolichos lablab*) in an intercropping system. The CA practices are being compared with a block of maize cultivated according to conventional tillage (CT) practices. Results from the 2006/2007 growing season are discussed. Soil respiration (CO₂ evolution) was calculated from soil temperature measured at various depths, while organic C and N were determined in the 0-30mm soil layer. Diurnal CO₂ evolution was lower under CA maize and soybean than under CT maize. Soil respiration with depth was much lower under CA maize than under CT maize. Seasonal C emission through soil respiration under crops grown with CA practices was lower than under CT maize. Sequestered soil organic C was much higher (up to 1050 kg C 30mm soil depth⁻¹ ha⁻¹) under CA crops than under CT maize. Sequestered soil organic N was much higher (up to 110 kg N 30mm soil depth⁻¹ ha⁻¹) under CA crops than under CT maize. The measured lower soil temperatures under CA crops would lead to reduced soil respiration and lower soil water loss compared to CT maize (*Dolichos lablab*) in an intercropping system. The CA practices are being compared with a block of maize cultivated according to conventional tillage (CT) practices. Results from the 2006/2007 growing season are discussed. Soil respiration (CO evolution) was calculated from soil temperature measured at various depths, while organic C and N were determined in the 0-30mm soil layer. Diurnal CO evolution was lower under CA maize and soybean than under CT maize. Soil respiration with depth was much lower under CA maize than under CT maize. Seasonal C emission through soil respiration under crops grown with CA practices was lower than under CT maize. Sequestered soil organic C was much higher (up to 1050 kg C 30mm soil depth ha) under CA crops than under CT maize. Sequestered soil organic N was much higher (up to 110 kg N 30mm soil depth ha) under CA crops than under CT maize. The measured lower soil temperatures under CA crops would lead to reduced soil respiration and lower soil water loss compared to CT maize.

It can be concluded that CA practices can: (1) reduce CO₂ emission to the atmosphere, and (2) sequester C and N in the soil, thereby mitigating global warming and climate change while contributing to sustainable agricultural production.

Keywords: conservation agriculture, carbon sequestration, global warming, climate change

IRRIGATED SUGARCANE: AN ENVIRONMENTALLY FRIENDLY C-SEQUESTRATION C4-CROP

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Commercial sugarcane is a semi-perennial C4 crop usually harvested each 12 months. Stalk yields exceeding 100 t/ha/year are obtained with best farming practices in warm areas with high net radiation, such as in the semiarid zone. The C-level of grumulosic vertisols in Sudan under irrigated sugarcane for 15 years was compared with sugarcane under traditional dry-land farming. The analysis concerns also the bagasse production of the cane crop while it furnishes the energy needed by the mill and for the irrigation.

In the studied area, the cane crop is burned immediately before the harvest and, due to the presence of termites, all crop residues are burned before regrowth of the ratoon cane or cane planting.

The presented results are based on, (i) measurements of the organic C content and of the bulk density (at litre level, on field capacity) of the soils at four levels between 0 and 105 cm depth, and, (ii) general data concerning above-ground green matter production of cane at harvest as well as data on root growth.

In the first meter of the soil, irrigated sugarcane cropping boosted the C content by almost 30 % (115 vs. 84 C tons/ha) and by 82, 50, 7 and 9 % for the depths 0-15, 30-45, 60-75 and 90-105 cm respectively. Due to the burning of all crop residues, this increase in C is essentially due to the yearly root growth of the cane.

Considering the energetic aspect, at a mean cane stalk yield of 100 t ha⁻¹ or more, the burning in the mill of the bagasse by-product covers during the crushing season, largely caters for the energy need of the sugar mill as well as those used by the neighbouring township and for the irrigation of the cane fields. Moreover, if a significant improvement of the conversion into energy of the bagasse is realised (the current conversion efficiency is 15 to 20 % but it may reach 30 to 35 % with high pressure technology), it will be possible not only to recover the energy needs for year round irrigation, but also the energy that is required for the manufacturing of the fertilizers and mechanical operations involved in cane production.

In conclusion: in semi-arid areas, well-managed sugarcane is a crop that presents the advantage to increase, over a 15 year period, the carbon content of the soil to a much higher level (+ 30 %, i.e. + 30 t C ha⁻¹) than is observed under traditional rainfed farming. On the other hand, by the efficient burning of bagasse, this crop may produce more energy than needed for its production and processing. At the same time, cane growing produces more than 10 t sugar and several tonnes of molasses per ha, which are very energetic C rich products.

Keywords: Sugarcane, irrigation, vertisol, carbon sequestration, bagasse, energy

EVALUATION OF CULTURAL PRACTICES USED BY SMALLHOLDER FARMERS IN CASSAVA PRODUCTION: MSELENI VILLAGE KWAZULU-NATAL

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In South Africa, cassava is mainly produced by subsistence farmers. Local production is constrained by agronomic, biological, environmental and socio-economic factors. According to van der Mescht, (1996), cultural practices which are fundamental and crucial in cassava production were not properly executed in cassava producing areas, these included fertilization, irrigation, pest control and weeding. A study was conducted at Mseleni village which is located in the coastal zone of Northern KwaZulu-Natal during August 2006 to evaluate cultural practices applied in cassava production and to determine causes of yield reduction. A multidisciplinary team composed of scientists from the Department of Agriculture (KwaZulu-Natal) and the Agricultural Research Council ARC (Institute for Industrial Crops) collected primary data using a questionnaire with open-ended questions. A list of farmers was compiled randomly by the field assistants and extension officers during preliminary survey. A list comprise of 45 farmers who were known to be cultivating cassava. Seventy eight percent of the farmers (35) both male and female were selected systematically to take part in the survey, since farmers on the list were already in randomized order. Results from the survey revealed that there was no application of chemical inputs (fertilizers or pesticides) used in the production process of cassava. Important production constraints in cassava production were pests and diseases with Cassava Mosaic Disease being the most severe disease found in farmers' fields. It was found that 91% of the farmers in the village did not control pests in their cassava at all, while 9% indicated that they use household remedies. Generally, cultural practices were not properly executed. In most cases cassava is weeded late while other farmers do not weed at all and these had a significant negative impact on cassava total yield, consequently, yields were low. This problem was exacerbated by continuous use of Cassava Mosaic Disease infected plant material.

Keywords: Cassava , fertilizers , pests and diseases, weeding

EVALUATING MAXIM® (3,5,6-TPA) FOR THE INCREASE IN FRUIT SIZE AND RETENTION IN LITCHI, CV. HLH MAURITIUS

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Fruit size plays an important role as a quality parameter and is as important as yield in the determination of profitability in litchi production. There is a limited increase in fruit size through optimization of standard cultural practices like fertilization, irrigation and pruning. Auxins play an important role in fruit size as they stimulate cell division and enhance cell enlargement. Therefore, the application of auxins increases fruit growth rate and influences size, ripening time, colour and storage quality. Many attempts have been made to increase litchi fruit size. Maxim®, a synthetic auxin, has shown good results on litchis in many countries including , and . Maxim® is already registered for citrus in and registration on litchis is planned. The aim of this research, therefore, was to evaluate Maxim® for the increase in fruit size and fruit retention in litchi (*Litchi chinensis*, Sonn.), cv. HLH Mauritius, for the registration of Maxim® as fruit size enhancer. In the first year (2005/06) Maxim® was applied at the 1-, 2- and 3-g fruitlet stage at 20 and 40 ppm, and the effect on yield and fruit size was determined. All treatments increased yield and fruit size, with the 40 ppm treatment at the 3-g stage performing best. In the second year (2006/07) the Maxim® applications were extended due to the first year's results. Maxim® was applied at the 2-, 3- and 4-g fruitlet stage at 20, 40 and 80 ppm. The effect on yield, fruit drop and fruit size was determined. All treatments increased yield and fruit size. The applications at the 3- and 4-g fruitlet stage, after the natural second fruit drop, proved to be most beneficial in increasing litchi fruit size. Considering the data obtained in both years Maxim® application at 40 ppm after the natural second fruit drop (3- to 4-g stage) can be recommended. Furthermore, economical calculations revealed that the application of Maxim® can benefit producers financially.

Keywords: *Litchi chinensis*, Maxim®, 3,5,6-TPA, synthetic auxin, fruit size, fruit retention

COMPOSTING OF BT MAIZE RESIDUES AND ITS EFFECT ON THE QUANTITIES OF THE *Bacillus thuringiensis* CRY 1AB PROTEIN

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Production of transgenic maize modified to express the *Bacillus thuringiensis* (Bt) Cry1Ab, insecticidal protein (Bt-maize) leads to large quantities of Bt residues returned to the soil. It is necessary to develop residue management strategies that reduce the amounts of the protein that enter the soil system since the protein persist for extended periods of time when sorbed on soil particles. Thermophilic composting is could be a possibility as the high temperatures could degrade or denature the protein and render it inactive. An experiment was carried out to assess the effect of thermophilic composting on the amounts of the Cry1Ab protein in Bt maize residues. Temperatures, nutrient contents and the Cry1Ab protein in compost residues were monitored throughout the composting period. The experiment was carried out with residues (leaf plus stem) of mature Bt maize (DKC 7815B) and its near-isogenic line (CRN 3505) using 1m³ wooden compost boxes. The analysis of Bt disappearance and decomposition will aid in the development of potential implications of transgenic maize farming practices.

Keywords: Bt-endotoxin, composting, maize, decomposition

MICROBIAL COMMUNITY RESPONSE TO COPPER OXYCHLORIDE CONTAMINATION IN ACIDIC SANDY LOAM SOIL

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A study was carried out to determine the response of different microbial parameters to copper oxychloride in acidic sandy loam soil. The soil that was used to prepare microcosms was collected from three different wine farms near Stellenbosch and Somerset West in the Western Cape, South Africa. The sampling sites where the soils were collected were covered with vines, grasses or indigenous fynbos vegetation. Culturable microbial populations were monitored periodically for 245 days in a series (Series 1) of soil microcosms spiked with copper oxychloride at different concentrations. The first series of soil microcosms was prepared by adding copper oxychloride to each of nine samples of soil i.e. 0, 10, 20, 30, 40, 50, 100, 500 and 1000 mg Cu kg⁻¹. Microcosms prepared for series 2 to 4 received 0, 30, 100 and 1000 mg Cu kg⁻¹. For series 2 to 4, soil microbial community metabolic profiling was carried out on day 70, while it was only performed on day 245 for series 1. Protozoa were enumerated on days 70 and 245 for all four series. Microbial populations responded differently to the applied copper (Cu). Number of protozoa and metabolic potentials of the soil microbial communities decreased. Metabolic potentials of the soil microbial communities were not significantly affected by ≤ 100 mg kg⁻¹ additional Cu. In contrast, a negative impact on protozoa was observed in soil that contained only 15 mg Cu kg⁻¹. This negative impact on numbers of protozoa was less severe in soils containing raised concentrations of phosphorous and zinc.

Keywords: copper oxychloride, metabolic potential, microbial community, protozoa, soils

OPTIMUM BURNING FREQUENCY FOR SOIL HEALTH AND GRASS BIOMASS PRODUCTION IN A SAVANNAH SWEET THORNVELD OF SOUTH AFRICA

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The use of fire in grass management is a common practice in most rangelands of South Africa. Burning is principally used to remove moribund and unpalatable grass from the previous growing season and to stimulate the re-growth of fresh herbage with higher nutrient content. This practice portends ecological implications both in the short and long run on the sustainability of the rangeland as a system. A long-term trial was established at the University of Fort Hare, Honey-Dale farm in August 1980 to evaluate these effects and determine the frequency of burning that yield optimum benefits. The experimental treatment consisted of five different bush burning frequencies, viz., no burning (K), annual burning (B1), biennial burning (B2), triennial burning (B3), quadrennial burning (B4) and sexennial burning (B6). Soil samples (0-15 cm) were collected from each experimental unit after 26 years of treatments implementation. The soils were analyzed for total N, organic C, available P, exchangeable cations (K, Ca, Mg, and Na), pH and EC. The total grass biomass in each experimental unit was estimated on dry weight basis by destructive quadrant sampling. Soil macro-fauna density was assessed from a 50cm x 50cm monolith system replicated 4 times in each experimental unit. All data sets were subjected to the normality test, then analysis of variance and correlation. The multidimensional analysis technique was also used to generate the treatments index of suitability from all the measured variables. Burning did not significantly ($P < 0.05$) affect the top soil concentration of total N, organic C, exchangeable K, Mg and Na in the treatment plots. Soil pH increased slightly with burning in the short run due to ash deposit on the soil surface. Burning also significantly ($P < 0.01$) increased the soil macro-fauna population density. A rapid increase of 21% was observed in the burned plots, a few weeks after burning, while long-term effects ranged between 15.1% – 51.4%, which increases with reduced frequency of burning until a peak at B3 and thereafter a reduction. A significant inverse correlation ($P > 0.05$; $r -0.56$) was observed between the grass biomass and fauna density. There was a relative reduction of 23% in grass biomass in the frequently burnt plots (B1, B2 and B3). The B3 plots had the highest suitability index of 44, which indicated the frequency of burning at which optimum benefit will be derived from this veld type. Results from this study showed that frequent fire treatment of veld led to reduction of grass biomass, which could be attributed to rapid mineralization of the organic matter pool and volatilization of basic soil nutrients. Results further suggest that the best burning frequency is every three years.

Keywords: Fire treatment, rangeland management, soil health, soil macro fauna, grass biomass

EFFECTS OF SULFONYLUREA HERBICIDES ON ROTATIONAL CROPS IN SMALL GRAIN CROPPING SYSTEMS OF THE WESTERN CAPE

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Symptoms of crop stress in Western Cape Province grain fields are often attributed to sulfonylurea herbicide residues, probably because this group of herbicides are used extensively on wheat and barley. However, laboratory analyses of residue concentration in the soil does not indicate how much residue is available to plants and therefore a field trial was established in 2003 at Tygerhoek Research Farm (Riviersonderend). The trial area was not sprayed with sulfonylurea herbicides for the previous fifteen years. Half of the trial plots treated with sulfonylurea herbicides received chisel cultivation and the other half no cultivation. Sulfonylurea (iodosulfuron) dosage rates included no treatment, which also served as the control treatment, the recommended dosage rate (10 g a.i. ha⁻¹) and double the recommended dosage rate (20 g a.i. ha⁻¹). Wheat served as the main crop on which iodosulfuron was applied from 2003 until 2005. Plant measurements were plants per m², number of tillers, grain mass, hectolitre mass and yield. The grain mass per plot was determined and the yield calculated. Yield in 2005 for canola under chisel cultivation, and following wheat in 2003 and 2004 which was treated with a double rate of iodosulfuron in both years, was the greatest. Lupin yield in 2006 from zero till and chisel cultivation plots, and following wheat which was treated with a single rate of iodosulfuron in all three years, was greatest. In contrast though, lupin yield grown on zero till plots in 2005, and following wheat which was treated with either a single or double rate of iodosulfuron in both years, was reduced. Medic crop stand in 2006 under both zero till and chisel cultivation, and following wheat, which was treated with a double rate of iodosulfuron, was greatest. Canola, lupin and medic yields were not affected after three consecutive years of sulfonylurea application. It appeared that chisel cultivation could reduce sulfonylurea residual action.

Keywords: sulfonylurea herbicide residues, wheat, rotational crops

EFFECTS OF GOAT MANURE AND INORGANIC PHOSPHORUS ADDITION TO A P-FIXING SOIL FROM FLAGSTAFF, EASTERN CAPE ON INORGANIC AND MICROBIAL BIOMASS P FRACTIONS

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Phosphorus (P) transformations in untreated and manure treated soils at increasing inorganic P application rates were assessed under controlled laboratory conditions using a sequential fractionation procedure. Triple super phosphate was added at rates of 0, 90, 180, 270 and 360 kg P ha⁻¹ with or without 20 t ha⁻¹ of goat manure (dry weight) and incubated moist for 12 weeks. Resin P, soil microbial biomass P (biomass P), 0.5 M NaHCO₃ extractable inorganic P (NaHCO₃-P_i) and 0.1 M NaOH extractable inorganic P (NaOH-P_i) concentrations were determined on days 1, 7, 14, 28, 56 and 84. Addition of inorganic P increased all P fractions but the increases were greater when goat manure was co-applied. The control treatments contained 17.2 and 27.5 mg P kg⁻¹ of resin extractable P in the un-amended and manure amended treatments respectively, which increased to 118.2 and 122.7 mg P kg⁻¹ at the highest rate of P application (360 kg P ha⁻¹) on day 28 of incubation. NaOH-P_i was the largest extractable P_i fraction and ranged from 144.3 to 250.6 mg P kg⁻¹ and 107.5 to 213.2 mg P kg⁻¹ in the unamended and manure amended treatments, respectively. Inorganic P addition increased the biomass P concentration from 16.8 to 43.9 mg P kg⁻¹ in P alone treatments but the fraction was greatly enhanced with manure addition, increasing it from 32.6 to 97.7 mg P kg⁻¹. The largest improvement in biomass P due to manure occurred at lower rates of added P, indicating the potential of goat manure to enhance the fertilizer use efficiency of small inorganic P applications. This increase in biomass P following goat manure addition implies that it increased the proportion of added P immobilized in microbial cells that would be subsequently released into the soil solution and be available for plant uptake following biomass P turnover.

Keywords: P fractionation, goat manure, biomass P, resin-P, NaHCO₃-P_i, NaOH-P_i

PROSPECTS FOR DIVERSIFYING LEGUMES IN THE LIMPOPO BASIN IN SOUTH AFRICA

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Diversification of leguminous crop species in the small-holder farming communities located in the semi-arid areas in South Africa can enhance household food security, soil fertility and family incomes. The objective of this paper is to assess the potential of three tropical grain legumes in the Limpopo province, South Africa. The three leguminous species namely chickpea (*Cicer arietinum*), pigeonpea (*Cajanus cajan*) and tropical (promiscuous) soybean (*Glycine max*) types are suitable for introduction into the small-holder sector in the Limpopo basin in South Africa. Preliminary results of studies aimed at evaluating the agronomic potential of chickpea in the region indicated that desi genotypes can attain $\geq 1.2 \text{ t ha}^{-1}$ while kabuli types can achieve $\geq 2.4 \text{ t ha}^{-1}$. Medium duration types of pigeonpea evaluated in the semi-arid areas in Mpumalanga province that has similar agro-ecological conditions as Limpopo, showed good yield potential (2.3 t ha^{-1}). Current efforts in Limpopo aimed at producing biodiesel from soybean, are conducive for the introduction of tropical types of soybean (that require no application of commercial inoculants to optimize grain yield) in the small-holder sector in the province. The three leguminous species offer several advantages in terms of drought tolerance, storage and market value. They can be used in the production of stock feeds. Moreover, pigeonpea can be ratooned after the main crop in order to produce a second harvest. These legumes offer flexible options for the farmers.

Keywords: diversification, legumes, chickpea, pigeonpea, soybean

NDVI IMAGES AS TOOL FOR PRECISION FARMING

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SPOT satellite images were used as an operational tool over the past 3 seasons to monitor variations in yield across the GWK irrigation area, and to identify possible factors responsible for the variations. Visual and infrared information recorded by onboard satellite sensors are processed to Normalized Difference Vegetation Index (NDVI) images which provide a relative measure of chlorophyll activity and crop performance. This information is captured twice during a particular growing season and it enables agronomists to monitor variation over vast areas effectively and in real time. Targeted areas are then inspected during GPS field surveys to identify the causes of variation and to make appropriate recommendations to producers. Timely correction in terms of certain factors could result in significant economic benefits to the farmer. Two categories of variation can be detected, namely: pro-active management actions (fertilization and irrigation) and retrospective management actions (tillage, crop spacing, weed and disease control). Good correlations were found between variation on NDVI imagery and combine yield maps. This supports the idea that satellite images, complimented by targeted field surveys and scientific recommendations, could play a significant role in precision farming.

Keywords: SPOT satellite images, infrared information, combine yield maps, precision farming

SELECTED SOIL AND CLIMATE PROPERTIES OF THE FORT HARE/OAKLEAF ECOTOPE RELATED TO THE IN-FIELD RAINWATER HARVESTING TECHNIQUE

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Climate and soil data from the Land Type Survey was used to identify a potential strip of land in the interior part of South Africa for applying the in-field rainwater harvesting (IRWH) technique. The strip encountered many soil types and climate zones which demands research, especially where a relatively new technique is to be introduced. An ecotope with great agronomical importance to poor and ultra-poor families within the proposed strip, running through the Eastern Cape near Alice, was identified for the field experiment. The site is located at the University of Fort Hare and was selected because it provided the necessary infrastructure required for ensuring a properly controlled environment. The climate of the ecotope was characterized in terms of rainfall amount and intensity, temperature and humidity. Results indicated that the climate is semi-arid with an aridity index of between 0.2 and 0.5. Several soil properties related to sustainable IRWH were studied, viz. slope, clay percentage, internal drainage, evaporation from the soil surface and runoff processes. Results indicated that the slope of the study area is 1.5% in a northerly direction. It was possible to describe the internal drainage process of both the A and B horizons through mathematical functions. Evaporation for phase 2 of the drying cycle was found to be 4 mm day⁻¹. Runoff was determined by the Area Under the Curve (AUC) method.

Keywords: climate properties, internal drainage, runoff, soil properties, evaporation from the soil surface

BIOLOGICAL DIVERSITY OF WILD MUSHROOMS IN VHEMBE DISTRICT

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In many rural parts of Africa , wild mushrooms are collected for consumption. The mushrooms are rich in protein and vitamins. They often substitute for meat, particularly in poor and vulnerable rural communities. In addition, both edible and non-edible mushrooms are important in breaking down organic matter and nutrient recycling. In Vhembe District (Limpopo,), the diversity and utilization of wild mushrooms species has not been characterized systematically. Because of the changes in habitat use, mushroom species are probably being lost as land allocation for settlement and cultivation in the province is increasing. The objective of this study is to (i) assess the potential of characterizing the biological diversity of wild mushrooms in Vhembe District and (ii) cultivate the edible types using simple artificial techniques suitable for rural communities. Based on information collected from the local communities, the preferred types of edible mushrooms will be characterized in the laboratory for possible artificial cultivation. The mushroom cultivation technology that uses simple mushroom houses and agricultural wastes such as dry banana leaves and maize stover, will be transferred to the local communities in Vhembe. This approach for mushroom production is independent of seasonal factors. Therefore, mushrooms can be produced throughout the year. Moreover, the mushroom cultivation technology has potential for contributing towards income generation and enhancing food nutrition in resource-poor households and those involved in caring for HIV/AIDS patients.

Keywords: mushroom, characterization, cultivation, technology, nutrition

INTRAGUILD PREDATION OF PARASITIZED GREENBUGS (*Schizaphus graminum*) BY *Coccinella septempunctata* AND *Hippodamia convergens*

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Generalist predators prey upon other predator species, causing significant mortality. This type of predation is referred to as intraguild predation and is defined as the killing and eating of the species that use similar resources and are thus potential competitors. It is however important to determine whether coccinellid lady beetles feed on their competitors. The larval instars of *Coccinella septempunctata* and *Hippodamia convergens* were evaluated for their ability to consume greenbug mummies parasitized by *Lysiphlebus testaceipes* in a laboratory experiment. The results obtained showed that the first instars of both coccinellid species were not able to feed on parasitized greenbug mummies. The second instar larvae of both species attempted to feed on the mummies, but did not completely consume them. Third and fourth instar larvae readily consumed greenbug mummies. This study confirms the hypothesis that *C. septempunctata* and *H. convergens* are capable of feeding on mummies of greenbugs that are parasitized by *L. testaceipes*.

Keywords: Intraguild predation, Coccinellidae, Aphidiidae

EVALUATION OF MAIZE STAND AND MAIZE ESTABLISHMENT PRACTICES AT MAFARANA AND GABAZA VILLAGES IN MOPANI DISTRICT, LIMPOPO PROVINCE

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A survey was conducted at Mafarana and Gabaza villages in Mopani district of Limpopo province in April 2007 to determine maize establishment practices used by farmers and the maize stands they achieve. The data were collected through farmer interviews using a questionnaire and plant stands were determined in the fields of the respondents. The survey sample comprised of 30 farmers, 15 randomly selected from each village. The results showed that most of the farmers who are engaged in farming are elderly females. The survey also revealed that most farmers in the study area broadcast the seed rather than using row planting. Farmers broadcast seed on unploughed weedy fields ahead of a ploughing tractor. Most farmers (63.35%) admitted to poor preparations of their fields. Ploughing is often done when the fields have been overgrown with weeds, preventing soil inversion to bury all the weeds. Only 20% of the farmers achieved reasonable plant populations (20 000 to 29 000 plants ha⁻¹) as compared to 40% who achieved between 5 000 and 19 000 plants ha⁻¹. The low plant stands and poor seedbed preparation lead to high weed pressure which in turn causes low yields and heavy demands of manual weeding.

The study findings suggest that farmers need to be encouraged to plant in rows after proper land preparation, possibly including harrowing, rather than broadcast on unploughed fields. This could lead to enhanced plant stands and lower weed pressure leading to improved maize yields. Population density trials/demonstrations are also necessary for the Mafarana and Gabaza area to sensitize the farmers on the importance of correct management of plant stands in maize.

Keywords: Mafarana and Gabaza villages, Maize establishment methods, Plant stands

EFFECTS OF FERTILIZER PHOSPHORUS RATES ON GROWTH AND YIELD OF THREE SOYBEAN (*Glycine max*) CULTIVARS IN LIMPOPO PROVINCE, SOUTH AFRICA

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Appropriate phosphorus (P) fertilizer recommendations have not yet been developed for emerging, small-scale farmers in Limpopo Province, South Africa. Therefore this study aimed at assessing the effects of P rates on the growth and yield of three soybean cultivars in Vhembe district, Limpopo province. Field experiments were carried out at the University of Venda's experimental farm in 2005/06 (season I) and 2006/07 (season II). The experiments consisted of a factorial combination of P fertilizer rates (0, 30 and 60 kg P ha⁻¹) and soybean cultivars (Pan 520RR, Highveld Top, and LS 555) arranged in a randomized complete block design and replicated three times. No supplementary irrigation was used. Crop biomass was determined on two occasions, firstly at the 50% flowering phase, and secondly, at harvest maturity, and grain yield was determined at harvest maturity. In season I, application of 30 kg P ha⁻¹ increased crop biomass at 50% flowering in Highveld Top (27 kg ha⁻¹) and LS 555 (103 kg ha⁻¹), but decreased crop biomass in Pan 520RR (7 kg ha⁻¹). Increasing the application to 60 kg P ha⁻¹ increased crop biomass in LS 555 (103 kg ha⁻¹) but decreased biomass in Pan 520RR (128 kg ha⁻¹) and in Highveld Top (49 kg ha⁻¹).

At harvest maturity the application of 30 kg P ha⁻¹ increased crop biomass in Highveld Top (20 kg ha⁻¹) and LS 555 (143 kg ha⁻¹) but decreased crop biomass in Pan 520RR (10 kg ha⁻¹); whereas application of 60 kg P ha⁻¹ increased crop biomass in both Highveld Top (53 kg ha⁻¹) and LS 555 (53 kg ha⁻¹) but decreased crop biomass in Pan 520RR (from 247 kg ha⁻¹). P rates and cultivars did not significantly affect grain yield in season I. In season II P fertilizer rates and cultivar did not affect crop biomass at 50% flowering. However, P did not affect crop biomass at harvest maturity but the effect of cultivar was statistically significant (P=0.05); LS 555 had lower crop biomass (1682 kg ha⁻¹) compared with Pan 520RR (2982 kg ha⁻¹) and Highveld Top (2889 kg ha⁻¹). LS 555 had lower grain yield (701 kg ha⁻¹) compared with Pan 520RR (1457 kg ha⁻¹) and Highveld Top (1241 kg ha⁻¹). These preliminary findings show firstly, that the addition of P may not affect grain yield of soybean in this area and secondly, that Pan 520RR and Highveld Top may be suitable for cultivation in this area.

Keywords: P application, cultivar, crop biomass, grain yield

A COMPARISON OF DIFFERENT ARTIFICIAL SUBSTRATES FOR THE CULTIVATION OF SHIITAKE MUSHROOMS

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The Shiitake mushroom (*Lentinus edodes*) is an edible wood rotting fungus belonging to the family Tricholomataceae. The mushroom species is used in folk medicine to treat various ailments such as cancer; lower cholesterol levels and it boost immune system and have anti-oxidant activities. It tastes good either fresh or dried and is a dietary source of protein and essential amino acids, carbohydrates, vitamin B and D, and minerals. Cultivation of shiitake is generally on natural hardwood logs. However, there is a challenge to develop reliable artificial substrates for cultivation particularly in developing countries. Therefore the objective of this study was to compare different artificial substrates for the cultivation of shiitake mushroom. Three independent trials were conducted to evaluate the performance of different substrates on shiitake mushroom cultivation. The experiment was conducted within the growing chamber at the Agricultural Research Council-Institute of tropical and subtropical crops (ARC-ITSC). The trials were arranged with the randomized complete block design (RCBD) with four replications. In the first trial, substrates from oak, pine and eucalyptus sawdust without supplements were used. The results showed that eucalyptus substrate performed better followed by oak and pine. The biological efficiency (BE %) was 59%, 45.8% and 20.5% respectively. In the second trial, eucalyptus with woodchips (2:1) and pine with woodchips (2:1) substrates with supplements (wheat bran, gypsum) were evaluated. Eucalyptus substrate gave the BE of 138% and pine substrate yielded the BE of 38%. In the third trial, a substrate made of wheat straw and pine (7:2) with supplements (sucrose, CaSO₄, CaCO₃ and citric acid) and from wheat straw and eucalyptus (7:2) with supplements were investigated. Results showed that wheat straw and pine substrate performed better than wheat straw and eucalyptus substrate. The former had the BE (%) of 35.7% while the latter yielded the BE (%) of 14.4 %. In conclusion, eucalyptus substrate with or without supplements provided better results.

Keywords: Shiitake Mushroom, Biological Efficiency, substrates

IMPROVEMENT OF A DAILY SOLAR RADIATION PRODUCT FOR SOUTH AFRICA FOR APPLICATION IN CROP MODELS

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A daily solar radiation product that utilizes Meteosat Second Generation (MSG) Spinning Enhanced Visible and Infrared Imager (SEVIRI) data has been developed at the ARC-ISCW. The algorithm, which is applied on a per-pixel basis, uses a United Nations Food and Agricultural Organization (FAO) formula in which SEVIRI data throughout the day with a 15-minute temporal resolution and roughly a 3 km spatial resolution are incorporated to estimate the fraction and time of day during which direct sunlight falls on a specific location. The mean potential daily solar radiation curve, which varies spatially and temporally throughout the year, was calculated from automatic weather station data and used as a further input for the algorithm.

The current method, which uses the satellite data only for cloud-cover information, has a root mean square error for a daily solar radiation estimate in the order of 2.5MJ/m^2 , which is representative of about 10% of the spatial variation of daily total solar radiation over South Africa.

While cloud cover accounts for a large proportion of the variation in daily solar radiation, other atmospheric constituents like water vapour and aerosols also play a role in the attenuation of direct sunlight through the atmosphere.

The current focus is on the inclusion of these constituents in order to estimate attenuation of solar radiation and to improve the accuracy of the product. An atmospheric radiative transfer model is used to derive aerosol quantities while water vapour data, derived from SEVIRI data, are already available. A look-up table was developed through the use of automatic weather station data and aerosol and water vapour amounts to correct the estimates for these atmospheric constituents. The improvement to the daily solar radiation product after inclusion of these atmospheric constituents is reported.

Keywords: Solar radiation, Satellite data

EFFECT OF INDIGENOUS CYANOBACTERIA STRAINS ON PLANT GROWTH AND NITROGEN CONTENT OF A CHEMICALLY DEGRADED SOIL OF THE EASTERN CAPE PROVINCE IN SOUTH AFRICA

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Some cyanobacteria strains could be an economically attractive, ecologically sound alternative to chemical fertilizers because of their ability to fix nitrogen. As a result of lack of information on these effects in , a glasshouse study was conducted to evaluate the nitrogen fixation benefits of cyanobacteria strains 3g and 7e, indigenous to , and a reference strain 9v from , in a split split-plot design. A chemically degraded Typic Haplustalf soil from Hertzog village in Seymour was used. Suspensions of cyanobacteria were uniformly applied to potted soils with or without maize seeds planted. After 6 weeks, the maize biomass was harvested and the top 15 mm of the soils mixed, before a second maize crop was grown for six weeks. Inoculation with strains 3g, 7e and 9v resulted in maize dry matter increases of 17.3, 22.3, 18.04%, respectively at the first harvest. At the second harvest, the dry matter increases were 12.9, 14.8, and 19.01%. Tissue N and N uptake also increased significantly with inoculation at both harvests. Soil nitrate N was higher where the soil was inoculated and not cropped than where the control was cropped in the first harvest. After the second harvest, soil ammonium N was highest where 7e inoculated soil was cropped once, relative to the control. The study suggested that cyanobacteria strains 3g and especially 7e have potential benefits in maize growth and for soil N improvement.

Keywords: Cyanobacteria, degraded soil, dry matter, nitrogen uptake, tissue N, N uptake

GERMINATION AND SEEDLING VIGOUR OF KENAF (*Hibiscus cannabinus* L.) AS INFLUENCED BY TEMPERATURE

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Soil temperature plays a fundamental role in the germination and seedling vigour of Kenaf (*Hibiscus cannabinus* L.). Farmers in the Winterton area experienced problems with poor germination percentage and seedling vigour. Planting of Tainung #2 in this area normally needs to commence as early as October to ensure a long enough period of growth before the onset of frost. The company Sustainable Fibre Solutions approached the Department of Plant Production and Soil Science of the University of Pretoria to ascertain whether the observations made by farmers were valid.

The study was conducted to determine the temperature sensitivity of Tainung #2 at several temperatures (5 to 35°C at 5°C increments), following the ISTA guidelines. No germination occurred at 5 and 10°C after four days; where as germination of more than 80% was recorded at 15-35°C. Optimum germination for Tainung #2 was recorded at 25°C, confirming that it is cold sensitive. Based on these results the farmers were advised to delay planting until November in an attempt to increase plant stand, hereby compensating for the shorter growth season with an increase in harvestable plant material.

Seedling etiolation could be used as an indicator of possible field emergence of seedlings. Total seedling lengths recorded at 8 days varied from 6.6mm at 10°C to 177.4mm at 25°C. At a planting depth of 50mm and soil temperature of 25-35°C it can be assumed that seedlings should emerge 2-3 days earlier than at soil temperature of 20°C and lower. Further studies are to be conducted to confirm the correlation between etiolation and seedling emergence, as well as identifying more suitable cultivars for the Winterton area.

Keywords: Kenaf germination, seedling vigour, temperature

EVALUATION OF ANTIBACTERIAL AND ANTIOXIDANT ACTIVITIES IN ETHANOL EXTRACT OF WILD BUSH TEA (*Athrixia phylicoides* DC.)

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Bush tea (*Athrixia phylicoides* DC.) is a popular plant in Southern Africa, predominantly used as an herbal tea and for medicinal purposes by traditional African people, including the cleansing or purifying blood and the treating of boils (carbuncles) and coughs. In some parts of, bush tea leaves and roots are used as an aphrodisiac. To validate its medicinal potential, an ethanol extract from wild bush tea leaves was used *in vitro* for antibacterial and antioxidant activity determination. In this study, the antibacterial assay showed inhibitory activity against five bacterial strains evaluated with minimum inhibitory concentration (MIC) values between 3,13 and 6,12 mg ml⁻¹. The extract demonstrated the potent antioxidant activity by effectively scavenging DPPH, a free radical, with an EC₅₀ value of 28,12 µg ml⁻¹.

Keywords: Minimum inhibitory concentration (MIC), 2,2-diphenyl-1-picrylhydrazyl (DPPH), Gram-negative, Gram-positive, phenolic compounds

INVESTIGATING THE EFFECT OF SOIL FERTILITY (BORON AVAILABILITY) ON YIELD AND QUALITY OF SOUTH AFRICAN WHEAT AND BARLEY CULTIVARS

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Soil boron deficiency is a major problem in wheat producing areas such as Thailand and China as it may cause up to 100% yield loss due to sterility. South Africa was among the African countries found to have a certain degree of soil boron deficiency in the late 1990's. In 2000, a study on sunflower showed that there is definitely a significant boron deficiency in the Bethlehem region (Eastern Free State). With a number of reports of sterile wheat ears and the reduction in yield in the wheat growing regions of the Free State, it is relevant to investigate the effect soil boron deficiency might have on the yield and quality of South African wheat and barley cultivars. This study was aimed at characterizing 20 commercially available South African wheat cultivars and three barley cultivars for their boron efficiency and the effect of boron treatments on their yield and quality. The pot trial was set up in a randomized complete block design, with three replicates and four boron concentrations (0, 1, 2 and 4 mg kg⁻¹) in July 2007 in a tunnel. Two international wheat cultivars, Bonza and Fang 60, were used as boron inefficient and boron efficient control cultivars respectively. Plants were grown to maturity and evaluated for grain set index, number of kernels per ear, kernel weight and number of ears per plant. All three barley cultivars (Clipper, Puma and SSG 564) showed toxic symptoms to the boron treatments used.

Keywords: boron deficiency, yield, barley, wheat

INCIDENCE OF ARBUSCULAR MYCORRHIZAL FUNGI IN INOCULATED AND UNINOCULATED FIELD GROWN GRAPEVINES

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In a previous field trial, the author assessed the success of inoculating young grapevines with selected arbuscular mycorrhizal (AM) inoculums and quantified the benefits of this symbiosis, under unsterile soil conditions. It was established that the grapevine roots were already adequately colonised with indigenous AM fungi and that these fungi seemed to have masked the effects of inoculation since little improvement in vine performance was observed. However, the findings with regard to the mycorrhizal status of the vineyard soils were tentative and required substantiation.

The objective of this study was to obtain supportive evidence for the presence of indigenous AM fungi associated with inoculated and uninoculated grapevines, which include quantifying and identifying the indigenous and introduced AM fungi. The trial was carried out in two commercial vineyards on the farm Groenland near Stellenbosch. Vineyards containing Merlot vines on 101-14 Mgt and 110 Richter (110R) rootstocks were planted on a ridged soil late in 1998, at which time another vineyard, containing Merlot on 99 Richer (99R) was established on an unridged Fernwood soil. Five treatments were applied during planting. Three of the treatments CAM1, G1054 and CAM2 each involved inoculation with AM inoculums. The fourth treatment consisted of a fungicide soil drench, applied shortly after planting. The fifth treatment (control) received neither fungicides nor inoculum. Soil pH levels over the trial period ranged from 5.6 to 6.1, which are considered near-optimal for such fruiting perennials as grapevines. Inoculation with commercial AM carriers had little effect on spore density. Soil AM counts in winter 2000 were relatively high in these vineyard soils, namely between 1000 and 3799 spores/100g dry soil, despite the prevailing adequate to high soil phosphorus (P) concentrations of up to 89 mg/kg P. Using morphological criteria to identify AM fungi, these vineyard soils were found to consistently harbour seven indigenous species of AM fungi belonging to the genera *Acaulospora*, *Gigaspora*, *Glomus* and *Scutellospora*. A further AM species was specific to one rootstock cultivar only. Other indigenous species occurred sporadically.

Keywords: arbuscular mycorrhizal fungi, grapevine rootstock, indigenous, inoculum, spore density, vineyard soils

EFFECT OF MYCORRHIZAL FIELD INOCULATION ON THE PERFORMANCE OF YOUNG GRAPEVINES

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The benefits of inoculating grapevines with selected arbuscular mycorrhizal (A) inoculums are well documented. Farmers may reap these benefits by inoculating vines at large-scale. Most of these benefits have been largely demonstrated under control conditions in pot trials. In the field however, in soils of unknown mycorrhizal status, it is difficult to predict the grapevine's response. The objective of this study was to assess the success of inoculating young grapevines with selected AM inoculums under field conditions and to quantify the benefits of this symbiosis.

The trial was carried out on the farm Groenland near Stellenbosch in two commercial vineyards. Vineyards containing Merlot vines on 101-14 Mgt and 110 Richter (110R) rootstocks were planted on a ridged soil late in 1998 in December, at which time another vineyard, containing Merlot on 99 Richer (99R) was established on an unridged Fernwood soil. Five treatments were applied during planting. Three of the treatments CAM1, G1054 and CAM2 each involved inoculation with AM inoculums. The fourth treatment consisted of a fungicide soil drench, applied shortly after planting. The fifth treatment (control) received neither fungicides nor inoculum. Over a period of two growth seasons after the treatments were applied (1998/99, 1999/2000), the vines were subjected to measurements of vigour, leaf water potentials, leaf nutrient concentrations and xylem sap composition. Percentage root colonisation by AM fungi was also determined over both seasons. Root colonisation rates among the three rootstocks after the first season ranged from c. 40% to 85%, and increased after the second growing season to rates ranging from c. 70% to 90%. That the rootstocks in the control treatments were also colonised confirmed the presence of infective indigenous AM fungi in these vineyard soils. These naturally occurring AM fungi were sufficiently abundant and sufficiently infective to ensure root colonisation rates of two of the three rootstocks that received AM treatments, and did not significantly differ from those in the controls after one season. After two seasons, no differences in colonisation rate were apparent. As a result, the responses of the grapevines to AM fungal treatments and to the fungicide application were generally inconsistent in terms of growth, leaf nutrient concentrations and xylem sap composition. Evidence was nevertheless obtained, as indicated by leaf water potential, which suggests that inoculation with AM inoculants at planting may result in less water stress being experienced than where colonisation is achieved by the native soil AM population only.

Keywords: grapevines, indigenous arbuscular mycorrhizal fungi, leaf water potential, root colonisation, rootstocks, arbuscular mycorrhizal fungi

ARBUSCULAR MYCORRHIZAS IN GRAPEVINE NURSERIES OF THE WESTERN CAPE: A SURVEY

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Arbuscular mycorrhizal (AM) fungi form an integral part of agricultural production systems. Grapevines are highly reliant on mycorrhizas for their nutritional needs, normal growth and development. In grapevine nurseries of South Africa, basic information with regard to the mycorrhizal status is lacking. Since pre-inoculation with AM fungi is particularly vital with regard to dormant nursery plants that received hot water treatment prior to transplantation, these research aspects need to be effectively addressed.

The objective of the study was to conduct a survey of AM fungi in grapevines nurseries of the Western Cape. Nine different areas including fifteen different nurseries were monitored over one growth season. The areas include Wellington (4 nurseries), Malmesbury (3 nurseries), Paarl (2 nurseries), Rawsonville (1 nursery), Bonnievale (1 nursery), Montagu (1 nursery), Piketberg (1 nursery), Klawer (1 nursery) and Hermanus (1 nursery). The cultivar, Chenin blanc/R99, was selected for all the nursery farms. The first plant roots and soil samples were collected about three months after plant during February/March 2006, and again towards the end of the growth season in June/July 2007, just prior to removal of the plants. The soil samples were analysed for standard chemical and physical properties and the rest of the soil samples and root samples were subjected to microbiological analyses. Spore counts were made and root colonisation was measured. Mycorrhizal fungi were identified using morphological criteria. Arbuscular mycorrhizal fungi identified belong to the genera *Glomus*, *Acaulospora*, *Gigaspora* and *Scutellospora*. The species *Glomus mosseae*, *Glomus* spp., *Scutellospora calopspora*, and *Acaulospora* spp., were consistently found in all the nurseries. High P-concentration seemed to have had little effect on mycorrhizal root colonization. On one farm the root colonisation rate was 84% despite a soil P-concentration of c. 226 mg kg⁻¹ P. Spore numbers ranged between 150 and 1000 spores/ 100g dry soil earlier in the season and between 200 and 1600 spores/100g dry soil, towards the end of the season. However, with the exception of a few, all the nurseries, had spore numbers lower than a 1000/100g dry soil. The pH did not seem to have affected the spore numbers in a particular fashion, although a slightly higher pH tended to be associated with lower counts. Tentative evidence for an increased effect of organic material on spore abundance was also demonstrated.

Keywords: arbuscular mycorrhizal fungi, grapevines, indigenous, nurseries, root colonisation

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

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Past research suggest that the activity and balance of the soil microbial community is dynamic, and may change quickly in response to practices such as mulching, the growth of cover crops, cultivation and irrigation. However, very little is known about the ways in which fruit tree roots interact with, and are affected by the micro-organisms and the non-living organic components in the soil.

The aim of the current study was to carry out a preliminary investigation into the effects of common soil surface management practices on the diversity of the soil microbial community over two growth seasons in an apple orchard, as part of an ongoing multidisciplinary trial, established three years ago. Treatments consisted of two management practices applied to the tree row, namely chemical control or mulching. This was applied in combination with different treatments applied in the work row. The latter treatments included full surface mulching, cover crops during winter, controlled chemically or slashed during summer, as well as these two management practices applied to weeds. A total of eight treatment combinations were applied. To determine whether shifts have occurred in the microbial community composition in response to the various soil surface management practices, the community's carbon source utilization profiles were determined using Biolog Eco-Microplates. Samples were taken both at the tree row and work row in September during each year of the two growth seasons (2005/2006 and 2006/2007). Clustering analyses showed that treatment one (chemical control in tree row and weeds slashed in winter in the work row) and treatment two (mulch + EM applied in the tree row and cover crop sown in work row) were at the extreme opposite ends of the scale of cluster formation, which was observed both at the work row and tree row, for two consecutive seasons. The other treatments were fairly inconsistent with no particular or recurring clustering differences observed over the two seasons, in either the work row or tree row.

Keywords: Apple, cover crop, diversity, microbial community, mulch, organic

USE OF 1-METHYLCYCLOPROPENE, MODIFIED ATMOSPHERE AND IMAZALIL TO EXTEND THE STORAGE LIFE OF 'SANTA' TOMATOES

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Loss of quality occurs when tomatoes are stored for more than approximately 3-5 weeks at 12^oC. The most common disorders found in tomatoes during storage are colour development to an unacceptable shade of red, softening, shrivelling due to moisture loss, loss of flavour and fungal infections. Storage life of tomatoes is generally extended by storage under refrigeration. Further, extension of shelf life can be achieved by modified atmosphere packaging (MAP). This is done by sealing actively respiring produce in polymeric film packages to modify the O₂ and CO₂ levels within the package atmosphere. Also, 1-methylcyclopropene (1-MCP) has been proven to be an effective postharvest treatment to prolong the storage life of tomatoes.

The effects of MAP, 1-MCP and Imazalil either as combined treatments or as single treatments were studied for their effect on the quality of tomatoes (*Lycopersicon esculentum* cv. Santa) stored for 4 weeks at 12^oC. The results indicated that ripening related changes were delayed following 1-MCP treatment and MA packaging in 17 micron low density polyethylene film bags. 1-MCP treated fruit were firmer, had reduced TA losses, slower colour development, and reduced physiological disorders associated with long term storage. Elevated CO₂ in MAP after a long storage period induced anaerobic metabolism with the generation of off-odours and the proliferation of anaerobic microbes. Imazalil at a rate of 0.005 g.L⁻¹ was found to reduce fungal infections by 50% when used in combination with MAP and 1-MCP. The combination of Imazalil, MAP and 1-MCP therefore appears to be the best treatment combination to export "Santa" tomatoes by sea freight to Europe.

Keywords: Tomato, *Lycopersicon esculentum* cv. Santa, storage life, sea freight, 1-MCP, MAP, Imazalil

GRAIN YIELD AND YIELD COMPONENT RESPONSE OF MAIZE AND LEGUME VARIETIES IN INTERCROP SYSTEMS

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Intercropping maize and legumes is a common cropping system among small-scale farmers in the Limpopo Province, but to date information about the productivity of the system is inadequate. A field experiment was conducted to assess yield performance of maize in sole and intercropping systems with two cowpea cultivars (Bechuana White and Glenda), and two lablab bean cultivars (Rongai and Common), to determine grain yield and yield component as well as agronomic characteristics of component crops. The experiments were carried out as randomized complete block design (RCBD) with two replications at two locations in the Limpopo Province namely: University of Limpopo experimental farm at Syferkuil and on a farmer's field at Dalmada, during the 2002/2003 growing season. Seed yield of cowpea responded significantly to cropping system at Dalmada and not Syferkuil. The grain yield range at Syferkuil was 740 to 1008 kg ha⁻¹. At Dalmada, the highest legume seed yields were recorded in sole (Glenda and Bechuana white). Maize grain yield was significantly influenced by the cropping system at both locations, ranging from 43 to 1213 kg ha⁻¹. Grain yield of intercropped maize was lower than that of sole crop maize at both locations. The findings point to further research to establish component crop combination for enhanced complementarity and improved yields in the intercropping system.

Keywords: Intercropping

NODULATION, DRY MATTER ACCUMULATION, SYMBIOTIC ACTIVITY OF COWPEA AND LABLAB UNDER SOLE AND INTERCROPPING SYSTEM WITH MAIZE

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Legumes are sources of plant N that can be produced *in situ* and complement inorganic fertilizer requirements in intercropping systems. When fertilizer N is limited, biological nitrogen fixation (BNF) is a major source of N in legume-cereal intercropping systems. A field study was conducted in 2002/2003 at Syferkuil and Dalmada to determine the effects of different intercropping systems on nodulation, and biomass accumulation of the companion crops in the system. The experiment was established as a randomized complete block design (RCBD) with nine treatments replicated three times at each location. The treatments were sole maize cv. SNK 2147, sole legume species (Glenda, Bechuana white, Rongai and Common) and the four legume species intercropped with the maize. The following parameters were measured: dry matter, nodule mass, nodule number and nodule effectiveness. The effect of the cropping system on maize dry matter was non-significant, implicating the possibility of beneficial co-existence of companion crops. Intercropping effect on dry matter accumulation did not differ much between the sole and intercrops for the individual legumes. The total biomass of cowpea and lablab cultivars (sole and intercrop) ranged from 403 to 5760 kg ha⁻¹ at both locations. Nodule formation differed among the legume species tested; with sole Glenda and Bechuana white producing nodules which were 82% heavier than when grown as intercrops. Intercropping caused decreases in nodule mass and number of nodules at 88 and 95 days after planting (DAP) at Syferkuil and Dalmada respectively. Nodule effectiveness was observed among the cropping systems at both locations during the different sampling dates. The findings contribute to the knowledge that, a companion non-legume crop may not benefit from N fixation by a legume crop in intercropping system during a current season.

Keywords: nodulation, sole cropping, intercropping

RESPONSE FARMING: ADAPTING AGRICULTURAL ACTIVITIES TO WEATHER AND CLIMATE FORECASTS

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A Response Farming project aiming at reducing agricultural risk caused by climate variability has been initiated at the Makhado Municipality of the Limpopo Province . The objective is to use weather and seasonal forecasts to adapt to day-to-day management of subsistence crop farming. The on-farm field trials will look at intercropping of maize and cowpeas. Each trial is equipped with a standard rain gauge for continuous measuring of rainfall during the growing season. Crop water satisfaction index will be calculated on a decadal basis using actual rainfall, normal rainfall, evapotranspiration and normal evapotranspiration. The normal rainfall, evapotranspiration and normal evapotranspiration will be estimated from the interpolated climate surfaces generated by the ARC-ISCW. Recommendations on managing the fields are then made based on rainfall data, crop water satisfaction index, crop growth status and field status. The weather and climate forecasts are sent together with the recommendations on appropriate field activities to the farmers via an SMS. The weather forecasts and their regular updates are the core of the recommendations aimed at reducing impacts of weather and climate on agricultural production.

Keywords: Response Farming, weather forecasts, rainfall, climate variability

RAINWATER HARVESTING TECHNIQUES

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To feed the growing population in the arid and semi-arid areas of the world, more irrigation is needed but the quantity of irrigation water is extremely limited. As rainfall in dry areas is often lost through evaporation and runoff, rainwater harvesting, which is the collection of surface runoff mainly for agricultural and domestic purposes, might be an alternative.

Rainwater harvesting (RWH) is defined as the process of concentrating rainfall as runoff from a larger area for its productive use in a smaller target area. Traditional water harvesting techniques have long been practised in many dry areas and various techniques are used. A literature review was conducted to study the classification, characteristics and advantages of the various RWH techniques. An alternative classification system has been proposed whereby water harvesting methods are categorized as simply 'ex-field rainwater harvesting' – outside the farm/field/land boundary; 'in-field rainwater harvesting' – inside the farm/field/land boundary; and 'non-field rainwater harvesting' – an artificially man-made runoff area. All these techniques have the potential to (1) increase available water for crop production, and (2) reduce the risk of crop failure.

Ex-field RWH (e.g. contour stone bunds, Jessours) is characterized as a technique that makes provision for excess water, either where runoff is stored in the soil profile or in a reservoir below the soil surface. In-field RWH (e.g. basins, semi-circular bunds) is characterized as a technique where most of the time there is no provision for overflow, where runoff is stored in soil profile and overland flow is harvested from a short catchment length within the farm/field/land boundary. It has the benefit of increasing crop production whilst preventing runoff and erosion from the field. Non-field RWH (e.g. rooftops) stores runoff in reservoirs either above or below the soil surface. Compared to ex-field RWH, the in-field and non-field RWH techniques make use of relatively small collection surfaces. They have the potential to supply drinking water, as well as water for other domestic purposes.

Keywords: Rainwater harvesting, runoff

THE DEVELOPMENT OF THE “BIO-VILLAGE” MODEL FOR FOOD PRODUCTION AND POVERTY ALLEVIATION

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The “bio-village” model is a concept on sustainable and equitable human development based on the principles of natural resource conservation and utilization, as well as on equity and economic well being. In this model, community members are involved in the production of crops, livestock and poultry, amongst other commodities. The concept also includes the use of available natural resources to produce handcrafts and other works of art to be sold. The methods used to achieve the objectives are: empowerment of rural communities through capacity building, knowledge, skills and information sharing, and access to funds. The improvement which the “bio-village” concept made to the lives of many poor Indian communities led the ARC to share the concept with South African local farmers especially a group of unemployed women and youth “Remmogo Basadi Temong” of Winterveldt in the Gauteng Province of South Africa. The objective for this group is to develop a sustainable rural enterprise encompassing diverse commodities, through agricultural production. The aim of the “bio-village” project is to promote the efficient and sustainable use of natural resources, and to achieve a continuous and steady growth of agricultural production, while conserving and improving the environmental resources of a community. This poster is aimed at highlighting the basis of the model and its setup.

Keywords: agricultural production, poverty alleviations, "bio-village" model

**EFFECT OF ADULT AGE AND MATING STATUS ON THE REPRODUCTION OF
THE BANDED SUNFLOWER MOTH, *Cochyliis hospes* WALSINGHAM
(LEPIDOPTERA: TORTRICIDAE)**

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The banded sunflower moth, *Cochyliis hospes* Walsingham, is a major pest of cultivated sunflower, *Helianthus annuus* L. The effect of adult age on mating, and of adult age and female polygyny on reproductive output were investigated. Male and female age had significant effects on mating, with a significantly smaller percentage of 1-d-old adults copulating or a significantly smaller proportion of 1-d-old males transferring a spermatophore, than for older females. One-day old adults (both sexes) of *C. hospes* also tended to copulate later in the scotophase than comparable older adults. Female age at first mating also had a significant effect on fecundity and fertility; fecundity and fertility tended to decrease with increasing age at first mating. In contrast, female longevity increased for with an increase in age at first mating. However, females first mated at an earlier age and tended to spread egg-laying over a greater time span than did females first mated at an older age; and tended to lay a very high proportion of their eggs within a few days after mating. Increased age of males at first mating, resulted in decreased fecundity and fertility of female *C. hospes*. Finally, fecundity and fertility of twice-mated females was compared with that of once-mated females. And twice-mated females were significantly more fecund than once-mated females, but fertility was similar.

Keywords: Helianthus annuus L., Banded sunflower moth, *Cochyliis hospes*

**ANTIFUNGAL PROPERTIES OF *Tulbaghia violacea* HARV. (WILD GARLIC)
PLANT EXTRACTS AGAINST *Alternaria solani* AND *Sclerotium rolfsii***

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Tulbaghia violacea is indigenous to South Africa and belongs to the Alliacea family. A variety of medicinal properties have been ascribed to this plant species, such as antifungal, antibacterial and antiviral properties. It is, therefore, widely used by South African traditional healers for the treatment of flu, fever, cold, tuberculosis, asthma and many other diseases. A study was conducted to determine the best harvesting time and to determine which part of the plant had the highest bioactivity. Ammonium sulphate and calcium nitrate were applied as topdressing treatments at a total of 0, 50, 100, 150 and 200 kg.ha⁻¹, at three-month intervals. *T. violacea* plants were harvested monthly. The dry aerial and underground plant parts were milled separately. Crude extracts, prepared separately from each of below ground parts of *T. violacea*, restricted the growth of two plant pathogenic fungi, *Alternaria solani* and *Sclerotium rolfsii*, in an agar/petri dish inhibition assay. The highest levels of inhibition (>90%) were observed when using crude extracts prepared from below ground parts that was harvested at the end of the growing season, and which had been fertilized with ammonium sulphate. The lowest levels of growth inhibition were observed from plant material that had been harvested during November and December 2007. Calcium nitrate fertilizer did not improve plant bioactivity while ammonium sulphate fertilizer resulted in high bioactivity. The application of ammonium sulphate fertilizer in all levels improves the antifungal properties of *T. violacea*.

Keywords: Alternaria solani, antifungal, Sclerotium rolfsii, Tulbaghia violacea

DETERMINING THE VIGOUR AND ALLELOPATHIC POTENTIAL OF NINE SELECTED SOUTH AFRICAN SPRING WHEAT CULTIVARS

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The development of herbicide resistance in weeds is one of the major factors hampering profitable crop production worldwide. In South Africa, herbicide resistant grass- and broad leaved weeds cause substantial crop losses, in particular in the Winter Rainfall Region of the country. The lack of sufficient different modes of action herbicide groups that can be rotated in these conditions, necessitates the implementation of integrated weed management programmes. One of the alternative physical weed management strategies is to maximize crop competition to the weed population. One aspect of such strategy is to plant crop species or cultivars that have greater interference potential than others. In this study nine spring wheat cultivars were investigated with the objective of determining their vigour and allelopathic potential. The nine cultivars were grown in a temperature controlled glasshouse and plants were harvested every two weeks to determine the vegetative growth parameters of the plants. In a second experiment, aqueous extracts of the nine cultivars were prepared and diluted to result in five concentrations viz. 100% (undiluted), 75%, 50%, 25% and 0% (control = distilled water). Seeds of ryegrass (*Lolium multiflorum cv Midmar*) were germinated in petri dishes to which one of the different concentrations were added. The rate of germination and total final germination percentage were calculated after two weeks. Thirdly, ryegrass seedlings were established in 8 cm x 8 cm square plastic pots. After the seedlings were well established, the aqueous solutions described above were administered to the seedlings. Two weeks later the seedlings were harvested and the vegetative growth parameters were determined. Based on these results three cultivars were selected. These three cultivars will be used in future experiments with weed species to determine correlations between the measured attributes and their performance in competition experiments in pots with various weed species. These attributes may be used in breeding programmes of spring wheat to breed more competitive cultivars that can be used in integrated herbicide resistance management programmes.

Keywords: Allelopathy, competition, interference, spring wheat, weeds

EVALUATION OF DIFFERENT INORGANIC AND ORGANIC FERTILIZERS ON SPINACH YIELD

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A field trial was conducted at the ARC-Roodeplaat experimental farm during April-October 2007, with the aim of evaluating the effect of different organic and inorganic fertilizers on spinach (*Spinacea oleracea*) yield. These were: guano, Pikitup® compost, compost, compost + guano, NPK and NPK + guano. The highest yields were obtained with the NPK + guano (76.80 t.ha⁻¹), followed by NPK only (72.70 t.ha⁻¹), and then by guano only (68.88 t.ha⁻¹), all being higher than the target yield of 60 t.ha⁻¹. The compost and the Pikitup® compost treatments produced the lowest yields of 49.10 t.ha⁻¹ and 51.81 t.ha⁻¹, respectively. The results indicate that guano and inorganic fertilizers improved yield, and with a price comparable to that of inorganic fertilizers, guano would be an excellent organic alternative fertilizer. Despite falling below the target yield, compost and Pikitup® compost produced relatively good yields that are above the recommended yields (40 t.ha⁻¹). The higher yields can be attributed to an extended growth season of 6 months, which allowed for repeated harvests.

Keywords: spinach, yield, compost, fertilizer

GRAVIMETRIC SOIL MOISTURE CONTENT OF A MAIZE-LABLAB INTERCROPPING SYSTEM AT DIFFERENT LABLAB DENSITIES

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Water is a medium for proper nutrition and healthy growth in plant and it is an important constituent of living cells. It comprises approximately 90% of the plant tissue. Water is required for cellular activities and maintenance of turgor pressure within cells, water in plants cell keeps the stem upright and maintains expanded leaves to receive sunlight for photosynthesis. The quantity of moisture in the soil determines dry matter accumulation and grain yields in crop production. Field experiments were set up over the period of 2 years at 2 locations in the Limpopo Province of South Africa namely; the University Limpopo experimental farm at Syferkuil and a smallholder farmer's field at Dalmada near Polokwane. The experiments were established as a randomized completely block design in factorial arrangement with 3 replications at each location with 2 planting dates and 5 planting densities of lablab as treatments. Lablab densities were; 0 (sole maize), 2, 4, 6, 8 plants per meter length (2001/02) and additional of 10 plants per meter length during 2002/03 growing season. These densities were either planted simultaneously with maize or 28 days after planting maize. The maize cultivar used was SNK 2147 and lablab was Rongai. The lablab was planted between 90-cm inter row spacing of maize and thus creating a distance of 45 cm between the maize and the lablab. Five rows were planted at both locations in 2001/02 growing season at both locations and 8 rows in the 2002/03 growing season. Three centre rows were harvested in the 2001/02 growing season at both locations and 5 rows in 2003/03 growing season. Row length was 4 m in the 2001/02 growing season at both locations, whereas in the 2002/03 the length was 4.5 m. Soil water dynamics during a growing season was assessed gravimetrically at specific intervals throughout the growing season. Soil samples were collected from 0-15 cm and 15-30 cm. Gravimetric soil moisture content was calculated using the method described by Scott (2000). Soil samples were collected at 14 day intervals, if it did not rain. Wet weight was measured immediately after sampling. The samples were oven dried at 110⁰C until constant weight for dry weight determination. The objective of the study was to assess gravimetric soil moisture content at specific intervals through the growing season under maize-lablab intercropping. Soil moisture content increases with planting density at both locations and in all growing seasons at 98 and 112 Days After Planting (DAP), because of high canopy which provided shade. Gravimetric soil moisture content of top and sub soils, recorded during the reproductive stage of intercropped maize in 2001/02, were generally higher when lablab was planted 28 days after maize than the simultaneously planted system. Therefore, lablab densities of 2 and 4 plants m⁻¹ can be incorporated in predominantly maize culture in the Limpopo province.

Keywords: Soil moisture, maize, intercropping, lablab, water

GROWTH AND YIELD RESPONSE OF DRYLAND PRODUCED PIGEON PEA (*Cajanus cajan*) CULTIVARS TO "ZEBA", A SUPERABSORBENT POLYMER

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Most growers are faced with the challenge to produce better quality and higher yields without increasing the inputs and cost. Water availability continues to diminish while irrigation costs are rapidly rising. Furthermore, crop nutrients are costly and should be used in precise amount to meet crop needs. Zeba is a unique superabsorbent polymer based on natural cornstarch and as result it is environmental friendly, biodegradable, non-toxic and virtually odourless granule. According to Neville (2003), Zeba maximizes crop input investment by absorbing and releasing soil nutrients, water-soluble fertilizers and chemicals thereby creating a healthy microenvironment in the plant root zone. Zeba was found to be a new-patented soil amendment that absorbs and releases water as needed by plants to help growers produce consistently higher quality and greater yields using reduced inputs and water. However, Zeba has not yet been tested in South African soils and conditions. The trial was conducted at the Agricultural Research Council Experimental Station during the 2005/2006 growing season to determine the influence of Zeba on pigeon yield, growth response and moisture conservation. The trial design was a random complete block design (RCBD) with three replicates, six cultivars of pigeon pea and three Zeba levels (0, 5 & 10 kg ha⁻¹) as treatments. Total yield (pods & seeds) was higher at an application rate of 5 kg Zeba ha⁻¹ compared to 0 and 10 kg Zeba ha⁻¹ regardless of cultivar. Average seed yield at 5 kg ha⁻¹ application rate was 47% and 30% higher than by applying 0 and 10 kg Zeba ha⁻¹ respectively. Total moisture conservation in the treatments increased with increased Zeba application rates. At 94 DAP, where 5 and 10 kg Zeba ha⁻¹ were applied, average conserved soil moisture was 54% and 74% higher than at 0 kg Zeba ha⁻¹ respectively. Generally, pigeon pea growth response was not influenced by Zeba levels but varied between pigeon pea cultivars. Zeba application exhibited potential to increase moisture conservation, resulting in a yield increase.

Keywords: Pigeon pea, cultivars, yield, Zeba

FATTY ACID AND OIL CONTENT OF SIX COTTON GENOTYPES AS INFLUENCED BY DROUGHT

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Like other common vegetable oils, cottonseed oil consists predominantly of triglycerides. In addition, crude cottonseed oil contains a certain proportion of fatty acids in free form and minor amounts of a variety of other substances such as phospholipids, sterols and hydrocarbons. Cottonseed oil is used in the manufacture of salad and cooking oils, shortenings and margarine. To a lesser extent, it is used in the packing of fish and cured meat. Cotton seeds fatty acids and oil content are said to be influenced by moisture deficit. Trials were planted in split plot design with three replications where irrigation was assigned to main plot and varieties were subplots in 2005/2006 growing season. The two irrigation types were irrigation, and rainfed. Under rainfed conditions the plants were irrigated at crucial stage of development for example after sowing and for four weeks after emergence. Twelve cotton varieties, grouped in to three groups namely: very tolerant to drought (Marico; Nebo 108; Tugela; Alpha), sensitive to drought (RB50 x DC 2417; Tetra; Sicala; DPAc90 X S42) and very sensitive to drought (Molopo; 1208 x SJS; OR19; and OR3) were evaluated and screened for drought at the Agricultural Research Council-Institute for Industrial Crops (ARC-IIC), at Kroondal. One rainfed trial was also planted under a rain-out shelter as a control. Cotton seed was used to determine fatty acid and oil content. The lipid extraction procedure described by Folch *et al.* (1957) was used. A modified procedure described by Slover and Lanza (1979) was used for determine methylation. The objective of the study was to determine correlation between oil content and yield of cotton seed as influenced by drought. The statistical package Agrobase Generation II was used to do simple descriptive analysis and correlation coefficients. The predominant fatty acids found in all 12 varieties were oil content namely, Lauric, Myristic, palmitic, palmitoleic, margaric, heptadecenoic, stearic acid, oleic, linolenic, eicosenoic, behenic, tricosanoic, eicosopentaemoic. Both positive correlation and negative correlation between fatty acid and oil content was detected.

Keywords: Cottonseed, oil, fatty acid

DEVELOPMENT AND EVALUATION OF SUITABLE METHODS FOR SCREENING DROUGHT TOLERANCE IN POTATO

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Potato (*Solanum tuberosum L.*) is one of the world's most important crops, exceeded only by wheat, maize and rice in total production. Shortage of water in the growing season influences tuber yield and quality. Drought is one of the major causes of reduced agricultural production worldwide. Search for traits related to drought tolerance is a main step in the selection of potato with improved performance under limited water supply. The objective of the study was to screen and evaluate ten varieties for drought tolerance under normal irrigation and stressed conditions. The trial was planted on the 4th of April, 2007 in a glasshouse. Tubers of all the varieties were well sprouted (physiologically older seed). Soil mixture used was: topsoil (6): sand (3): vermiculite (3). The soil mixture was fertilized with 3:2:1 (25) and LAN. The first row of pots in the "Stressed replicates" were planted with the variety Up-to-date. These rows were used as indicators of the level of drought stress (as Up-to-date is known to be susceptible to drought). Drought stress treatments included R0 (irrigated control) and R1 (progressive drought after tuberisation, with a recovery period). The trial design was a split plot with irrigation being the main plots and varieties the sub plots. Varieties used were Darius, Pentland Dell, 890/20, Hertha, BP1, Vanderplank, Up-to-date, Caren, Buffelspoort, and Mnandi. The objective of the study was to develop and evaluate suitable methods for screening drought tolerance in potato. The trial was harvested in July 2007 and fresh foliage weight was determined in grams per pot. Samples were oven dried at 60°C. Varieties yielded significantly different with regard to fresh and dry foliage weight, and tuber yield per pot. Amongst the stressed treatments Darius, BP1, 890/20, Hertha and Caren had the highest fresh foliage weight. Darius, 890/24 and Hertha also had the highest tuber weights, whereas Caren gave the lowest tuber weight per pot. In conclusion Darius, Hertha and 890/24 gave the highest yield for all the potato growth parameters (fresh and dry foliage, and tuber weight); this is a good sign that these varieties may be tolerant to drought. Further research and field trials are recommended to confirm the results.

Keywords: Drought tolerance screening, potato varieties

A SURVEY OF RYEGRASS IN THE WESTERN CAPE: RESISTANCE TO ALS- AND ACCASE-INHIBITORS

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Lolium spp (annual ryegrass) is a widespread troublesome weed that occurs throughout the Western Cape small grain production areas. Herbicides are used for crop weed control across the Western Cape to address the major weed challenge posed by competitive annual ryegrass. The herbicides, mainly depended on for ryegrass control, are diclofop-methyl and sulfonylureas. In the past (till 1993 when the first herbicide resistant ryegrass was reported) ryegrass control in crop fields was successfully achieved with these herbicides. However, ryegrass is a genetically highly variable, cross-pollinated species and herbicide over-reliance has resulted in the widespread occurrence of herbicide-resistant weed populations. In 2005, a random survey was conducted in the Western Cape to establish the distribution of herbicide resistance in ryegrass populations infesting crop fields. Cropped fields were visited at crop maturity and 167 ryegrass samples were collected. Each sample was screened with an ACCase- and ALS-inhibitor herbicide. Most of the samples were found to be resistant to the ALS-inhibitor (Cossack®), as well as the ACCase-inhibitor (Topik®), indicating multiple herbicide resistance. The ryegrass samples that showed multiple herbicide resistance were also screened with Gramoxone® and Roundup® to find alternative chemical control methods. All of the screened ryegrass samples were effectively controlled with both these herbicides at their recommended rates. Ryegrass across the Western Cape now exhibits resistance across many but not all herbicides, posing severe management and sustainability challenges.

Keywords: Resistance survey, *Lolium rigidum*, multiple resistance

EFFECT OF HARVEST DATE ON GROWTH AND YIELD OF HONEYBUSH TEA (*Cyclopia subternata* & *C. genistoides*)

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Cyclopia genistoides and *C. subternata*, used for the preparation of 'Honeybush tea' (a herbal tea), are endemic to specific climatic zones in the Western and Eastern Cape regions of South Africa. Commercial plantations were established to supply a growing demand and ensure sustainability of the industry.

The time of harvest and its effect on re-growth, bio-mass yield, and yield of commercially marketable (leaves and fine stalks) tea (CMT) from *C. subternata* and *C. genistoides*, was evaluated in non-irrigated commercial plantations over three seasons. The effect on the total polyphenol, mangiferin and hesperidin content of *C. genistoides* was also determined.

Harvest date affected re-growth, and CMT of both species, while bio-mass yield was only affected in the case of *C. subternata*. Re-growth of this species was faster during the cooler, wetter months of July to September, while the highest bio-mass yield occurred during autumn (April) and winter (July). The highest yield of CMT (less woody material) was obtained with harvesting during July. September and January harvests of *C. genistoides* gave the best re-growth and highest CMT, but harvest date had no effect on bio-mass yield. Harvest date had no effect on the total phenolic and hesperidin content of *C. genistoides*. Its mangiferin content was higher in material harvested in September.

Keywords: *Cyclopia* species, Honeybush tea

DO ADJUVANTS AND APPLICATION DATE OF CALCIUM NITRATE SPRAYS AFFECT 'GOLDEN DELICIOUS' APPLE FRUIT CALCIUM AND NITROGEN CONCENTRATION?

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Export apple producers in must apply calcium sprays to reduce the incidence of bitter pit, a calcium deficiency-related physiological fruit disorder. Conflicting reports exist as to the optimal timing of these calcium sprays and benefits of adjuvant use on calcium and nitrogen uptake into the fruit. Four adjuvants were evaluated relative to an unsprayed control, adjuvant-free control and commercially used adjuvant Agral-90^R, together with calcium nitrate (Ca(NO₃)₂) sprays (CaN) applied at six potentially optimum days after full bloom (DAFB), in terms of their efficacy in facilitating the entry of calcium and nitrogen into apple fruit. Seasonal average fruit calcium concentrations were ~20% higher in CaN sprayed fruit (without adjuvant) than in those not receiving. The increase in calcium concentration at 40 DAFB coincided with the end of cell division and inflow from the roots, while the increases at 63 and 83 DAFB coincided with the cessation of vegetative growth. None of the adjuvant treatments improved fruit calcium or nitrogen concentration when added to CaN sprays at any monitoring date. Trees receiving CaN had a ~12% higher overall average fruit N level than those not receiving CaN with peaks at 40, 54 and 89 DAFB, the latter coinciding with the cessation of vegetative growth. The mixture of the penetrant 'Partner^R' and humectant 'NPX' was the only treatment potentially promoting both calcium and nitrogen uptake over time and also significantly increasing final fruit nitrogen levels.

Keywords: Penetrant, humectant, bitter pit, calcium nitrate

EFFECT OF FLOWER PRUNING ON GROWTH, YIELD AND QUALITY OF TOMATO

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The effect of reducing fruit load on tomato was investigated in a tomato crop grown under winter conditions, at the Experimental Farm of the Natuurboedery Research Center, Mooketsi Station, Limpopo Province. Treatments consisted of pruning of inflorescences to six (6FP) or four (4FP) flowers per cluster and a control (0FP = no flowers pruned). Intensive flower pruning (4FP) increased plant leaf area, which probably increased light interception and photosynthesis. This was confirmed by the high vegetative dry matter production observed under 4FP and 6FP. Reducing fruit load to four fruits (4FP) also increased percentage of class-one fruit (> 67 mm), fruit weight, and total yield but decreased percentage of marketable yield due to the high incidence of fruit cracking. Optimal yield and marketable yield were recorded with the 6FP treatment. This was due to the high percentage of class-one and class-two fruit (> 54 mm), low class-three and class-four fruit (< 54 mm) and low percentage of cracked fruit. The control (0FP) resulted in a high number of fruits per plant but with low total and marketable yield due to the high percentage of class-three and class-four fruits. There was no correlation between flower pruning and fruit pH, total soluble solids (TSS), EC and Brix.

Keywords: Fruit load, inflorescence, leaf area, marketable yield, fruit cracking

GREEN MANURE LEGUME COVER CROPS FOR IMPROVING SOIL FERTILITY IN SMALLHOLDER FARMS

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Declining soil fertility is one of the major factors contributing to low crop yields in smallholder farms in Limpopo Province. Supplementing inorganic fertilizers with legume green manuring may add nutrients to help alleviate the problem. The objective of this study was to evaluate the effect of green manure legumes on maize yield under smallholder farmer managed conditions. Four green manure legume species, mucuna, lablab, sunhemp and cowpea were established at smallholder farms at two locations in the Vhembe district, Limpopo Province. A bare plot was also included as a control treatment. The legumes were established in plots measuring 5 x 10 m and incorporated as green manure at flowering. Each of the plots was then split into two subplots measuring 5 x 5 m and maize was planted either with or without the addition of an equivalent of 60 kg ha⁻¹ N fertilizer applied as Lime Ammonium Nitrate (LAN). Green manure legume aboveground biomass at incorporation ranged between 0.4 to 2.7 t ha⁻¹ at Mphaila and between 2.0 to 6.9 t ha⁻¹ at Rambuda. Maize yield with no application of N fertilizer or green manure was 0.9 and 3.3 t/ha at Mphaila and Rambuda, respectively. Addition of 60 kg ha⁻¹ of N produced 2.97 and 4.97 t ha⁻¹ of maize at Mphaila and Rambuda, respectively. Maize yield obtained by incorporation of green manure alone was 4.0, 2.7, 2.6 and 6.1 t ha⁻¹ for mucuna, sunhemp, lablab and cowpea respectively, at Mphaila and 4.0, 4.0, 5.1 and 3 t ha⁻¹ for mucuna, sunhemp, lablab and cowpea respectively, at Rambuda. Maize yield obtained by a combination of green manure + nitrogen fertilizer was 8.7, 3.9, 5.1, and 8.1 t ha⁻¹ for mucuna, sunhemp, lablab and cowpea + N, respectively, at Mphaila and 7.6, 5.9, 7.5, and 3.7 t ha⁻¹ for mucuna, sunhemp, lablab, and cowpea + N, respectively, at Rambuda. This study indicates that legumes established as green manure cover crops in smallholder farms may increase maize yield significantly and therefore, should be promoted for use by smallholder farmers.

Keywords: green manure, biomass, nitrogen, maize yield, smallholder, soil fertility

THE INFLUENCE OF UNICONAZOLE ON VEGETATIVE GROWTH, YIELD, KERNEL RECOVERY AND KERNEL QUALITY IN MACADAMIA - PRELIMINARY FINDINGS

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The crop management division of the ITSC has carried out research on the effects of plant growth inhibitors on a number of horticultural crops in recent years. In the late 1990's uniconazole was shown to provide numerous benefits in avocado production, including the inhibition of elongation of vigorous flushes, improvements in fruit yield and quality (by reducing competitiveness of the vegetative growth) and improvements in fruit shape, particularly in "Pinkerton" where the long neck was shortened to give a more compact fruit. Despite this considerable work in avocados, as well as in mangos and litchis, uniconazole has not received any attention in the macadamia industry. A literature survey indicates that very little has been done in any other macadamia producing country. The exception is Australia, where the product has been shown to give highly variable results in terms of its effect on vegetative flush control (le Lagadec, pers. com.).

In 2006 a preliminary trial was carried out in the Barberton area to gauge the effect of the product on several macadamia cultivars. Five cultivars were sprayed with a mixture of 1% [®]Sunny (active ingredient 50 g/l uniconazole) and 2% UP50 (a water based solution of urea-phosphate, recommended for use with Sunny to facilitate uptake of the uniconazole). The 1% application rate was selected as it is cost effective for large scale applications and has previously been found to be effective in avocados. The application was made on a single spraying date at which the five cultivars were at different stages in the phenological cycle, ranging from late flower to six weeks after full flower. One cultivar was in the early stages of a vegetative flush. The elongation of the vegetative flush was inhibited to some extent, with considerable variation between flushes. However, the most promising result was the effect on yield and kernel recovery. The late 'Beaumont' cultivar, in the stage of late flower to early fruit set at spraying, showed a 42% increase in average tree yield relative to control trees. Yield data for the earlier flowering 816 and 788 cultivars, with nuts ranging from 3 – 6 weeks old at spraying, was not available. However, samples taken from these earlier cultivars at harvest showed an increase in kernel recovery of up to 36%. Preliminary indications are that this is due to an increase in kernel size as well as a reduction in shell thickness. This increase in kernel recovery was not observed in the 'Beaumont' cultivar, possibly due to the difference in the timing of the application. A replicated trial is currently in progress to determine the relationship between application timing, total yield and kernel recovery.

Keywords: Macadamia, uniconazole, inhibitor, yield

VARIATION IN YIELD AND QUALITY PARAMETERS IN MACADAMIAS GROWN FROM 'NELMAK 2' AND 'BEAUMONT' SEED

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The South African macadamia industry is in a state of rapid growth, but still relies primarily on imported Hawaiian cultivars selected for growing conditions considerably different to those experienced here. Commercial growers also have access to two Australian cultivars and currently grow two South African selections which were made more than 30 years ago. Macadamia cultivar research at the ARC-ITSC has previously focused on evaluation of imported cultivars, with a few local selections also being examined. The aim of the macadamia breeding program is to make local selections of new cultivars which will deliver improved yields, kernel recovery and quality under local climatic conditions.

In 2004 a commercial orchard containing approximately 3000 - 4000 ungrafted seedling trees was identified in the Alkmaar (Mpumalanga) area. Preliminary observations confirmed considerable variation between these seedling trees in terms of yield and kernel quality. Between 2004 and 2007, 350 of these trees were selected for further evaluation as possible cultivars. The trees bore their first commercial crop in 2007 with yields ranging from 0 – 17.6 kg dry nut in shell (DIS) and total kernel recoveries (TKR) ranging from 18.6 – 49.3%. The best of these selections compares extremely well with existing commercial cultivars where yields in trees of similar age (6 years old) range from 0.1 – 7.9 kg DIS per tree and TKRs of 25.9 – 40.1% are obtained. The limiting factor at this point is that very few of the selections combine both good yields and high kernel recovery.

The best selections from the above 350 trees will be further evaluated in a replicated trial, with the trees planted on their own as well as commercial clonal rootstocks (rooted “Beaumont” cuttings). The breeding program is being expanded to accommodate annual plantings of seedlings from both controlled- and open-pollinated crosses.

Keywords: Macadamia, cultivar, yield, quality

THE ROLE OF A FARMER SUPPORT PROGRAM AS PART OF THE BEKKERSDAL RENEWAL PROJECT

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The aim of the farmer support program as part of the Bekkersdal Renewal Project is to create and build an economy based on peri-urban agricultural production. The Bekkersdal Renewal Project is sponsored by the Gauteng Department of Housing and implemented by Powerhouse Consortium and will be responsible for relocating 15 000 households to areas that do not pose the threat of sinkholes. However, this will not improve poverty in this community where the unemployment rate is 60% and previous agricultural ventures have failed. The farmer support program will focus on capacity-building and training of individuals and groups while providing constant assistance in the form of management support. A number of agricultural projects will form part of this program and will be implemented in a three-phase system. These projects are instant lawn farming, an ornamental nursery, food gardens, irrigated crop production, sheep farming, dairy farming and extensive cattle production. The farmer support program forms an integral part of The Development Hub that was constructed in Bekkersdal and which provide development support in the form of marketing, financial assistance, labour brokering, etc. The concept of the farmer support projects were based on the principles of Maslow's Hierarchy of Needs and therefore food gardens for the community forms the basis of the pyramid of projects. All these projects are planned with an exit strategy to ensure that support will lead individuals and groups to financial independence.

Keywords: farmer support, peri-urban agricultural, development support, Bekkersdal

HYDROPONIC HERB PRODUCTION USING GRAVEL FLOW TECHNIQUE (GFT)

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Herb production for culinary purposes using hydroponic systems is on the increase. Trials were conducted at Welgevallen Experimental Farm, University of Stellenbosch for training, research and for demonstrating the gravel flow technique (GFT). The objectives were to investigate different EC levels and harvesting regimes on herb production. Using GFT, and EC's of 0 and 1.7 mS.cm⁻¹, herbs such as parsley, chamomile, oregano, sorrel, butterhead lettuce and Viola F1 were grown from plug seedlings. The medium was washed gravel with municipal water as a continuous circulating system. The system was housed in a small net covered tunnel and air movement occurred freely. It was noted that some herbs could grow without added nutrients for a short time period. A further study in a polycarbonate greenhouse utilizing GFT and an EC of 2 and 1.4 mS.cm⁻¹, the growth and production of parsley, coriander, marjoram, basil and oregano plants was studied using a randomized block design. Plants were harvested once per two week period; twice per week and three times per two week period. The light intensity, temperature, relative humidity, actual EC and pH were measured weekly. After 6 weeks the results indicated that EC and the three harvesting regimes influenced yield. The system proved that for small scale production, GFT can be effectively used with minimal inputs.

Keywords: culinary herbs , harvesting regime, hydroponics

MICROBIAL ENZYME ACTIVITIES AS AFFECTED BY CROP ROTATION SYSTEMS IN TYPICAL MAIZE PRODUCING SOILS

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Maize production at farm level is subject to a high level of inherent risk. Soil health, moreover, soil microbiology as an integral part of our agricultural production systems and a key factor in quality crop production, has been implicated as a possible underlying cause. Any improvement in the efficiency of biological farming production technologies might contribute to the alleviation of these problems through the reduction in the cost of production (R ton⁻¹) of maize. During the 2006/07 season the first series of representative surface soil samples (0-15cm) from maize fields in crop rotation trials were collected for microbiological analysis at three localities, viz. Bloekomspruit, Bothaville and Vaalharts. All soil samples were taken during the active growing phase of the crop. Various soil parameters (i.e. chemical and biological) were studied and included that of selected soil microbial enzymes important in agricultural systems. Knowledge of soil enzymes activities can be used to describe changes in soil quality due to land use management and understanding of soil ecosystem functioning. Activities of β -glucosidase, urease and acid phosphatase involved in C, N and P soil nutrient cycling in maize as affected by crop rotation are reported on. Although the 2006/07 season was a very dry season suggesting that microbial activity might have been suppressed, the results at Bloekomspruit revealed that microbial phosphatase activity was higher in soils where maize and soybean preceded maize than that where sunflower preceded maize. At Vaalharts, the soils where maize was grown after wheat showed a higher microbial phosphatase activity than that where maize was grown after canola. At Bothaville, phosphatase activity showed no significant difference between the cropping systems. Enzyme activities for β -glucosidase and urease, however, were not significantly affected by the rotational system at all the localities. Since this was the first season, further investigation is needed to support the findings.

Keywords: microbial enzymes, maize production, crop rotation

GENERATING FINE RESOLUTION CLIMATE PARAMETER MAPS FOR VITICULTURAL APPLICATIONS

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The weather station network in South Africa is of insufficiently high resolution to adequately describe the climate over much of the wine producing areas. A "Winetech Terroir Programme" project was consequently initiated which encompass the use of a high resolution atmospheric model to simulate this climate. Except for the fact that the model simulations have much higher resolution than is facilitated by weather stations alone, the model simulations can also provide time series data at locations where long observational records are absent. Such a high resolution dataset that is continuous in time may be used to identify the ideal locations for vineyards, and more particularly locations for specific vine cultivars, within the South African wine producing areas. The Conformal-Cubic Atmospheric Model (CCAM) developed by the Australian CSIRO is presently being used to simulate the climate over the Stellenbosch wine producing area. CCAM is a global circulation model and high resolution simulations can be obtained over any selected region if the model is run in stretched grid variable resolution mode. CCAM simulations for the February months of 1996 - 2005 have been performed on a spatial resolution of 60km, 8 km and 1km. Climate parameter maps of the 1km resolution temperature, relative humidity, wind speed and solar radiation have been produced. Comparisons of the hourly averages with automatic weather station data from the ARC-ISCW as well as the South African Weather Service were performed. A very good correlation was found between the simulated data and the station values, especially with respect to screen temperature. The simulated points were mainly within one degree Celsius of the observed station values. Simulations at a 200 m resolution are currently attempted.

Keywords: Atmospheric model, viticulture, CCAM, climate simulations

EVALUATION OF NORMAL AND ABNORMAL SEEDLINGS FROM FARM COLLECTED SEED

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The primary aim of this study was to gain information on seed quality from commercial seed, collected randomly on farms in the maize producing area. Collected seed samples from randomly chosen farms across the maize producing area, were subjected to seed analysis to evaluate normal and abnormal seedlings. Seed sampling and analysis were conducted according to the rules of the International Seed Testing Association (ISTA) and the Plant Improvement Act of SA (Act no. 53 of 1976). From seed analysis, the percentages normal and abnormal seedlings as well as non-germinated seeds were determined. The cold test, a seed vigour tests were only conducted on maize and wheat seed. Sunflower seed were visually evaluated for *Sclerotinia sclerotiorum* (Lib.) de Bary [Sclerotinia head rot]. Normal seedlings, lower than the specifications of the Plant Improvement Act were only reported at maize and sunflower seed samples. The percentage normal seedlings at all the other crops sampled were within the range of commercial acceptability. Percentage normal groundnut seedlings during the 2006/2007 growing season, are much higher than those recorded during the 2005/2006 growing season. The illegal use of non-registered seed dressings caused high economic losses. Although the percentage normal seedling at all wheat samples exceeded 95%, seed vigour of these samples were low. No *Sclerotinia sclerotiorum* (Sclerotinia head rot) were recorded at any of the sunflower samples.

Keywords: Seed quality, germination, vigour

DEVELOPMENTS IN THE CLASSIFICATION OF ANTHROSOLS IN SOUTH AFRICA

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Following international trends, a process has been on-going during the past six or seven years of investigating the classification of Anthrosols in South Africa. Looking back and forward, a sequence of about four phases can be distinguished in this process: (1) awareness and field observation by championing individuals (ensuing from consultative projects, field experience, international movements and world literature), resulting in the testing of ideas at local and international congresses; (2) involvement of the National Soil Classification Working Group (SCWG); (3) debating and refining of ideas within the SCWG and subgroups; and (4) concepts, definitions, soil form and family schedules being finalized for inclusion in Third Edition of Soil Classification System.

After much debate, consensus is being reached that three kinds of diagnostic Anthropogenic materials can be recognized and defined, viz. (1) human-transported soils and materials, (2) physically disturbed soils and (3) soils with strongly altered hydrological properties. This will result in three new soil forms being recognized. Due to the wide spectrum covered by each of these forms, no less than 30 sets of new family criteria are in the process of being finalized.

In giving recognition to Anthrosols, possibilities have to be minimized, however, that pedologists mistakenly classify soils as Anthrosols. To this end, the boundary between Anthrosols and natural soils is defined as follows: "Anthrosols are natural soils that have been physically, chemically or hydrologically altered by human activities to such a degree that their land use options, as well as the performance of plants supported by them, are strongly and often permanently altered. The natural sequence of genetic and diagnostic horizons is altered and the original soil form is not recognizable or no longer applies. Reclamation to the original state would be almost impossible or could only be realized at excessive cost".

Keywords: soil classification

SURVEY OF WEED SPECIES AND WEED CONTROL PRACTICES IN MAIZE BASED CROPPING SYSTEMS AT MAFARANA AND GABAZA VILLAGES IN MOPANI DISTRICT (LIMPOPO PROVINCE)

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A survey of weed species and weed control practices in maize-based cropping systems was conducted in Mafarana and Gabaza villages in the Tzaneen municipality area of the Limpopo Province. A stratified random sampling method was used at both sites to collect data. A total of 30 farmers were interviewed, 5 per village. Most of the farmers interviewed were old, and the results reflect the non-participation of the youth in farming activities. About 47% of the farmers from Gabaza were more than 61 years old while 40 % of Mafarana farmers fell into that age range. Only 7% and 20% of the respondents were in the 30-50 years category at Mafarana and Gabaza, respectively. The major weed species identified in the survey were *Cynodon dactylon*, *Richardia scabra* and *Xanthium strumarium* with *Acanthospermum hispidum*, *Striga asiatica*, *Tagetes minuta* L and *Datura stramonium* being the other important weeds. The majority of farmers do not effectively control the three major weeds, name them!! in the villages. About 73% of farmers from Mafarana and 80% farmers from Gabaza had never managed to control weeds effectively. Most farmers weed between one and two times. About 93% farmers from Mafarana and 73% from Gabaza experienced weeds in the early part of season. Farmers spent a considerable amount of money on hiring labour to assist with weeding, some in excess of R500-00/ha. A high proportion of the farmers reported that it took between 8-14 days to weed a hectare. In both villages 53% of farmers weeded a hectare in a period of two weeks, while 27% of farmers from Mafarana and 7% from Gabaza indicated that they weeded within a week. Most farmers in the study area do not remove the weeds from the field. The survey results and researcher observations confirmed that weed pressure is a major constraint to crop production in Mafarana and Gabaza. Current control methods are not effective and alternatives, among them chemical weed control, need to be considered for effective and timely weed control.

Keywords: Cynodon dactylon, Xanthium strumarium, Striga asiatica, Ricardia scabra

THE CHALLENGE OF HEUWELTJIE SOILS FOR VITICULTURE IN THE SOUTH WESTERN CAPE

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Many soils in the South Western Cape are characterized by *heuweltjies* or Mima-like mounds, which are attributed to the ancient action of termites, although mammalian perturbation cannot be excluded. They influence the biological, physical and nutrient status of the soil, resulting in a “patchy” or “measle-like” soil distribution. As soil characteristics and grapevine performance are intrinsically linked, this holds implications for homogeneity of grapevine growth and production, and thus quality.

Multispectral images were used to characterize grapevine vigour in a commercial Sauvignon blanc vineyard in Stellenbosch with the characteristic presence of *heuweltjies*. Soil samples and vegetation parameters were collected at three sites on *heuweltjies* and in between *heuweltjies* in this vineyard. Soil physical and chemical analyses were made. Grapevine vegetative characteristics were determined after harvest, during the pruning season, after bud burst and at 50% flowering.

The number of lateral shoots per vine, lateral shoot length per main shoot, lateral leaf area per main shoot, total leaf area per vine, number of main shoots per vine, trunk diameter, pruning weight per vine, cane diameter shoot growth rate were all higher in the *heuweltjie* plots than the surrounding plots. The percentage of shaded bunches was also higher in *heuweltjie* plots than surrounding plots. This holds implications for grape ripening and berry composition and thus poses challenges for vineyard management for homogenous fruit production.

Keywords: heuweltjies, termites, grapevine-performance

USE OF CHLORPYRIFOS TO CONTROL AMERICAN BOLLWORM (*Helicoverpa armigera*) ON ORANGES (*Citrus sinensis* L.)

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American bollworm (*Helicoverpa armigera*) is a serious pest for citrus and causes huge yield losses. *Helicoverpa armigera* is estimated to cause yield losses of 15 to 30% on citrus (Mosinkie, 2007). To reduce the risk of yield losses due to *Helicoverpa armigera*, South African farmers tend to spray chlorpyrifos pesticide onto orange trees to suppress its populations. In the research conducted on agricultural farms in Ethiopia, Mekonnen et al, (2002) reveal that, the health hazard associated with pesticide handling are little understood by the sprayers and the communities living around the fields may also be unaware of the health hazards. Brennan (2002) supports that pesticide education and safety training are critical to reducing personal and environmental exposure to pesticides.

This study intends to determine the effectiveness of chlorpyrifos in suppressing *Helicoverpa armigera* population and also to determine chlorpyrifos toxicity level in farm pesticide operators.

Studies will give a direction to ways of reducing *Helicoverpa armigera* population and lowering of human chlorpyrifos poisoning. This is an initiative supported by Total South Africa (Pty) Ltd in trying to reduce careless handling of pesticides and also to address preservation of environment.

Keywords: Helicoverpa armigera, chlorpyrifos

THE INFLUENCE OF AN ORGANOSILICONE, BREAK-THRU S240, ON THE MOVEMENT OF A SPRAY APPLICATION OF WATER INTO THE WHORLS OF MAIZE PLANTS

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Chemical control of the maize stem borer *Busseola fusca* and *Chilo partellus* is often uneconomical or ineffective. Conventional insecticides often do not reach larvae inside whorl leaves and only penetrate up to the “dew-line”. Thorough coverage of the target area is an important factor affecting the efficacy of insecticides. Organosilicones reduce the surface tension of water in spray solutions thus improving spreading of droplets on waxy, hydrophobic surfaces of the target plant's leaf surface. The aim of this study was to determine the effect of different dosages of the organosilicone, Break-Thru S240, on the depth of water movement into whorls of maize plants.

Field experiments were conducted to assess the effect of different dosages of Break-Thru S240 on the depth of penetration into plant whorls. These experiments were conducted during the 2006/07 growing season. A randomized block design was used and the different Break-Thru S240 dosages applied by using a CO₂ pressurised knapsack sprayer. The spray formulation was directed into the whorls of maize plants six weeks after emergence. The sprayed formulation consisted of different Break-Thru S240 dosages in water applied at a spray volume of 2 and 3 l water per 100 m⁻¹ row length with a delivery pressure set at 7 l CO₂ per minute. A “UV dye” colourant was added to facilitate the process of monitoring water movement and coverage. These water volumes represented a typical tractor mounted sprayer application.

Five plants of each replicate were sampled. The length of each of the six youngest leaves, of which the ligule was unfolded, was measured. The length of each leaf blade was determined and the distance of the spray mixture's movement down the leaf blade was determined. The distance of penetration of the spray formulation was calculated as a percentage of leaf coverage. Factorial analysis was conducted with three factors. Multiple directional ANOVAS' were conducted for each of the three factors. TUKEY and DUNNET tests were used for all post hoc comparisons.

A significant Break-Thru dosage × water volume interaction ($P < 0.001$) was observed. The depth of penetration of the Break-Thru spray formulation into each of the six whorl leaves recorded in each treatment was also significantly different ($P < 0.001$).

This study provides information about the movement of organosilicones and water mixtures which may lead to improved stem borer control measures.

Keywords: Organosilicones, *Chilo partellus*, chemical control, Insecticides

DEVELOPMENT OF THE AGRO-CLIMATE INFORMATION SYSTEM ON AGIS

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Agriculture represents one of the main pillars of the economy of , not only in terms of crop production but also in terms of employment. Agricultural production is highly sensitive to climate perturbations and therefore 's semi-arid climate can be seen as the single most important restraint for the agricultural sector. Climate fluctuations can lead to variable crop yields as well as increased risks for livestock farmers and therefore have an influence on the economy of the entire country. For planning and decision making purposes, accurate and timely weather and climate data is needed. The weather station network and Agro-Meteorology database of the ARC-Institute for Soil, Climate and Water are equipped to provide such data, but access to this valuable source of data is limited and does not fully exploit the potential of the Agro-Meteorology database. In order to obtain a greater level of access to climate and weather data as well as integrated applications, an online Agro-Climate Information System is being developed on the Agricultural Geo-referenced Information System (AGIS). This online system will serve as the point from which the climate and weather data will be disseminated to the agricultural community. The Agro-Climate Information System will allow the user to obtain current and historical climate data, either per weather station or spatially in either text, graph or map format. Other products that will be made available on the web include climate zone maps, the Umlindi newsletter as well as many other climate data reports. The user will also be able to perform data comparisons.

Keywords: Agro-Climate Information System, AGIS

VS-FAST ASSESSMENT OF SOIL PROPERTIES IN THE LADA PROGRAMME

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The Land Degradation Assessment in Drylands Programme (LADA) of the FAO aims to develop and implement strategies, tools and methods to assess and quantify land degradation (LD) at different temporal and spatial scales. It is also aimed at building national, regional and global assessment capacities in order to design and plan interventions to mitigate land degradation and establish sustainable land use management practices. South Africa is one of six pilot countries participating in the global LADA programme. Land degradation assessments will be done at both a national (LADA-N) and local (LADA-L) scale. LADA-L is focussed on conducting clear and informative assessments that promote an understanding of the biophysical, socio-economical and land management aspects of LD, as well as institutional, economic and policy environments that need to be in place for sustainable land management. The DPSIR framework is used as a basis for the analysis. Part of the LADA-L assessment includes an investigation of the soil properties related to LD. The tools used for this assessment come from the Visual Soil - Field Assessment Tool (VS-Fast) methodology. Through this methodology, a core set of critical indicators is measured in order to present, investigate and rationalise important elements of land degradation. These soil characteristics comprise basic descriptive information of the soil sample, aggregate size distribution, presence of a tillage pan, soil biota (earthworms and roots), slaking and dispersion, pH, water infiltration and labile organic carbon. Each indicator is scored and the scores are weighted into both visual indicators of soil quality, as well as soil measurements thereof. The VS-Fast methodology presents a simple, yet scientifically robust method of land assessment and the tool is intended for comparative assessments. Assessments are based on either comparing one situation to a reference soil condition, or on the monitoring of change in the soil condition over time or as a result of a change in practices.

Keywords: LADA, soil condition

NITROGEN MINERALIZATION AND IMMOBILIZATION UNDER DIFFERENT WATER REGIMES IN A VERTIC SOIL

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As part of a water-conservation study on an Arcadia soil form, the effect of a crop residue mulch is being investigated. In conservation agriculture (CA), crop residues are often used as a soil cover to reduce evaporation from the soil surface, thereby increasing soil water storage. Consequent benefits are improved growth and yield of crops. After water availability, adequate nitrogen supply is the next most important determinant of good crop yield. Too little N restricts growth, resulting in poor yields. Too much N is not only costly to the farmer, but can result in environmental pollutants, such as groundwater contamination through NO_3^- leaching, or production of greenhouse gases such as N_2O , due to denitrification.

A laboratory incubation trial was conducted to investigate the dynamics of N after the application of wheat straw as mulch on a vertic soil. The experimental soil was incubated at a constant temperature of 24°C and at two different water contents: 100% field capacity (FC) to simulate higher water content as expected under water-conservation practices; and 50% FC to simulate drier field conditions, as expected under conventional tillage. A 7-day pre-incubation step was carried out to ensure that the microbial population adapted to the experimental conditions. On the seventh day, wheat straw was added at 2500kg ha⁻¹, and samples were taken at regular intervals to be analyzed for NO_3^- and NH_4^+ .

The results indicated that the $\text{NO}_3\text{-N}$ levels in the control treatments (both 100% FC and 50% FC) increased significantly over time, and could be ascribed to the mineralization of the residual organic matter (OM) in the soil, even though this residual OM was low. Under the wheat straw treatments, it was found that N release from the drier soil (50% FC) was higher than for the 100% FC treatment, probably due to immobilization. A relatively high C:N ratio (23:1) of the wheat straw is likely to result in N immobilization, which could also be enhanced by an increase in soil water content. Saturated soil conditions could also result in denitrification and N losses through N_2O and NO gases. Reduced availability of N under wet soil conditions has important implications for CA and resource-poor farmers, and additional measurements must be taken to ensure successful yields.

Keywords: nitrogen, immobilization, mineralization, wheat straw, moisture content, vertisol

INVESTIGATING BIPHENYL SORPTION TO MODEL CLAY MINERALS

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Results of a systematic study on the interaction of biphenyl to kaolinite, illite and bentonite are reported. Biphenyl concentrations were determined using solid-phase microextraction, and/or liquid extraction, coupled with the GC/MS-Ion Trap. After 6 days of incubation, the sorption of biphenyl to kaolinite followed the Freundlich isotherm, while no sorption was observed after 21 days of incubation, indicating fully reversible sorption. Sorption to illite and bentonite followed linear sorption isotherms after 6 and 21 days of incubation. The dimensionless partition coefficient K values for illite were equal to 1.71 ± 0.08 after 6 days and equal to 4.80 ± 0.32 after 21 days. The K values for bentonite were equal to 2.03 ± 0.03 after 6 days, and to 2.30 ± 0.11 after 21 days. Since the illite sample contained 0.97%, the results could suggest the time-scale at which SOC becomes an important factor in the sorption of biphenyl soil particulate matter. Expandable clay minerals could be important in the retention of biphenyl in soils for up to three weeks, with organic matter becoming more prevalent after longer periods of time.

Keywords: clay minerals, sorption, biphenyl

COMPARING THE PERFORMANCE OF SUMMER AND WINTER GROWN CHICKPEA IN LIMPOPO PROVINCE, SOUTH AFRICA

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Chickpea can improve the productivity of low-input maize-based cropping systems of the smallholder farmers in Limpopo province, . This study aimed at evaluating the performance of chickpea grown during summer and winter in one region of Limpopo province. Two field experiments, sown on 26 May 2006 (winter planting) and 5 December 2006 (summer planting), were conducted at the University of Venda 's experimental farm. The experiments consisted of a factorial combination of chickpea genotypes (ICCV97314, ICCV92337, ICCV97306, ICCV88202, ICCV37, ICCV201 and ICCV97031) and planting densities (20, 25, 33 plants m⁻²) arranged in a randomized complete block design and replicated three times. Crop biomass, grain yield and harvest index (HI) were determined at harvest maturity; and bird damage was estimated at physiological maturity. Genotype and planting density did not affect crop biomass, grain yield and HI (mean of 0.38) in the winter planting. Crop biomass varied with genotype (from 1440 kg ha⁻¹ to 2999 kg ha⁻¹, respectively for ICCV37 and ICCV97314; with a mean of 2187 kg ha⁻¹) in the summer planting. Crop biomass was 104% greater at the high planting density (3163 kg ha⁻¹) compared with the low density (1553 kg ha⁻¹) and greater by 19% at the medium density (1845 kg ha⁻¹) compared with the low density. Genotype and planting density did not affect grain yield and HI in the summer planting. Grain yield was 212% greater in the summer (1484 kg ha⁻¹) compared with the winter (475 kg ha⁻¹) planting. Bird damage was greater in the winter (50%) compared with the summer (0%) planting. The low grain yield in the winter crop was attributed mainly to bird damage. These preliminary results show that birds may be the major constraint to winter production of grain chickpea in one area of Limpopo province.

Keywords: Plant density, bird damage, biomass, grain yield, genotypes

RUSSIAN WHEAT APHID RESISTANT CULTIVARS IN SOUTH AFRICA: SYNOPSIS 1985 – 2005

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Diuraphis noxia (Kurd.) (Hom.: Aphididae) has been the most important pest of wheat, *Triticum aestivum*, in South Africa since its first report as pest in 1978. Chemical control of *D. noxia* has been limited to the use of systemic insecticides such as disulfoton, dimethoate and demeton-s-methyl, vapour action insecticides such as chlorpyrifos and parathion which penetrate the rolled leaf and more recently, seed dressings like imidacloprid and thiametoxam. In South Africa the use of *D. noxia* resistant cultivars was made possible by the discovery of host plant resistance against this pest, by Francois Du Toit in 1985. The first crosses between resistance donors and South African cultivars were made in 1986, the first field evaluations of back-cross progeny were done in 1989 and the first cultivar, Tugela-Dn, released in 1992. The adoption of *D. noxia* resistant cultivars in South Africa was fast as resistant cultivars released for commercial use had a yield advantage above susceptible cultivars in farmers' fields. By 2001 it was estimated that between 70- 85% of the area planted to wheat was under resistant cultivars. By 2005 a total of 27 cultivars with *D. noxia* resistance had been released in South Africa. During 2005 high populations of Russian wheat aphid were reported by farmers and replicated trials conducted at ARC-Small Grain Institute confirmed a new, more damaging Russian wheat aphid biotype. The identification of a resistance breaking biotype of the Russian wheat aphid in South Africa brings the initial phase of successful use of plant resistance to a close and opens the door to the more complex, biotype specific virulence/avirulence approach of utilising genetic resistance as control measure. This poster gives a synopsis of the period from 1985–2005 in which resistant cultivars contributed to enormous savings in insecticide application costs in addition to the environmental benefits associated with their use.

Keywords: Diuraphis noxia, host plant resistance

THE INFLUENCE OF SPATIAL ARRANGEMENT ON SEEDLING SURVIVAL OF WHEAT WHEN ESTABLISHED IN CONSERVATION TILLAGE SYSTEMS IN THE WESTERN CAPE

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The adoption of conservation tillage requires a major change in the way cereal crops are established in the Western Cape. In order to establish the crop successfully in retained crop residue, row widths wider than those conventionally used (175 - 180 mm) have to be considered. A row width of 250 mm is considered the minimum that can be used for planting in low residue levels, but for high residue levels, even wider row widths (up to 300 mm) have been used. Effective and early seedling establishment is important in such Mediterranean environments due to the uncertainty of rainfall in the season and the possibility of early terminal drought. The effect of wider row widths on seedling emergence and survival when the no-till planting method is used within conservation tillage systems has not been determined in the Western Cape and therefore, seedling emergence and survival were determined in factorial field trials, three to four weeks after planting. Trials were conducted over two seasons (2005 and 2006) at three localities in the Southern Cape region (Riversdale, Swellendam, Caledon) and two localities in the Swartland (Moorreesburg and Hopefield). These trials were planted with a experimental size DBS–Multistream, airseeder and treatments included different cultivars in different row widths (250-350 mm) and at varying ranges of target planting densities. Results indicated that seedling emergence and survival was reduced by increases in row width and planting density (due to increased inter-plant competition). Despite this negative response, 80% or more seedlings survived in all trials with the exception of Caledon and Swellendam in 2005. It was concluded that the no-till planting method and seeding equipment used is efficient and improves on plant establishment of 50-70%, often found for conventional planting methods.

Keywords: Seedling survival, row width, planting density, no-till, Western Cape

THE EVALUATION OF A DECISION SUPPORT PROGRAM TO ESTIMATE THE ECONOMICAL IMPLICATIONS OF TRASHING VERSUS BURNING

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Pressure is mounting worldwide to use agricultural land sustainably. The impact of agriculture on the environment and the return of organic matter to the land are factors impacting on sustainability in sugarcane industries the world over. It is common practice to burn sugarcane at harvest to facilitate a higher cutting rate; in so doing, however, a fair amount of smoke and ash fall-out is created, which is a nuisance to the general public. A more environmentally friendly practice is to harvest the cane without burning; dead sugarcane leaves ('trash') are removed from the stalk and left as a mulch on the surface. This is called 'trashing' or green cane harvesting. Currently only about 10% of all cane fields in the South African sugar industry are trashed. The uncertainty of the economic impact of a switch away from burning at harvest is part of the reason for the low adoption rate. A decision support program (DSP) was developed at SASRI (Wynne & Van Antwerpen, 2004) but needed verification before it could be released. Growers harvesting both burnt and trashed sugarcane were therefore surveyed, and their economic and agronomic data entered into the DSP. Differences between DSP predictions and actual economic figures were compared using a paired T-test. This poster reports on the verification process, and the performance of the DSP to estimate real life economics on farms, comparing burning with trashing at harvest. The output from the DSP proved to be realistic in estimating the financial consequences of a burnt versus a trashed harvesting practice.

Keywords: economics, decision support program, burn, trash, sugarcane

USE OF CAPACITANCE SENSORS FOR IRRIGATION SCHEDULING OF GREENHOUSE CUCUMBERS (*Cucumis sativus*)

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A glasshouse study was conducted to determine the lower extraction level (as a percentage of plant available water content; PAWC) on plant growth, yield and water use efficiency (WUE; volume water used per gram of yield produced) of greenhouse grown cucumbers (*Cucumis sativus*). The experiment comprised of the scheduling of irrigation with capacitance sensors in a coir substrate. Six different capacitance sensors were programmed to start irrigation at 5 %, 20 %, 35 %, 50 %, 65 % and 80 % of PAWC respectively. The volume of water applied per irrigation was calculated as the difference between PAWC at 100 % (container capacity) and the PAWC of each treatment. These irrigation treatments were compared to the standard irrigation method (control) used in SA greenhouses, which consists of a fixed irrigation frequency (7 irrigations per day) while the volume was increased throughout the growing period to maintain a drainage percentage of 20 %. Vegetative growth (leaf area and dry mass) was increased by higher irrigation frequencies (65 % & 80 % PAWC) irrespective of the plant's developmental stage. At 50 % and 80 % PAWC, plants yielded significantly more than the control. Although not significant, the 35 % and 65 % PAWC treatments also yielded more than the control, while there were no significant differences in yield between plants at 35 %, 50 %, 65 % and 80 % PAWC. The number of marketable fruit was significantly higher at 50 % PAWC compared to all other treatments, while irrigation treatments of 35 %, 65 % and 80 % PAWC produced significantly more marketable fruit than the control. Control plants used between 143 % and 397 % more water ($L\ plant^{-1}\ season^{-1}$) than all other irrigation treatments. WUE correlated with marketable yield with the highest WUE achieved at 50 % PAWC, while irrigation treatments of 20 %, 35 %, 65 % and 80 % PAWC had a higher WUE than the control. These results indicated that the irrigation treatment for maximum vegetative growth was at 65 % and 80 % PAWC, while maximum reproductive growth and WUE and minimum water use per plant per season (on average 49 % of the control) were achieved for irrigation treatments between 35 % and 80 % of PAWC. Therefore, irrigation in coir can be much more efficient by using capacitance sensors to schedule irrigation instead of the conventional method where indirect measures of the plant-water-status are not taken into account.

Keywords: Coir substrate, marketable yield, plant available water content, water use efficiency

INVESTIGATION OF SOIL PREPARATION, MULCHING AND PLANTING PRACTICES FOR THE PRODUCTION OF VEGETABLES AND FRUIT BY URBAN PRODUCERS

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Organic production is thought to be a sustainable way of producing healthy, nutritious vegetable and fruit crops whilst simultaneously improving the soil, a process that is supposed to occur when natural biological systems are allowed to proceed without interference, or where such interference is limited to the supply of natural materials, such as organic compost. If it can be shown that an adequate supply of nutritious fruit and vegetables can indeed be produced by such methods, at scales consistent with those of urban home gardens, then the food security and health of urban dwellers may potentially be improved by the dissemination of information concerning the successful techniques, and their subsequent implementation. This work describes the initial stages in a trial aimed at identifying soil preparation and cropping methods likely to prove successful in urban settings. The objective is to study and refine the principles and practice of organic production, to determine the potential for sustained crop production from these systems and to study differences or shifts in the microbiology of the internal soil environments associated with these production systems.

A matrix of 40 trenches, each 1.5 m x 13 m, arrayed in 4 blocks of 10, was mechanically excavated during autumn 2007. The c. 600 mm deep trenches were manually refilled to create the following soil preparation treatments: field soil only, field soil plus organic compost (ratio 33%:66% v/v), soil plus wood chips (33%:66% v/v), soil plus organic compost (33%:66% v/v) with commercial microbiological inoculum (Biocult®) added during planting, and soil only, with post-plant nitrogen and potassium. All of the soil treatments received agricultural lime, gypsum and super phosphate during bed preparation at rates determined by soil analysis. Each of the beds thus prepared was fitted with micro-drip irrigation and divided into four 1.5 m x 2.0 m sub-plots with guard spaces between. The plots in each bed were planted in accordance with 4 planting schemes: permanent legumes, permanent non-legumes, rotation between legumes and non-legumes and a mixed plot containing an assortment of legumes, non-legumes and perennials. Each guard space contains a young fruit tree (Summer Sun peach/Kakamas seedling) and grape vine (Sauvignon blanc/ ichter 99). Each bed (soil x planting treatment) is represented in mulched (wood chips) and unmulched form, in randomised distribution, in each of the 4 blocks.

At the time of writing, the first crops, which were planted in September 2007, have not yet reached maturity. Treatment-related differences in crop vigour are nevertheless becoming visually apparent, performance decreasing in the soil treatments in the sequence: soil plus fertilizer > soil plus compost > soil plus wood chips. A statistical analysis of the first crop will be presented in January 2008.

Keywords: organic production, urban producers

GEOLOGY AND LANDSCAPES OF THE WINE PRODUCING AREAS OF THE WESTERN CAPE

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The geology of the Western Cape testifies the former existence of a late Precambrian supercontinent, its fragmentation, the closure of an ocean between the South African and South American continental precursors (Kalahari and Rio de la Plata cratons), the accumulation of marine sediments and limestones, and their compression during a collision between these cratons. This event took place during assembly of the southern supercontinent of Gondwana, over 500 million years ago. In Cambrian times the landscape of the western and southern parts of the Cape were eroded to form an alluvial plain with granite hills. From the Ordovician to the Carboniferous, this plain intermittently subsided. The resultant Agulhas Sea, which at times extended from Vanrhynsdorp in the north to beyond Port Elizabeth in the east, and which was bordered by mountains to the west and north, received considerable volumes of sediment. These sediments were lifted and folded during the Permo-Triassic Cape Orogeny to form the mountains of the Cape Fold Belt, which are capped with erosion-resistant sandstones, whilst softer shales are locally preserved in downfolds. After Gondwana rifted, a remnant of the Rio de la Plata craton remained attached to South Africa where it underlies the vineyards of the Coastal Region. Erosion was rapid under the warm, wet conditions which prevailed through much of the Cretaceous. By the end of the Cretaceous the main topographic features of the Coastal Region had already been roughed-out. Sculpting of the landscape into its modern form took place during the Tertiary and Quaternary, a time of sub-aerial erosion, pronounced changes in sea level and climatic variation, tending towards increasing aridity. The form of the modern landscape reflects the abilities of the rock structures and materials to resist protracted weathering and erosion. The rugged nature of the landscape offers a range of potential sites for new vineyards. Since these differ in altitude, aspect, soils and mesoclimate, the potential for the development of new wine styles, and the establishment of new terroirs, are considerable. These sites are likely to rise to viticultural prominence as global warming progresses.

Keywords: geology, landscape evolution, terroir, vineyard, Western Cape