

## **P1. OPERATIONAL QUALITY CONTROL OF THE ARC-ISCW CLIMATE INFORMATION SYSTEM**

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Reliable surface measurements of meteorological variables form the backbone of weather-related research. For this reason the emphasis within the ARC-ISCW Climate Information System is to develop a reliable climate database and to ensure that the data quality is of an acceptable standard. This poster focuses on existing, as well as new quality control tests to maintain these high standards.

Climate data is obtained from various climate monitoring organisations across South Africa. These include the ARC-ISCW climate monitoring network, the South African Weather Service, the Department of Water Affairs and Forestry, commodity research stations, universities and private landowners. The quality assurance procedures differ at the different organisations and there is little liaison between them when poor data is detected. It is thus important to test data from all these sources to ensure data integrity. At present these checks focus on near real-time data from the ARC-ISCW climate monitoring network, and processes are being developed to ensure that the same checks are done on all historical data irrespective of the source. These tests include: Missing Data Check, High-Low Range Limits Check, Rate of Change Check, Minimum Variability Check, Spike Test, Consistency Check, Comparison Check, Sensor Drift and Extreme Values Check, and Manual Quality Checks using graphs and maps.

Currently the ARC-ISCW climate monitoring network consists of 375 automatic weather stations, the data from which is checked daily. Data from other sources is checked when it is received. Historical data from approximately 16 000 stations dating back to 1900 should also be checked.

*Keywords:* Climate Information System, Automatic Weather Station

## **P2. THE USE OF WATER BALANCE MODELLING IN STUDYING RAINFED MAIZE PRODUCTION IN THE HIGHVELD OF ZIMBABWE**

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One key limitation in the production of rain-fed maize in semi-arid regions is lack of a comprehensive and objective guideline for the optimum sowing date of the crop. In an effort to understand soil-crop-water relations the BUDGET model, with an integrated  $K_y$  yield simulator, was used to study the effect of crop water stress on maize yield decline in a sowing date x variety trial. Six maize varieties (short season: SC411, SC513 and SC525; medium season: SC635 and SC637; long season SC719) were sown on three sowing dates (12 November, 3 December and 24 December 2005) at the University of Zimbabwe Research Farm. A split-plot design with sowing date as the main plot factor and variety as the sub-plot factor was used. The experiment was planted in three blocks and the crop was under standard management. Above ground biomass, grain yield and harvest index were determined for each plot. Weather parameters were recorded on an on-site automatic weather station. The results showed that onset of the rainfall season (precipitation exceeding  $0.5ET_0$ ) was the first dekad of November and it ended in the last dekad of March. The 2<sup>nd</sup> dekads of November, February and March were dry (precipitation less than  $0.5ET_0$ ). Different varieties responded differently to the dry dekads. Based on total above ground biomass and crop transpiration, water productivity ranged from  $2.06 \text{ g m}^{-2} \text{ mm}^{-1}$  for SC513 (3<sup>rd</sup> sowing) to  $5.39 \text{ g m}^{-2} \text{ mm}^{-1}$  for SC719 (2<sup>nd</sup> sowing). Grain yields ranged from 2.76 to  $10.23 \text{ Mg ha}^{-1}$ . The early maturing varieties had highest yields for the 2<sup>nd</sup> sowing and lowest for the 3<sup>rd</sup> sowing. The medium and late varieties had highest yields for the 1<sup>st</sup> sowing and showed a steady decrease in yield with delayed sowing. This confirms the recommendation that long season varieties should be sown early. Short season varieties have a wider sowing period. In staggering sowing dates care should be taken in choosing appropriate varieties. After model calibration there was reasonable agreement between simulated and observed root zone water content and grain yield. However, this was preliminary and more data will be needed to rigorously validate the BUDGET model.

*Keywords:* BUDGET model, maize sowing date, crop water stress, water productivity

### **P3. DEVELOPMENT OF STEM-AND LEAF RUST RESISTANT SPRING TRITICALE**

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In triticale (*Triticosecale* spp.) the most widespread diseases are now those caused by wind-borne obligate pathogens, such as rusts (*Puccinia* spp.). During the 2005 season, new pathotypes of leaf rust (race *UVPt19*) and stem rust (race *UVPgt57*) appeared on triticale in the Western and Southern Cape regions of . A population of first backcross (BC<sub>1</sub>) and doubled haploid (DH) lines containing a source of rust resistance into an existing cultivar Tobie and an advanced breeder's line 98T376-A-A-3 were established. The wide hybridization method of DH creation was evaluated on local triticale material in comparison with near-isogenic lines (NILs) creation. Obtained rust-resistant lines could be used in subsequent selection and testing as new advanced lines. They also can be used as possible sources of resistance in a pre-breeding programme. Segregation analysis of F<sub>1</sub> showed that resistance to leaf rust race *UVPt19* in the donor line 95T159-A-A-3-PL1 is controlled by a dominant gene(s), and resistance to stem rust race *UVPgt57* controlled by a recessive gene(s).

*Keywords:* Puccinia, triticale, doubled haploid, NILs

## **P4. THE STELLENBOSCH UNIVERSITY TRITICALE BREEDING PROGRAMME – A STATUS REPORT**

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The Department of Genetics has been conducting a triticale breeding programme since the early 1970s. The programme aims to improve the yield, grain quality, protein content and disease resistance of triticale grown either as a feed grain or for grazing, hay and/or silage. Many cultivars have been released during this period; the more recent releases represent a wide range of maturity types that are used extensively in the Western Cape for feed and fodder production and as a cover crop in vineyards. Grain quality analysis showed that triticale could be a profitable substitute for a larger part of local feed formulations than is presently the case. Mean yield data suggest that a steady gain in average grain yield was realised in the past 13 years while the potential exist for continued yield advance through breeding and selection. Presently the best grain yield is obtained with Tobie, a locally bred cultivar. While the threat of rust infection has increased in recent years, ample genetic resistance could be identified for continued breeding.

*Keywords:* triticale, stem rust, leaf rust, feed grain

## **P5. CROP-CLIMATE MATCHING FOR THE MODDER/RIET CATCHMENT**

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Crop matching to environment is a crucial preliminary step in obtaining good quality crop production. Crops can be matched to environment through comparing mean daily temperatures for each month, since minimum/maximum temperature has a significant influence on the performance of crops. In addition to temperature, environmental factors that need to be considered are rainfall, frost, heat waves and hail etc., since they all influence crop performance. Six automatic weather stations in Modder/Riet catchment were selected to analyse short and long-term climatic data. Short-term data (<10 years) may fail to produce the high and low extremes and may fail to produce a representation of the real seasonality of rainfall pattern for a particular location. Climate and soil water availability are the major elements that determine the suitability of the crop at a particular location. Suitability is a relative measure of a location's ability to meet a crop's abiotic environmental requirements. Ehlers Zones and ECOCROP are crop-matching methods that were used to best identify the most suitable crops for Letsemeng Municipality. These crop-matching methods can be used for short and long-term planning to select cultivars, planting dates, etc. Climate factors can determine management of limiting factors for crop selection at a specified area.

*Keywords:* crops, climate, suitability

## **P6. INCORPORATING A STANDALONE CROP MODEL INTO THE DSSAT CSM FRAMEWORK: AN EXAMPLE USING THE CANEGRO SUGARCANE MODEL**

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The Decision Support System for Agrotechnology Transfer (DSSAT) is a crop modeling package that allows the user to run individual and sequences of simulations, with several crops. It is derived from the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) set of models, which was intended to assist agricultural management in resource-limited developing countries. Originally, DSSAT was a collection of crop models with a common user interface. Many of these models have been developed over a long period of time, and have been subject to testing, improvement, and application, internationally. The most recent release version of DSSAT features the CSM – Cropping System Model. This system is built of independent modules; a number of these modules are generic, common to several crops. Specific crops are represented by ‘Plant’ modules, which model only the plant growth and development; these Plant modules interface with common modules performing various tasks such as simulation control, management control, irrigation, soil water balance, evapotranspiration and soil nutrient processes. DSSAT (v.4) is provided with a number of supplementary tools for analysis and processing of inputs (e.g. weather data, setting up model runs) and outputs (e.g. crop yields, plant development, cost-benefit analysis). The CANEGRO sugarcane model has been under development by the South African Sugarcane Research Institute (SASRI) since the late 1980s, and is internationally considered to be among the best sugarcane models. It is, however, very difficult to use, and even more difficult to maintain and develop further, as a natural outcome of a research system that has been under development by a large number of individuals over many years. Although an older version of CANEGRO was modified and made available in an older version of DSSAT (v.3), and is still available as a non-CSM ‘legacy’ model, the SASRI CANEGRO model has been extensively developed since. These changes are not available in the legacy DSSAT sugarcane model. The International Consortium for Sugarcane Modeling (ICSM) was set up to facilitate international cooperation and work towards better sugarcane modeling. As a first project, the ICSM has funded the incorporation of SASRI CANEGRO into the DSSAT CSM. A prototype DSSAT CSM CANEGRO Plant Module has been developed. Upon completion, it will allow a large international community of researchers to use the CANEGRO model (via the DSSAT CSM) in a standardised and relatively easy manner, using the graphical DSSAT user interface. The DSSAT CSM provides an extremely mature, developed framework for model development of this nature. The experience of developing the DSSAT CSM CANEGRO Plant Module has revealed a number of strengths of the DSSAT CSM as a model development and deployment platform. It has, however, also revealed some limitations.

*Keywords:* CANEGRO, DSSAT

## **P7. EVALUATING REGULATED DEFICIT IRRIGATION (RDI) PRACTICES FOR CITRUS PRODUCTION IN SOUTH AFRICA**

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The trial consisted of eight Regulated Deficit Irrigation (RDI) scheduling treatments, replicated four times. The data were collected over three seasons and were investigated on an Oxisol (Rhodic Ferrasol) with an effective rooting depth of 900 mm. Experimental site is located in Nelspruit, Mpumalanga, in the summer rainfall area of South Africa. An annual rainfall of 750 mm, in the form of thunderstorms, occurs. The average daily maximum temperature is 30°C in January (mid summer) and 23°C in July (mid winter). The average minimum daily temperature varies between 18°C in January and 8°C in July. The area is frost-free.

The Citrus cultivar, *cv. Olinda*, on *cv. Cairn* ruff lemon rootstock with a tree spacing of 7 x 7m was used in the trial. The twenty-six year old trees have an average yield of 200 kg/tree. Irrigation water classified as a class C1S1 (USDA) was used to irrigate the trees with two micro jets (each covering 270°) placed 30 cm from the stem on both sides in the row. The growing season was divided into three growth phases, during which different regulated deficit irrigation treatments were applied. No irrigation was applied and represents the maximum stress possible.

During the stress treatments the citrus trees had depleted all the stored soil water. The soil was filled to field capacity following a stress period and during the non-stress period of the growing season. Treatment 1 was the control treatment in which the water content was kept at an optimum level for this soil.

*Keywords:* Regulated Deficit Irrigation (RDI), water use, stress, citrus

## **P8. THE EFFECTS OF STRATEGIC NITROGEN FERTILISER APPLICATION DURING THE COOL SEASON ON SOIL N DYNAMICS IN A PERENNIAL RYEGRASS-WHITE CLOVER PASTURE AT THE OUTENIQUA EXPERIMENTAL FARM, SOUTHERN CAPE**

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Applications of fertiliser N to boost grass production when the activity of the clover component in a perennial ryegrass-white clover pasture is restricted by low temperatures, is confined to applications in autumn, winter and spring, seasons characterized by high rainfall. Of major environmental concern is the flow of N from the pasture into water reserves. The strategic application of fertiliser nitrogen, if managed wrongly, can therefore be regarded as an important environmental pollution hazard. The objectives of this study were to monitor the mineral N content of the soil after fertiliser N application to develop strategic N fertilisation norms that will ensure 1) maximum N response efficiencies and 2) minimum contamination of natural resources as a result of leaching.

The dynamics of soil inorganic-N as a result of a single, strategic application of fertiliser N was studied during the period 2003 to 2005 in an typical duplex soil with a clay content increasing from 2.4% in the top 0-100mm soil layer to 5.0% in the 400-500 mm layer. Soil inorganic-N was monitored to a soil depth of 500 mm (0-100, 100-200, 200-300 and 400-500 mm layers) over a seven week period (7, 21, 35 and 49 days) following the application of 0, 50 and 150 kg N ha<sup>-1</sup> in the form of LAN (28), applied as a once off application to the pasture during five different seasons (autumn, early winter, late winter, early spring or late spring).

A root study showed that the pasture was extremely shallow-rooted with 76, 11, 6, 4 and 3 % of the total root dry matter located in the 0-100, 100-200, 200-300, 300-400 and 400-500 mm layers of the soil profile, respectively. This shallow root system potentially reduces the duration that the applied N remains within the root zone. The application of 50 kg N ha<sup>-1</sup> did not result in significant differences in soil inorganic-N content compared to the 0 kg N ha<sup>-1</sup> treatments during almost the entire study and can therefore be regarded as a low risk treatment with regard to environmental pollution. The effect of 150 kg N ha<sup>-1</sup> on soil inorganic-N content lasted for at least 5 weeks in the soil layers sampled. Leaching of fertiliser N within one week after application of 150 kg N ha<sup>-1</sup> in 2003 and 2004 to the 400-500 mm soil layer emphasized the possible negative effect of high N application rates on possible contamination of natural resources. The optimal N rate would clearly be the rate that results in sufficient N to last for only one regrowth cycle. This will require relative low rates of fertiliser N when pasture productivity is low and/or under high rainfall conditions and may be increased as pasture productivity increases in spring and water supply is managed by thorough irrigation scheduling.

*Keywords:* Inorganic nitrogen, perennial ryegrass, strategic nitrogen, white clover



**P9. THE EFFECTS OF STRATEGIC NITROGEN FERTILISER APPLICATION DURING THE COOL SEASON ON SPECIE COMPOSITION OF A PERENNIAL RYEGRASS-WHITE CLOVER PASTURE AT THE OUTENIQUA EXPERIMENTAL FARM, SOUTHERN CAPE**

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The application of fertiliser N to stimulate DM production of perennial ryegrass-white clover pastures during the cool seasons can be an important management tool. Application of fertiliser N should however maintain clover contents between 30 and 50 percent. The aim of the study was to develop a better understanding of the effect of a single strategic N fertiliser application during the cool season on the grass-clover balance and to identify possible management guidelines that would maximise dry matter production without suppressing clover content to values lower than required to maintain the benefit of clover in the pasture.

A perennial ryegrass-white clover pasture was established under irrigation in autumn 2002 and treatments commenced in autumn 2003. The trial was laid out as a 5 x 3 factorial arranged in a split-plot design plus one control plot (0 kg N ha<sup>-1</sup>) per replicate. Treatment combinations were replicated four times as blocks. The main plot factor was five seasons in which N was applied in either autumn (late April), early winter (early June), late winter (mid July), early spring (late August) or late spring (early October) and a sub-plot factor of three N levels (50, 100, or 150 kg N ha<sup>-1</sup>) surfaced applied as LAN (28). N-treatment plots (control excluded) received a single annual application of fertiliser nitrogen after cutting, the timing of application depending on season. To facilitate soil N studies the pasture was grazed at four weekly intervals in summer and mowed five weekly from late autumn to late spring. Clover content was determined 5 and 10 weeks after fertiliser N application.

Increased fertiliser N rates of up to 100 kg N ha<sup>-1</sup> normally resulted in increasingly lower clover percentages five weeks after fertiliser N application. No differences in clover percentage were recorded between the 100 and 150 kg N ha<sup>-1</sup> application rates five weeks after fertiliser N application. Although the effect of season of application was inconsistent, a tendency of lower than 30% clover contents was observed when 100 or 150 kg N ha<sup>-1</sup> was applied between autumn and late winter during all years covered by the study. This study showed that, except for early winter 2003, the application of 50 kg N ha<sup>-1</sup> did not reduce the clover content to less than 30% during any season if the pasture contained a clover content of ca 50% when fertiliser N was applied. The application of 100 and 150 kg N ha<sup>-1</sup> in the current study resulted in numerous treatment combinations to have clover percentages of less than 30% and are therefore regarded as risky especially when applied between autumn and late winter. Initial clover content (%) of the pasture and the season when N application is planned will therefore dictate the fertiliser N rate to be applied.

*Keywords:* Clover content, perennial ryegrass-white clover, strategic nitrogen

**P10. THE EFFECTS OF STRATEGIC NITROGEN FERTILISER APPLICATION DURING THE COOL SEASON ON SELECTED QUALITY PARAMETERS OF A PERENNIAL RYEGRASS-WHITE CLOVER PASTURE AT THE OUTENIQUA EXPERIMENTAL FARM, SOUTHERN CAPE.**

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The use of fertiliser N to increase pasture productivity when environmental conditions restrict nitrogen absorption and availability to perennial ryegrass-white clover pastures is regarded as an important management tool to boost dry matter production. The application of fertiliser N may however influence the quality of the pasture as environmental conditions, including soil N supply and the season of pasture utilization, effects fodder quality. The objective of this study was to determine the effect of fertiliser N application during the cool season on dry matter content (DM) and percentage crude protein of the ryegrass and clover components. This information will be instrumental in developing a strategic N management programme aiming at maximum dry matter production to bridge the winter gap.

The influence of a single application of fertiliser N (0, 50, 100 and 150 kg N ha<sup>-1</sup>) applied in either autumn, early winter, late winter, early spring or late spring on selected nutritive parameters of a perennial ryegrass-white clover pasture was investigated over a three year period. Responses were measured over one regrowth cycle (five weeks) after fertiliser N application. A sample of the plant material harvested was separated into grass and clover fractions, dried and ground. Dry matter content (DM) and crude protein (CP) content were determined. Increased fertiliser N rate resulted in lower DM contents. The effect of season of application on DM was inconsistent during 2003 and 2004, with no differences recorded in 2005. Winter applications of fertiliser N, in combination with the higher N rates, resulted in higher ryegrass CP contents. Clover CP content tends to be lower during the warmer seasons (autumn and spring) with fertiliser N rate not affecting clover CP content during 2004.

It is expected that fertiliser N application and the seasons when applied, for the combinations tested in this study, will not negatively affect the production potential of the grazing animals.

*Keywords:* crude protein, dry matter content, perennial ryegrass-white clover, strategic N fertilisation

## **P11. BIOLOGICAL NITROGEN FIXATION OF LABLAB IN ROW MAIZE AND LABLAB INTERCROPPING**

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In the Limpopo Province of South Africa, maize problems constraints are mainly drought, low fertility, pest and continuous maize production (monoculture) in smallholder farming. Field experiments were carried out at two locations in the Province, namely; the University of the Limpopo experimental farm at Syferkuil and a smallholder farmer's field at Dalmada near Polokwane during 2001/02 and 2002/03 growing seasons. The treatments examined were five different density of lablab, namely: (0 (sole maize); 2; 4; 6; 8 plants per meter length) in the 2001/02 and an additional 10 plants per meter length in 2002/03. These treatments were either planted simultaneously with maize or 28 days later. The objectives of the study were to determine biological nitrogen fixation by lablab in maize-lablab intercropping and nitrogen yield accumulation. Even though nodulation was not consistence in growing seasons at all locations, nitrogen yield at 68 DAP produced similar N for sole maize and maize intercropped at 2 and 4 plants per meter length at Dalmada and Syferkuil in 2002/03.

*Keywords:* Maize, Lablab, Intercropping

## **P12. BOLL FORMATION OF UPLAND COTTON GROWN UNDER RAINFED AND IRRIGATED CONDITIONS**

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Improved drought tolerance of upland cotton varieties through breeding would be a major contribution to increasing or stabilizing cotton production. The objective of this experiment was to evaluate boll formation of Upland cotton varieties under rainfed and irrigated conditions, where the rainfed conditions simulate drought conditions often experienced by farmers. Rainfed and irrigated treatments of 12 cotton varieties were compared in terms of boll formation. The varieties which were used, were Marico, Nebo 108, Tugela, Alpha C, RB50 x DC 2417, Tetra, Sicala, DPAC90 x (DC X S 542), Molopo, 1208 x SJ5, OR 19, OR 3. The experimental layout consisted of a split plot with irrigation types assigned as main plot and varieties as subplot. Varieties were randomized to small plots. Plots were 0.9m apart and varieties within each treatment under normal irrigated conditions were separated by 15cm and under rainfed conditions were separated by 30cm. A plot consisted of a single row, which was 9 m long. Sowing took place on the 3rd of November 2005 at the ARC-Institute for Industrial Crops experimental farm and was done manually. Boll formation was significantly influenced by irrigation type at two sampling dates. The total number of bolls formed for rainfed conditions and irrigated conditions were statistically different, with a higher number of bolls formed under irrigation.

**Keywords:** Rainfed conditions, irrigated conditions, upland cotton varieties

### **P13. EFFECT OF NUTRIENT STRESS ON REPRODUCTIVE DEVELOPMENT AND YIELD OF MAIZE IN A LONG-TERM TRIAL**

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The research objectives were to examine the effect of nutrient stress on the growth rate, reproductive development, yield components and yield of maize in a long-term trial. The study was conducted on the long-term fertilization trial on the Experimental Farm of the University of Pretoria. Treatments selected for this investigation were O, PK, NK, NP, NPK, and WNPKM. Growth analyses commenced from three weeks after emergence to silking. Embryonic tassel and ear development was recorded and developmental stages monitored. Rate of tasseling and silking was monitored. At maturity yield components were determined. The WNPKM treatment had a high growth rate, high biomass, high rate of meristem development, early inflorescences emergence, and high yield. The P and K deficient treatments resulted in low growth rates, small biomass, low rate of meristem development, late inflorescences emergence and low yield. The PK and NPK treatments were intermediate.

*Keywords:* nutrient stress

## **P14. IMPROVING EUREKA! SEEDLESS LEMON™ FRUIT SET**

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The Eureka! Seedless Lemon™ (ESL) is the first fully seedless lemon bred by the ARC-ITSC in Nelspruit, South Africa. The first ESL trees were planted under contract in 2000 and production started in 2003. Since then certain shortcomings, e.g. insufficient fruit set and excessive premature fruit drop in the hot production areas, have been identified. Therefore, studies have been undertaken to investigate these shortcomings in order to be able to supply the growing demand for seedless lemons.

The main focus of this research was to improve the low fruit set of ESL. Therefore, trials were conducted on two farms in the warm and hot areas of Mpumalanga Province, South Africa, for two consecutive seasons.

Cincturing was conducted at different times during the flowering period in order to identify the most effective application time. ProGibb®, a synthetic gibberellin, was applied at different concentrations (10, 20, 40 and 80 ppm) and application times (60 and/or 100% petal drop) alone, as a double application (at 60 and 100% petal drop) or in combination with cincturing.

Cincturing on its own two weeks before full bloom proved to be most effective in increasing fruit set. ProGibb® on its own gave inconsistent results and increased fruit set and yield only at one location. As a double application, ProGibb® increased yield in both locations by up to 21%. ProGibb® (at 10 and 40 ppm) in combination with cincturing (2 weeks before full bloom) increased yield by up to 50%.

The most promising treatments are currently being tested for a third season to confirm these results.

Studies on ESL flowers and fruitlets were conducted to determine the level of parthenocarpy and pollen viability. ESL anthers contain hardly any pollen and pollen viability is low. Cross-pollinations did not cause seediness in ESL.

*Keywords:* Seedless lemon, fruit set, cincturing, ProGibb®, parthenocarpy

## ***P15. PROPAGATION OF BLACK PEPPER (PIPER NIGRUM)***

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Black pepper is the most widely used spice in the world and is also known as the “King of Spices” and “Black Gold”. Africa is contributing only 2.4 % to the world production. Although pepper can be grown successfully in certain areas of South Africa due to the favourable climate, availability of land and labour, South Africa imported pepper in excess of R32 million in 2001. Cuttings obtained from runner shoots, hanging shoots, lateral shoots and climbing shoots of the pepper plants were evaluated. Different growth mediums, including river sand, filter sand, Hygromix and decomposed bark were used. Single-node-cuttings and double-node-cuttings planted both horizontal and vertical were compared. A rapid multiplication method using strong growing plants in the nursery was also evaluated. Rooted cuttings were obtained within 2 weeks, using the rapid multiplication method. Hanging shoots proved to be the best part of the pepper stem for pepper cuttings. Cuttings from climbing shoots produced bushy type of pepper. Double-node-cuttings developed into stronger plants than the single-node-cuttings. All the growth mediums, except the Hygromix, can be used for propagation. The use of a heated mist bed is an advantage in commercial nurseries, but successful vegetative propagation can also be achieved in rural areas by using any available growth medium.

*Keywords:* Black pepper, propagation, cuttings, growth medium

**P16. THIRTY PERCENT (30 %) RESIDUE IN COMMUNAL CONSERVATION  
TILLED LANDS IN KWAZULU-NATAL – A FARMER-RESEARCH-EXTENSION  
CHALLENGE**

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Communal farming areas of KwaZulu-Natal produce less crop maize under conventional (plough) methods (< 1 ton/ha). Conservation tillage locally termed "Planting without ploughing" (PWP) was introduced in communal areas of KwaZulu-Natal in 1999. The project took well with improvement in planting time, fertilizing and other acceptable field husbandry. The yields improved remarkably within four years (up to 12 tons/ ha).

The most challenging part is maintaining the 30% residue after planting for the system to be termed conservation tillage. The residue after planting is very low in most instances less than 5%. This is due to uncontrolled winter grazing by cattle and sheep in communal lands.

The introduction of cultivated pastures and veld management in Nquthu together with Dundee Research Station (Animal Science) in the Nquthu area of KwaZulu-Natal might mitigate / solve the problem.

*Keywords:* communal conservation tillage, Planting without Ploughing



## **P17. THE POTENTIAL OF OATS AND TRITICALE AS SILAGE CROPS IN THE SOUTHERN CAPE: PRELIMINARY RESULTS**

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Fluctuations in dry matter production rates (kg DM/ha/day) of perennial pastures in the Southern Cape motivate producers to investigate means to preserve fodder for use as roughage during times of scarcity. Growing annual crops suitable for hay and/or silage production can become an important management tool to ensure sufficient supplies of roughage throughout the year. The objectives of this study were therefore: 1) to evaluate the potential of oats and/or Triticale as silage crops and 2) to identify specific cultivars with superior silage qualities for the Southern Cape. Five oats and four Triticale cultivars were planted at the Outeniqua Experimental Farm (George) and Tygerhoek Experimental Farm (Riviersonderend) during the 2004 and 2005 seasons. The higher rainfall recorded at Outeniqua compared to Tygerhoek during both years resulted in more favourable conditions for dry matter production at Outeniqua. Chemical pest and disease control were done on both crops at both sites as soon as the crops reached the flag leaf stages (growth stage 15-16).

Dry matter yield (ton/ha) and moisture content (%) were determined at the flag leaf (GS 15-16), milky (GS 21-22) and soft dough (GS 23-24) growth stages. The mean dry matter yields at Outeniqua, when cut at the milky stage (Gs 21-22) were 10.6 and 8.5 ton/ha for 2004 and 2005 respectively. At Tygerhoek only 6.2 and 6.4 ton/ha were recorded during the same growth stages and years. Triticale produced the highest mean dry matter yields at both sites for both years covered by the study. Environmental conditions may strongly influence cultivar performance. The oats cultivar SSH 421 produced the third highest mean yield (10.3 ton/ha) at Outeniqua, but the lowest mean yield (5.5 ton/ha) at Tygerhoek. Two Triticale cultivars, Ibus and Rex, were the highest producers (10.9 ton/ha) at Outeniqua. Usgen 19 (7.0 ton/ha) and Ibis (6.8 ton/ha) were the highest producers at Tygerhoek with Sederberg (6.6 ton/ha) as the best oats.

The moisture content of the plant material was strongly influenced by the growth stage when ensilaged (or cut). The mean moisture content of Triticale during the flag leaf stage was higher than 80% and decreased to just below the critical level of 65% during the milky stage. The moisture content of oats during the milky stage remained high (above 70%) and therefore extends the duration of the optimum time to cut and make better quality silage. The oats cultivar SS H421 can be regarded as an ideal silage cultivar as it maintains constant moisture levels between the flag and milky growth stages, a quality that makes it possible to ensilage this cultivar at a later stage than most of the Triticale cultivars. The study has shown that both oats and Triticale can be used as silage crops in the Southern Cape.

**Keywords:** Silage, Oats, Triticale, Southern Cape

**P18. THE EFFECT OF TEMPERATURE AND CORM SIZES ON SPROUTING OF  
AMADUMBE (*COLOCASIA ESCULENTA*)**

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Amadumbe (*Colocasia esculenta*) is a tuber crop that is used by some communities in as a staple food source. In most of the South African provinces, Amadumbe is a relatively unknown vegetable crop. However, it has been cultivated by villagers of Kwazulu-Natal for so long that it is now regarded as an indigenous crop. The ARC-VOPI at Roodeplaat near Pretoria has initiated a research program with the aim of determining the optimum temperature for sprouting and the production of uniform plants. A split plot design with five replicates was used. Three different sizes of Amadumbe corms (small, medium and large) were placed in small crates. The crates were then positioned randomly in three growth chambers with three different night and day temperatures (15/20<sup>0</sup> C, 20/25<sup>0</sup> C and 25/30<sup>0</sup> C). Corm weight, as well as number and length of sprouts initiated, were recorded on a weekly basis. No sprouting was observed at the lowest temperature (15/20<sup>0</sup> C). Sprouting increased as the temperature increased, with the best results being obtained at the highest temperature regime (25/30<sup>0</sup> C). The size of corms also had a positive effect on the sprout length since an increase in size resulted in an increase in sprout length. The results indicated that a temperature of 25/ 30<sup>0</sup> C can be utilized to induce optimum sprouting of corms prior to planting.

*Keywords:* Amadumbe, sprouting, corm size, temperature

## **P19. SCREENING OF VARIOUS HERBICIDES FOR WEED CONTROL IN SWEET POTATO (*IPOMOEA BATATAS*)**

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A field trial was conducted in 2006 at ARC-VOPI to evaluate various pre-plant, pre-emergence and post-emergence herbicides for weed control in sweet potato. Herbicide treatments were EPTC, linuron, alachlor, clomazone, pendimethalin, glyphosate, fluazifop and paraquat. Crop injury and weed control effectiveness were assessed throughout the growing season. Storage root yield (weight, size and number) was assessed at harvest. Storage roots were analyzed for herbicide residues. No injuries were observed on crops treated with all herbicides except for glyphosate and paraquat. Both paraquat and glyphosate caused 100% crop injury at one and two weeks after application, respectively. However, paraquat-treated plants recovered from the injury. All herbicide treatments, with the exception of fluazifop, controlled at least 50% of the weed population as compared to untreated control. Sweet potato marketable yield increased significantly with all herbicide treatments. However, glyphosate treatment resulted in no yield since vegetative growth was destroyed. No herbicide residues were detected on the sweet potato storage roots. This study showed that the registered herbicides (linuron and EPTC) were effective in controlling weeds while other unregistered herbicides (alachlor, clomazone and pendimethalin) also provided reasonable weed control with no injury to the plants. Research is ongoing in order to identify the most promising herbicide and/or combination of herbicides for weed control in sweet potato.

*Keywords:* Sweet potato, weed management, herbicides

**P20. PERFORMANCE OF SUNFLOWER CULTIVARS UNDER DIFFERENT CLIMATIC CONDITIONS, IN THE EASTERN CAPE PROVINCE**

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Trials were conducted at two localities in the Eastern Cape Province (viz: Mqanduli and Tsolo) to evaluate the performance of nineteen different sunflower cultivars to establish which cultivars are the best performers in each area. Results showed that cultivar PAN 7033 was the best performer at Mqanduli compared to all other cultivars tested in that area whilst cultivar DK-4040 was the poorest performer. At Tsolo cultivar PAN 7043 was the best performer with cultivar Agsun 5383 on the opposite end as the poorest performer. Results obtained from this study therefore show that cultivars perform differently under different environmental conditions. Findings of this study suggest that farmers in Mqanduli can grow cultivar PAN 7033 whilst farmers at Tsolo may grow cultivar PAN 7043.

*Keywords:* Sunflower cultivars, Eastern Cape

## **P21. OPPORTUNITIES FOR ENHANCEMENT OF CROP-LIVESTOCK INTEGRATION IN THE NORTHERN GUINEA SAVANNAH OF NIGERIA**

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A project aimed at enhancing the net benefit crop-livestock production system was conducted at National Animal Production Research Institute (NAPRI) Zaria in the northern Guinea savannah between 2000 and 2003. A holistic approach to evaluate the potential interactions of herbaceous legumes in relation to weed dynamics, soil fertility and livestock management in a crop-livestock system in Nigeria was adopted. Herbaceous legumes, namely *Vigna unguiculata*, *Arachis hypogaea*, *Glycine max*, *Aeschynomene histrix*, *Centrosema pascuorum*, *Stylosanthes guianensis* and natural vegetation were used alongside with three management practices that includes: M1, 'residues left in the field'; M2, 'residues taken out of the field' and M3, 'residues fed to livestock, manure/urine/refused feeds returned'. Nigeria has a wide range of agro ecological zones (AEZ) among which the Northern Guinea savanna was prominent across the AEZ with contrasting climatic and soil properties variations. This zone has the potential for crop and livestock farming. Results indicate that length of fallow and legume rotation influenced forage biomass, grain yields of herbaceous legumes and maize growth. However, responses of forage legumes to residual N were significantly enhanced only after two years of consecutive fallow compared to the initial and final growing periods. The benefit of legume fallows to subsequent maize was mostly related to the residual N of the previous legumes and the management system. Forage legumes produced substantially more biomass than the grain legumes. However, grains components from grain legumes were able to compensate for this. Taking account of the legume biomass and grain production, maize grain and stover yields after the legume, and the performance of sheep fed with legume residues in terms of live weight gain and manure output over the three year period, *G. max* and *S. guianensis* gave the best overall performance, with *A. hypogaea* doing best on plots where fodder was fed to livestock and the manure returned to the plot. *S. guianensis* recorded the best outputs when the biomass was harvested and not returned to the field. The management systems of feeding livestock and returning manure to the field appeared to give best results, although there were variations between years and species. This appeared to be a very positive result with respect to opportunities to use herbaceous legumes to address issues relating to crop-livestock production in intensifying systems.

**Keywords:** herbaceous legumes evaluation, crop-livestock systems, forage management, forage legumes, grain legumes, residual effects

## **P22. COLD STRESS INDUCED HERBICIDE DAMAGE ON SORGHUM**

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The influence of pre-emergence herbicides on seed germination and seedling growth, both under optimum and sub-optimum temperatures was investigated. A greenhouse trial was conducted using 5 cultivars at two temperature regimes. Five herbicide mixtures were applied in soil with 19% clay content. Treatments included s-metolachlor/terbutylazine-mixture, s-metolachlor, acetochlor/atrazine/propazine-mixture, dimethenamid and alachlor. Herbicides were applied at registered dosages. Sorghum cultivars included PAN 8806, PAN 8564, PAN 8446, PAN 8706 and NS 5511. Seeds were treated with Concept. The trial was conducted under optimal temperature regimes (18°/28°C, night/day temperatures) and replicated under cold stress conditions with temperature regimes of 12° for 7 days in a clima-cabinet after which the pots were placed in the greenhouse for the duration of the trial. Throughout the observation period, the only visual symptoms of phytotoxicity that occurred were whiplashing, chlorosis and necrosis. There was a significant cultivar x herbicides interaction with regard to number of seedlings emerged and dry mass per plant. A significant interaction between cultivars and cold stress was only observed for phytotoxic symptoms. The herbicide x cold stress interaction was significant with regard to mean time to emergence and phytotoxic symptoms. Compared to other cultivars, PAN 8564 had the highest total seedling emergence (90.62%). The highest percentage phytotoxic symptoms were recorded for PAN8706 (24.26%), which is commercially unacceptable. When data were pooled over cultivars, the alachlor and dimethenamid showed a significant reduction in time to emerge when compared to the control and s-metolachlor/terbutylazine treatments. A significant reduction in dry mass per plant was, however, observed for the alachlor/atrazine/propazine-mixture, alahlor, dimethenamid and s-metolachlor. Cold stress had a significant effect on all phytotoxic variables measured. Sorghum plants under cold stress emerged significantly slower than sorghum grown under optimal conditions. The percentage total number of seedlings emerged and dry mass per plant were also significantly higher with sorghum grown under optimal conditions. A significant interaction between cold stress x optimal conditions x cultivars was observed for dry mass per plant. The herbicides x cold stress x optimal conditions interaction was also significant with regard to mean time to emergence and phytotoxic symptoms, where the most phytotoxicity was observed in plants receiving cold stress for all herbicides tested, even for the control treatment. No profound negative effect due to herbicide damage alone could be observed on all sorghum cultivars tested during this study. It is however, suggested that these symptoms are more induced by cold stress than by the effect of herbicides alone.

*Keywords:* herbicide, sorghum

## **P23. MINERAL NUTRIENTS AND STARCH CONTENT IN TARO CORMS GROWN IN GLASSHOUSE CONDITIONS**

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Corms of five taro landraces (*Dumbe-dumbe*, *Mginggeni*, *Pitshi*, *Pitshi-omhlophe* and *Dumbe-lomfula*) that were planted under different temperature regimes (22/12°C, 27/17°C and 33/23°C) were analysed for minerals and starch. There were significant differences in starch content between temperatures ( $P = 0.017$ ), taro landraces ( $P = 0.025$ ) and there was also a significant interaction of temperatures and landraces ( $P = 0.002$ ). Starch content increased with temperature for all landraces except for *Pitshi-omhlophe* and *Dumbe-lomfula* which showed a decrease from 22/12°C to 27/17°C. There were significant differences in mineral content between temperature, landrace and their interactions. It is concluded that the chemical composition of taro corms is influenced by growth temperature. The findings of this study may be useful in determining taro quality for processing.

*Keywords:* amadumbe corms, minerals, starch, temperature

## **P24. EVALUATION OF SOME BACTERIAL ISOLATES IN *STRIGA HERMONTHICA* GERMINATION**

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Two varieties of sorghum, CK60B and Mokwa Local, were grown in the presence of the flowering parasitic plant, *Striga hermonthica*. The ability of bacterial isolates to induce *S. hermonthica* seed germination, thereby depleting *Striga* seed bank in the soil with no detriment to the crop was studied. *S. hermonthica* seed germination was tested over time for the selected bacteria, using GR-24, a synthetic strigol analogue as a standard and water as a check. The sorghum seeds were treated with bacterial isolates by coating with a mixture of bacterial cells ( $5 \times 10^7$  cfu ml<sup>-1</sup>) from 24-hour old cultures that were suspended in 1% methylcellulose (mc). These were planted in pasteurized potted soil, which was infested with 0.05g (about 5000) viable *S. hermonthica* seed per pot 14 d before sowing. Results have indicated that bacterial isolates *Pseudomonas* sp. 10MKR4, *Klebsiella oxytoca* 10MKR7, *Pseudomonas* sp. 4MKS8 and *Enterobacter sakazakii* 8MR5 could stimulate *S. hermonthica* germination in the laboratory and in the screen-house. *In vitro*, only *Pseudomonas* sp. 4MKS8 gave significant stimulation of *S. hermonthica* seed at 5% level of probability as compared to the water check. In the screen-house, the four bacterial isolates stimulated significant germination of *S. hermonthica*.

**Keywords:** *Striga hermonthica*, *Pseudomonas* spp., *Klebsiella oxytoca*, *Enterobacter sakazakii*



## **P25. ENZYMES ENHANCE THE CONTROL OF ABUTILON THEOPHRASTI BY COLLETOTRICHUM COCCODES**

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Pectinase and cellulase are typically used by pathogens during infection. Thus, it was hypothesized that adding exogenous cell wall degrading enzymes might enhance fungal infection. Pectinase or cellulase was added to inocula of aqueous chopped mycelial suspensions of a *Colletotrichum coccodes* specific for control of *Abutilon theophrasti*. The shearing force of spraying did not affect pectinase activity. Plants treated with  $5.3 \times 10^6$  propagules  $\text{ml}^{-1}$  *C. coccodes* and  $1.65 \text{ U ml}^{-1}$  pectinase had more rapid and complete disease development. Similar trend was achieved when  $10 \text{ U ml}^{-1}$  of cellulase were added to  $2.2 \times 10^6$  propagules  $\text{ml}^{-1}$  *C. coccodes*. Adding pectinase or cellulase did not increase the host range of the wild type fungus. The results suggest that there might be value to transforming biocontrol agents to overproduce these enzymes.

*Keywords: Abutilon theophrasti, Colletotrichum coccodes, enzyme*

## **P26. EVALUATION OF YIELD AND PROTEIN CONTENT OF TWO COWPEA CULTIVARS GROWN UNDER DIFFERENT MANAGEMENT PRACTICES**

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Cowpea, (*Vigna unguiculata* L.) is a leguminous crop that can be used as food or fodder at all stages of its growth. Field research was conducted to assess the effect of intercropping early and late maturing cowpea varieties with sweet corn and to determine the impact of leaf removal on cowpea biomass, protein content and grain yield under sole and binary cultures. The two cultivars of cowpea (PAN 311 and red caloona) were used as test crops together with two levels of leaf removal; the control (where mature leaves were not removed) and leaf removal at five weeks after planting. All fully expanded cowpea leaves were harvested at five weeks after planting; also green immature pods were harvested, and seeds were harvested at physiological maturity. The grain yield and protein content of cowpea parts were determined after harvesting. PAN 311 had higher grain yield than red caloona. The grain yield of PAN 311 averaged over leaf removal and cropping systems was 14.90% higher than that of red caloona. Cowpea varieties grown under binary culture had lower grain yield than those grown as sole crops. Furthermore the combined effect of intercropping and leaf removal influenced grain yield in both cultivars. Hence, the mean highest seed yield of 526.80 kg / ha was observed in PAN 311 grown under sole cropping and leaf removal treatment combination. The variation observed in the protein content of plant parts did not follow any particular, trend for instance the highest protein content in cowpea stem (11.59%) was observed in red caloona while the least amount of 8.60% was observed in PAN 311 grown under the binary culture. The combined effect of leaf removal and cropping systems had more pronounced effect on cowpea grain yield compared to its protein content.

*Keywords:* cowpea, cropping systems, yield, protein content

## **P27. HERBICIDE RESISTANCE IN SOUTH AFRICA**

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Herbicide resistance in South Africa was first recorded in 1986 in *Avena fatua* to diclofop methyl. Since then reports of herbicide resistance in weeds in South Africa has increased dramatically. It is important to know as much as possible about the problem to be able to manage it effectively. The objective of this study is to verify the incidence and extent of herbicide resistance in South Africa. The incidence of herbicide resistance is monitored in two ways. Firstly, suspected herbicide resistant weed populations are tested at the Agronomy Department of the University of Stellenbosch under controlled conditions. Secondly, questionnaires are distributed to personnel of agrochemical companies in the winter rainfall region in which cases of suspected herbicide resistance are reported. These results are stored in separate databases. The numbers of weed samples sent in for testing has increased from 8 in 1999 when the service commenced to 194 in 2003. In 2004 and 2005 the numbers of samples tested has decreased to 87 and 67 respectively, due to various factors including on-farm tests performed by agrochemical companies and acceptance of the fact that herbicide resistance is present on farms. Up to now resistance to eight different herbicide modes of action groups has been verified in 13 weed species. The most important herbicide resistant species in annual crops are *Lolium* spp. and *Avena* spp. In perennial crops the most problems are caused by *Lolium* spp. and *Conyza bonariense*. The winter rainfall region of South Africa is the region with the highest incidence of herbicide resistance but isolated cases in the summer rainfall areas have also been reported. Comparison of the results of questionnaires distributed to the same agrochemical personnel in 2003 and 2005 showed that the number of suspected herbicide resistant cases increased by 20%. Information about herbicide resistance and the management thereof should be widely disseminated among all role players in agriculture. The problem can only be effectively managed if sufficient knowledge about it exists.

*Keywords:* Herbicide resistance

**P28. THE USE OF SMARTFRESH<sup>SM</sup> (1-METHYLCYCLOPROPENE, 1-MCP) TO SLOW DOWN THE SOFTENING RATE OF 'TAINUNG NO 1' PAPAYA SECTIONS IN FRESH CUT SALADS**

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'Fresh cut' or 'minimally processed' salads have become a permanent segment of the South African fresh produce marketing sector. These salads are either sold in up-market retail outlets or exported to Europe. In the case of papayas, the 'Tainung no 1' cultivar is primarily used for minimal processing. Due to the rapid decrease in quality that occurs after sectioning, producers presently harvest the fruit while still green (colour stage 1) and immediately dispatch them to the processor. This procedure has a number of disadvantages. The unripe sections may take a long time to reach the 'ready to eat stage' (if ever) and therefore have an inferior taste for much of the display period. If cut at a more advanced stage (e.g. colour stage 3), the sections have a very short shelf life. Any procedure that may contribute towards slowing down of the senescence process in riper harvested processing papayas will therefore contribute towards improving the taste and storage potential of fresh cut papaya products.

In the present study, 'Tainung' papayas were allowed to ripen on the tree to colour stage 3 after which the fruit were harvested and treated with the ethylene inhibitor 1-methylcyclopropene, (SmartFresh<sup>SM</sup>). The fruit were then diced into sections, packed into punnets and stored at 5°C. The sections were evaluated for firmness, sugar content, taste and colour after, respectively, 1, 4 and 8 days of storage. From the results it was clear that SmartFresh<sup>SM</sup> treated colour stage 3 sections became edible before untreated colour stage 1 sections and also retain their firmness for a longer period. Current trials are aimed at commercializing the process.

*Keywords:* 'Tainung' papayas, SmartFresh, 'fresh cut' shelf life, 1-MCP, 1-methylcyclopropene

## **P30. THE INFLUENCE OF ORGANIC FERTILIZERS ON THE YIELD AND QUALITY OF CABBAGE (*BRASSICA OLERACEAE* VAR. *CAPITATA*)**

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Agricultural production systems practised in KwaZulu-Natal range from subsistence farmers to highly developed large scale commercial farming. In subsistence farming, the input cost of fertilizers and chemicals are among the highest and have a large influence on farming at subsistence levels. The consequence is that these farmers tend not to use purchased fertilizers and chemicals and as a result they have developed farming systems that exclude these products. The Department of Agriculture has expertise to offer to the more developed farmers but this is lacking in relation to the subsistence farmers. The latter prompted this study and the attempt to find answers. A field trial was conducted at Umsunduze Training Centre during the 2005 and 2006 seasons. The effect of three different organic fertilizers namely chicken, kraal and compost manures was investigated on the growth, yield and quality of cabbage cv. Conquistador. Four application rates were used for each fertilizer (chicken manure: 0, 6.25, 12.5 and 25 kg 10 m<sup>-2</sup>; kraal manure: 0, 12.5, 25, and 50 kg 10 m<sup>-2</sup>; compost: 0, 25, 50 and 100 kg 10 m<sup>-2</sup>). 100 % of organic fertilizers was incorporated one month before planting. Chicken manure at a level of 12.5 and 25 kg 10 m<sup>-2</sup> showed a significant influence on the growth rate of cabbage during the first weeks after transplanting in both seasons. Although there was no significant difference in the date of maturity between the different treatments in both seasons, there were significant differences in the yield and quality. During 2005, the yield of cabbage that received chicken manure (12.5 and 25 kg 10 m<sup>-2</sup>) was significant higher and of good quality than the other treatments. During 2006, cabbage that received kraal manure (50 kg), chicken manure (25 kg) and compost (100 kg 10 m<sup>-2</sup>) showed significant higher yields of good quality than the other treatments. The control plants however, showed symptoms of phosphorus deficiency in both seasons. Conclusion was that organic fertilizers applied at a rate of 12.5 - 25 kg chicken manure, 50 kg kraal manure and 100 kg 10 m<sup>-2</sup> compost can produce the highest yield of good quality cabbages.

*Keywords:* Organic fertilizers, growth rate, yield, quality, *Brassica oleracea*

## **P31. THE EFFECT OF PLANTING DATE AND METHOD ON THE YIELD OF OUT OF SEASON ONION (*ALLIUM CEPA* L.) BULBS**

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High onion prices can be attained during the months of June and July on the major markets of the Eastern Cape. However, the supply of onions from the Eastern Cape is low during this period and it would be profitable for farmers if they could supply the market with onions during these months. The combined effect of five planting dates and two planting methods (set planting and direct seeding) on the yield and maturity dates of the onion cultivar "Z516" were studied for one season in a field trial conducted at Adelaide Experimental Farm in the Eastern Cape Province. Sets with a 10 to 12 mm circumference and seed at a rate of 8 kg ha<sup>-1</sup> were planted on five different planting dates. Planting dates were: the 4<sup>th</sup> week of January, 2<sup>nd</sup> week of February, 4<sup>th</sup> week of February, 2<sup>nd</sup> week of March and 4<sup>th</sup> week of March. A standard management programme was followed. Planting of onion sets resulted in significantly higher bulb yield than direct seeding. To decide on suitable planting dates it is necessary to consider yield as well as harvesting dates. Planting during the 4<sup>th</sup> week of February and 2<sup>nd</sup> week of March produced significantly higher yields than all other planting dates. These planting dates also resulted in harvesting dates which corresponded with the time period when prices on the major Eastern Cape markets are high.

*Keywords:* onion, planting date, planting method, yield

## **P32. RIDGES CONSERVE MOISTURE: A SENSIBLE WATER-HARVESTING TECHNIQUE FOR SMALL-HOLDER FARMERS?**

**Modi, AT**

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Collecting rainfall on the surface where it falls and conserving it is an ancient crop production strategy, but there is always a need to modify the strategy based on a variety of environmental, social and economic factors, among others. The objective of this study was to determine the effect of land modification by creating ridges on soil moisture conservation and crop production in cabbage and Chinese cabbage under low intensity irrigation during winter. Seedlings were planted on ridges separated by either a 0.5 m distance (Ridged plots) or by a 1 m distance between two ridged rows separated by 0.5 m (Run-off plots). Flat seedbeds were used as a control. Mulching (grass straw) was applied as a subplot of land modification treatments. Plant growth (height and leaf number) and soil moisture content (% w) near the root zone, were determined weekly for the first eight weeks after planting. Yield was determined 12 (Chinese cabbage) or 16 (cabbage) weeks after planting. Results showed that the use of ridges could significantly ( $P < 0.05$ ) increase gravimetric soil water content throughout the growing season, with a significantly positive effect on crop growth and final yield. Mulching enhanced the effect of ridging. The ridged plots significantly improved crop yield compared with the run-off plots. This preliminary study suggests that crops that are traditionally not associated with ridging could benefit from this cultivation practice because it enhances collection of water in the root zone.

*Keywords:* cabbage, water-harvesting

### **P33. FARMER-RESEARCHER PARTNERSHIP: TOWARDS COMMERCIALISATION OF HOMESTEAD FARMING**

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Participation of farmers in research has been shown to improve scientists' understanding of farmer's needs and empowers farmers to own research agendas and outcomes. Through participation in research and appraisal farmers analyse their own situations and engage in productive dialogue with research scientists and extension workers. The purpose of this study was to identify research questions for a participatory technology development approach for production of organic traditional crops in Umbumbulu, KwaZulu-Natal. Acceptance of a multi-disciplinary (stakeholder) partnership was requested from the farmers at the end of 2005. Farmers initiated the process by identifying problems focusing on farming issues that could be used as research questions. The questions were collated by a multi disciplinary research team (crop scientists, soil scientists, social agronomists and social scientists) and fed back to the farmers through a participatory workshop. Problems identified were poor soil fertility, low yields, poor plant protection, and lack of access to farming resources. Solutions proposed by the farmers were technologies described as local practices currently in use or innovations based on indigenous knowledge. Initial research projects were chosen to address key issues agreed upon between the farmers and the researchers. The present study reports the initial phase of an ongoing action research in social-agronomy.

*Keywords:* Farmer-researcher, participatory, homestead



**P34. THE SOIL HABITAT OF THE JULIANA'S GOLDEN MOLE  
(*NEAMBLYSOMUS JULIANAE*) ON THE BRONBERG RIDGE IN PRETORIA**

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Juliana's golden mole (*Neamblysomus julianae*) is the third most critically endangered mammal in South Africa. The golden mole occurs in three small, geographically isolated populations. It has a disjunct distribution even within each population. In the Bronberg population, this is particularly due to development. Other populations are under lesser threat. This species is extremely habitat-specific, and in order to understand the habitat of the golden mole better, thereby facilitating its conservation, physical properties of soils were investigated. A penetrometer was used to measure soil compaction in the field. Physical and chemical properties of the soils were determined in the laboratory. It was found that the Juliana's golden mole was habitat-specific with regard to specific physical soil properties. In general the mole preferred a loose sandy soil. Small but significant differences were found between the particle size distributions of the sand fractions in areas where the moles were found compared to areas where they were absent. These differences relate to the grading of the soil particles and it is postulated that the areas where the moles are found (poorly graded soils) are less prone to natural consolidation and compaction of surface soil horizons than areas where the moles were not found (well graded soils). Remote sensing and GIS were used to generate a map of Juliana's golden mole habitat preferences. Key habitat indicators were then extrapolated and a habitat suitability map for was compiled.

*Keywords:* Golden mole

## **P35. DIFFERENCE BETWEEN FIELD AND LABORATORY NITROGEN MINERALIZATION RATES AND THE IMPLICATION FOR SEWAGE SLUDGE APPLICATION RATES**

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The South African guidelines for sewage sludge utilization and disposal have recently been re-evaluated and revised. One of the major concerns regarding sewage sludge application is the risk of  $\text{NO}_3^-$  leaching and possible groundwater contamination. In evaluating the potential  $\text{NO}_3^-$  availability, laboratory incubation studies are normally used to quantify the mineralization rates of organic N. On the basis of these mineralization studies, important management decisions regarding inorganic N availability and subsequent application rates are made. N balances are notoriously difficult to measure and are influenced by a wide range of variables. In an attempt to determine the mineralization rates of sewage sludge for the revised sludge guidelines, a laboratory incubation trial and a field trial were conducted. The  $\text{NO}_3^-$  production is a function of  $\text{NH}_4^+$  availability, therefore in this study the  $\text{NH}_4^+$  production was used as an indicator of mineralization rate and subsequent  $\text{NO}_3^-$  availability. For the laboratory incubation trial, 50g soil samples were treated with an equivalent of 20 tons dry sludge per hectare, and incubated at constant temperature and moisture content. Cumulative inorganic N was measured by means of 1M KCl extraction methods. The results showed that all of the easily mineralizable N was depleted after only 28 days. This was evident in  $\text{NH}_4^+$  production, which after 28 days showed no significant differences from the control treatment. In the field trial, plots of 12m x 7m were used, and sewage sludge equivalent to 20 tons dry sludge per hectares was applied. Analysis of  $\text{NH}_4^+$  and  $\text{NO}_3^-$  levels showed that only half of the available N was utilized after 62 days. With such a significant difference between the laboratory results and the actual field results, many of the assumptions regarding availability of inorganic N would be wrong if based on laboratory results alone. This paper discusses the differences between field mineralization rates and laboratory mineralization rates, and the influence thereof on sewage sludge application to agricultural land.

*Keywords:* Nitrogen, Mineralization, Sewage sludge, Laboratory, Field, Fertilizer

**P36. INVESTIGATING THE ROLE OF THE SOIL RHIZOSPHERE, NITROGEN AND PH ON BANANA PLANTS (*MUSA ACUMINATA* L. A. COLLA) GROWN IN A FUSARIUM WILT SOIL**

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It has been documented that liming and nitrogen application can influence Fusarium wilt pathogens and diseases. It has also been proposed that there is at least a partial interaction between lime and nitrogen in the soil in terms of their effects on Fusarium wilt. This interaction was suggested to be due to the rhizosphere effect of nitrogen uptake by plants, whereby the uptake of nitrogen in the form of  $\text{NO}_3^-$  or  $\text{NH}_4^+$  could, respectively, increase or decrease the pH of the rhizosphere. Based on these findings, a greenhouse trial was conducted to determine the influence of liming and nitrogen application on the growth of banana plants in the presence of *Fusarium oxysporum* f. sp. *ubense*, when planted in soil obtained from Kiepersol (Mpumalanga), South Africa, where Fusarium wilt of banana occurs. This trial was expanded to include a hydroponic pot trial with the intention of removing the rhizosphere and comparing the results with those of the soil pot trial. The soil pot trial yielded significant differences in plant growth as a result of variations in liming, nitrogen levels, as well as  $\text{NO}_3^-:\text{NH}_4^+$  ratios. Less significant results were obtained in the hydroponic trial compared to the soil pot trial. This difference in trial results suggests that, in the hydroponic trial, the absence of a rhizosphere generally evened out the results across the different nitrogen treatments, both at the lower and the higher pH levels. It is thus suggested that the presence of the rhizosphere in the soil could play a role in the observed effect that liming and nitrogen application has on the growth of banana plants infected with Fusarium wilt.

**Keywords:** Fusarium wilt , Rhizosphere, Nitrogen

## **P37. A SISWATI SOIL IDENTIFICATION AND CLASSIFICATION HANDBOOK**

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Like all farmers, siSwati farmers have to be able to make informed decisions when working with their soils if the utilization of this resource for agricultural purposes is to be sustainable. As these farmers are non-scientists, information that is put at their disposal must be able to bridge the gap in communicating scientific information. The aims of the project are to produce a soil classification handbook in siSwati to enable the relevant farmers to correctly identify their soils and make informed management decisions as well as to record existing soil forms in the siSwati language.

The method that will be used in producing the handbook will be by translating the current Soil Classification – A Taxonomic System For South Africa (1991) diagnostic horizon descriptors into siSwati. These will be juxtaposed to the soil form pictures as seen in the current classification book. A table will then be drawn up for each soil form which will comprise various fields that will include; soil features, acidity hazard, salinity hazard, erosion hazard, nutrient status, agricultural potential, root penetration resistance, pH and clay percentage. The ARC-ISCW Soil Profile Information System will then be used to determine the above field data. A query was run to select all profiles with geographic coordinates falling within the Mpumalanga Province and within each of the three main regions that were digitised for the province, namely the Lowveld, Highveld and Escarpment. A total of 624 such profiles – with reasonable data - were found. Attributes relating to the above fields were extracted by querying the soil analysis component of the database. The soil-profile information derived for the province does not have all the 73 different soil forms as recorded in the current classification book. As a result, those not occurring have been omitted.

This data will be put on a scale ranging from one (very low) to five (very high) – where appropriate - and it is this derived information, which will be communicated for each of the fields. The soil features column will be largely based on soil properties that are visible or analytically measurable.

*Keywords:* soil classification

## **P38. APPLICATIONS OF THE ARC-ISCW SOIL PROFILE INFORMATION SYSTEM (SOILPRO)**

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The SoilPro database was established as a data capturing and reporting tool for all profiles described and analyzed at ARC-ISCW. This database makes provision for the registration of soil samples by all field personnel who may request any combination of analysis packages. Laboratory personnel then carry out the analyses and enter the results directly into the database. Approximately 2500 modal profiles (fully described and analyzed) and 10 000 other profiles are stored in the database. The SoilPro database can thus be used for various applications:

- Production of reports: The modal profile description and analytical tables as presented in the Land Type Memoirs are widely used by land users and researchers.
- Serving as a source of soil property values to be used in combination with other natural resource information. Agricultural advisors are now better equipped to characterize and interpret their production potentials and risks.
- The production of attribute maps by interpolating point data, for example producing a pH map of South Africa.
- Verification of modelled data. An example is where erosion was modelled - the database offered about 3600 points where erosion was recorded which could be used to verify the modelled results.
- Baseline data can be evaluated for monitoring of processes such as carbon sequestration, pollution, nutrient or trace element deficiencies and in rehabilitation exercises.
- The integration and correlation of soil information with other databases and information layers such as geology, climate, land cover and vegetation.

In conclusion, the SoilPro Profile Information System provides a wide range of land users with the means to obtain valuable and widespread soil data. Contributions from other academic institutions or organizations can be accommodated to further improve the information products.

*Keywords:* Soil profile database

## **P39. LAND SUITABILITY CLASSIFICATION FOR COWPEA PRODUCTION IN THENGWE VALLEY, VHEMBE DISTRICT, LIMPOPO PROVINCE**

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This study was conducted in the Thengwe valley, situated in the Vhembe District in the subtropical region of Limpopo Province. The objective of this study was to evaluate the land suitability of this valley for cowpea production. The Automated Land Evaluation System (ALES) was used to determine suitability of eight mapping units for cowpea production. Map units Mds 01, Mds 02, Vbt 01 and Vbt 02 were highly suitable for cowpea production. Map unit Mds 11 was moderately suitable for cowpea due to low nutrient availability and poor water holding capacity. Map units Rcl 01 and Vbt 11 were marginally suitable for cowpea production and were downgraded by poor drainage. In general, the Thengwe Valley is suitable for cowpea production, though precaution should be taken to prevent soil loss by erosion, particularly in moderately and marginally suitable units. The Automated Land Evaluation System is a versatile system for land suitability classification and is easily adaptable in less developed countries.

*Keywords:* Automated Land Evaluation System (ALES), Land suitability, Cowpea, Thengwe valley

## **P40. THE SOIL INFORMATION SYSTEMS OF THE ARC-INSTITUTE FOR SOIL, CLIMATE AND WATER**

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The Pedology Division of the ARC-Institute for Soil, Climate and Water has, over the years, accumulated a comprehensive body of Soil Information. The data and information can be utilized by means of the following information systems:

**SoilDoc Natural Resource Report System:** SoilDoc comprises a record of available soil reports and maps. It can be searched using author name, title, keywords and even co-ordinates to find all available information concerning a specific topic or area of interest.

**Land Type Information System:** This system is based on the results of a terrain, soil and climate survey of South Africa at 1:250 000 scale and is stored using ArcGIS. It provides reconnaissance information on dominant soil distribution, as well as more specific parameters, such as texture, structure, depth and agricultural potential. The great advantage is that the whole country is covered with uniform methodology. In a recent innovation, non-technical descriptions of the soil properties are available for each land type in English and seven other South African languages.

**Land Type Climate Zone Application:** As part of the land type survey, macroclimate information was collected, supplying (where available) rainfall, temperature, evaporation and frost parameters. The system is especially useful in conjunction with the land type information outlined above.

**Soil Profile Information System:** During the course of the land type survey, modal profile descriptions were made of more than 2300 representative soils, with accompanying comprehensive analyses. Later, soil profile descriptions and their analytical data from many other soil surveys were added to the database. All of these data are geo-referenced. The possibilities for making use of this massive amount of information are enormous. Searches can be made using descriptive or analytical parameters, either singly or in combination. Queries can be tailored to include or exclude certain data, or to look for specific ranges within a defined area, and can be adjusted to achieve optimum results.

**Detailed and Semi-Detailed Soil Information System:** This system stores information derived from semi-detailed soil surveys. Most of the area around Cape Town is covered at 1:50 000 scale, and areas in Gauteng are planned to be incorporated.

**Historical Soil Map Application:** The latest initiative comprises the scanning of a range of historical soil maps, both from the archive of ARC-ISCW and from elsewhere. These are usually available only in paper, transparency and linen copies and are often in a fragile state. The scanning process has commenced (more than 1300 maps have been scanned to date), with the ultimate objective being the digital storage and, where possible, geo-referencing of as many maps as can be sourced.

*Keywords:* Soil information, Soil maps

## **P41. THE MECHANISM OF NI TOXICITY IN MAIZE AND RESPONSE TO AMENDMENTS ADDED TO A SERPENTINE SOIL**

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In a 2 x 2 x 2 factorial pot experiment with maize, lime, gypsum and sewage sludge were added to a serpentine (ultramafic) soil that contained 90 mg kg<sup>-1</sup> of exchangeable Ni and had an exchangeable Ca:Mg ratio of 1:4. iron (as ferrous sulphate sprayed on leaves) and molybdenum (added to soil) formed separate treatments.

Interveinal chlorosis of leaves as a result of Ni uptake was reduced most by sewage sludge and Fe-spray, lessened to some extent by lime, but was enhanced by gypsum. Leaf edge splitting, a calcium deficiency symptom, was prevented by lime and sewage sludge treatments, was reduced by gypsum but remained moderate to severe in Fe and Mo treatments.

Sewage sludge gave the best vegetative yield response of 38 percent and responses to lime, gypsum and Fe-spray were 11, 9 and 21 percent respectively ( $p=0.05$ ). Response was attributed to significantly increased nutrients including Ca and Fe and reduced Ni for sewage sludge, increased Ca and reduced Ni for lime, increased Ca for gypsum and increased Fe and Zn and reduced Ni for Fe-spray treatments.

The effect of Ni on leaf Fe was investigated in a follow-up sand experiment in pots, comparing a treatment without added Fe to one with added Ni. Total Fe was high in iron sufficient leaves and remained relatively high in iron deficient and Ni-chlorotic leaves. However, Fe(II) iron was 23 percent lower in iron deficient leaves and 51 percent lower in Ni-chlorotic ones. By lowering Fe(II) in leaves, Ni interferes with chlorophyll production.

*Keywords:* serpentine soil, nickel, sewage sludge, lime, gypsum, maize



## **P42. GRAIN RESPONSE OF MAIZE ON SERPENTINE SOILS TO CA AND P AMENDMENTS**

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Serpentine or ultramafic soils are characterized by high magnesium content relative to calcium and high levels of heavy metals, principally nickel and chromium. Such soils occur in Zimbabwe and northern South Africa where toxicity prevents significant areas from being cropped. Vegetative responses of maize to amendments such as lime, gypsum and phosphate have been demonstrated on different serpentine soils. The objective of the work presented is to evaluate grain responses to these amendments in pot and field trials on two vertisolic serpentine soils.

The first soil, "Avondale Red", had exchangeable Ni, Ca and Mg contents of 33 mg/kg, 3.5 cmol(+)kg<sup>-1</sup> and 23.8 cmol(+)kg<sup>-1</sup> respectively and was low in P and total Cr. The other soil, "Avondale Black", contained lower exchangeable Ni at 10 mg/kg but higher Ca and Mg contents at 6.5 and 44.8 cmol(+)kg<sup>-1</sup> respectively. In pots using a 2 x 2 x 2 factorial design with 4 replicates, these soils were treated with calcitic lime (L), gypsum (G) and triple super phosphate (P) equivalent to 2000 kg/ha, 3440 kg/ha and 400 kg/ha, respectively. In randomized block field trials, treatments were 2000 and 4000 kg/ha lime and 3440 and 1720 kg/ha gypsum. Maize was fertilized and grown to maturity in pots and field, and grain yield and analytical soil and leaf data assessed statistically.

In pots, mean grain yield was 153 g/pot and mean responses to P, L and G were 67, 30 and 9% respectively for "A. Red", and for "A. Black" mean yield was 230 g/pot and mean responses to P, L and G were 12, 6 and 3% respectively. Responses were attributed to improved phosphorus and calcium nutrition as reflected by significant increases in leaf P% and leaf Ca% and in the case of "A. Red", decreased Ni toxicity as reflected in reduced leaf Ni content. "A. Black" was also highly responsive to zinc but not boron addition. Only the "A. Red" field trial was harvested (because of drought on "A. Black"), where significant grain responses were obtained to lime and attributed to increased Ca uptake and decreased Ni uptake and toxicity. Poor and negative responses to gypsum were attributed to reduced solubility and increased salinity effects under low rainfall conditions.

*Keywords:* serpentine soil, vertisols, nickel toxicity, calcium, phosphate, maize

## **P43. EVALUATION OF YIELD VARIATION ON CORN AND WHEAT IN THE NORTHERN CAPE**

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Variation on yield is often not due to just one factor. In the past, most cases could not be readily explained. The major factors that influence yield were identified and methods were developed to monitor these factors.

Temperature sensors were installed on different geographical levels. Soil moisture levels were measured on a weekly basis. A penetrometer was used to determine if the soil was compacted before tilling. Soil chemical information was gathered on a 1ha grid. Geo-referenced satellite images were used twice in the growing season to identify any variation on vegetation. Nitrogen levels in the plants were measured on a weekly basis with a N-Tester.

Yields on corn and wheat for 2004, 2005 and 2006 were gathered during the harvest process using yield monitors. Forty-eight farmers and almost 8000 ha was monitored during the course of this study which has been active for the past 6 months, and due to the success of the study, the monitoring will continue indefinitely.

In this study, the variation on yield under irrigation circumstances was more closely related to water, climate, geographical factors, weeds and pest than chemical deficiencies. In the future, the extent of each factor will be determined and quantified.

*Keywords:* High technology farming

## **P44. EFFECTS OF TILLAGE ON SOIL QUALITY INDICES AND CROP PRODUCTIVITY IN EASTERN CAPE PROVINCE OF SOUTH AFRICA**

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This study evaluates the potential of two tillage practices and crop rotations on improving soil quality and irrigated crop growth and yield under semi-arid conditions of the Eastern Cape Province in South Africa. A field experiment on effects of tillage on soil quality indicators and crop growth were conducted on black heavy textured soil (Mayo form). Two tillage methods tested were conventional tillage (CT) and no-tillage (NT). Preliminary results for 2005/2006 cropping season indicate that crop growth parameters in no-till system were not significantly different from those of conventional tillage. There were no significant differences for soil density, porosity and infiltration, and soil water holding capacity between the two tillage systems. Soil organic carbon, pH and electrical conductivity as well as plant nutrient uptake were also insignificant. The soil surface layer (0-5 cm) under NT had significantly higher extractable P than the lower soil layers (5-10, 10-15 and 15-20 cm). Farmers' ranking of conventional tillage higher than no-till despite equal grain yields largely reflected the fact that they are not fully convinced that NT is a feasible option to CT.

*Keywords:* Soil properties, Conventional tillage, No-till, Crop productivity

## **P45. EFFECTS OF SOIL AMELIORANTS, MAIZE AND DRYBEAN ON SOIL FERTILITY INDICATORS**

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The project aims at investigating effects of soil ameliorants, [that is, mineral fertiliser 173 (maize) and 155 kg/ha (drybean) bandplaced 1:1:0 (22), kraal manure (20 t/ha fresh matter basis), high rate compost (20 t/ha), low rate compost (3 t/ha) and compost tea (650 l/ha)] on rainfed maize and drybeans production. The project was on a Hutton soil with sandy-loam topsoil layer at Mogwase, Rustenburg. Mogwase is a subtropical area with high temperatures. The project was planted in early November 2004.

Soil samples taken during harvesting in June/July 2005, indicated that top- (0-30 cm) and sub-soil (30-60 cm) of both maize and drybeans showed no difference in Mg (223 mg/kg;  $P < 0.05$ ). Maize top- and sub-soil did not differ in K (277 mg/kg) while drybean top- and subsoil did not differ in pH (4.9), due to the treatments. Furthermore, maize topsoil nitrate (7.0 mg/kg), Bray 1 P (305 mg/kg) and Ca (640 mg/kg) did not differ, while drybean topsoil nitrate (13.1 mg/kg) and Ca (658 mg/kg) also did not differ due to treatments.

The maize topsoil and subsoil had pH of 5.0 in the control and manure treatments, higher in the low rate compost treatment (pH of 5.2), and lower in the high rate compost treatment (pH of 4.9). The mineral fertiliser treatment was with the low pH group, in the maize topsoil and with control group for the subsoil, while the compost treatment was with the control group for the topsoil and with the low pH group for the subsoil.

The drybean topsoil had moderate P and K amounts (1.9 and 234 mg/kg, respectively), and always had higher P and K from the mineral fertiliser treatment, but lower from the high rate compost treatment. The nitrate for maize and drybean and P for maize and drybean in the subsoil were 1.0, 4.5, 1.1 and 0.8 mg/kg, respectively, in the control, manure and low rate compost treatments, while it was higher, 17.9, 24.6, 10.5 and 1.6 mg/kg, respectively, in the mineral fertiliser treatment.

Compost tea treatment gave higher P amounts in both crops' plots. Higher amounts of nitrate from compost tea treatment were also obtained from maize plots. The Ca was lower in the control and compost tea treatments from the maize subsoil (628 mg/kg), but higher from the drybean subsoil (791 mg/kg), compared to all other treatments, 710 and 664 mg/kg for maize and drybean, respectively. Low rate compost tea had interesting results on soil fertility indicators, especially on pH, P and nitrate.

**Keywords:** Compost application rate, kraal manure, drybean, maize, soil fertility

**P46. THE RESPONSE OF THREE CABBAGE CULTIVARS TO APPLIED  
RECOMMENDED RATES OF FERTILIZERS AT MAXWELE CLINIC - O.R. TAMBO  
DISTRICT IN THE EASTERN CAPE PROVINCE, RSA**

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Correct fertilization and cultivar choice together with sufficient water supply are essential to vegetable production. The objective of the study was to determine the suitable cabbage cultivar at Maxwele Clinic. Three cabbage cultivars were laid out in a randomized complete block design with three replicates at Maxwele Clinic in the OR Tambo district. Cultivar Star 3301 produced higher fresh mass yields followed by Conquistador then Green Caronet, but the yields attained from Star 3301 and Conquistador did not differ significantly ( $P < 0.05$ ). Results obtained from this study therefore suggest that farmers at Maxwele clinic and surrounding areas with similar climatic conditions can either grow Star 3301 or Conquistador in winter.

*Keywords:* Cabbage cultivars, Fertilization

## **P47. 'WHERE THE LAND IS GREENER'– ACHIEVEMENTS IN COMBATING DESERTIFICATION**

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A total of 42 soil water conservation (SWC) technologies and 27 approaches were selected from the WOCAT (World Overview of Conservation Approaches and Technologies) knowledge base and reviewed and updated in an intensive contributor-reviewer interaction process. This evaluation process was highly effective and rewarding for all stakeholders involved. The book entitled 'Where the Land is Greener' presents these case studies together with analyses, conclusions and policy points.

WOCAT's vision is that knowledge on sustainable land management is shared and used globally to improve livelihoods and the environment. WOCAT mainly addresses SWC specialists, planners and decision-makers at the field level (farmers, extensionists) and at the planning level.

Technologies with low investment and maintenance costs can help small-scale subsistence land users alleviate poverty, while those with negative establishment, but positive maintenance cost-benefit ratios are possible options for development projects. Continuous investment in rural areas and sustainable land management is both a local concern as well as a global obligation, as SWC is crucial not only to feed the world but to maintain ecosystem functions and environmental services. Recognition and stimulation of local innovation and farmer-to-farmer extension can be a cost-effective and appropriate strategy, especially in response to changing environmental conditions.

Investing in documentation and evaluation of SWC knowledge is rewarding for all stakeholders involved. It brings them together and stimulates mutual discussion, while the WOCAT questions challenge them. This enhances capacity and develops into a learning process.

*Keywords:* WOCAT, Soil and water conservation, Soil and water management, Desertification

## **P48. SOIL PROPERTY RELATIONSHIPS IN A SELECTION OF SOUTH AFRICAN TOPSOIL HORIZONS**

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Twenty topsoil horizons, representative of South African soil forms, climatic conditions and parent materials, have been collected in connection with the EU-funded Borassus project (INCO-CT-2005—510745), which focuses on the beneficial effect of palm geotextiles in reducing soil erosion. Soil properties generally associated in international literature with erosional processes like texture, secondary iron (Fe) content, pH, clay mineral associations, organic matter (OC), cation exchange capacity (CEC) and exchangeable base cations have been determined. Relationships between certain soil properties or rainfall figures have been identified. As these results will not be documented within the Borassus project publications or reports, but may be of interest to pedologists, it is the objective of this presentation to report on them.

Rainfall figures are indirectly related to pH ( $R^2 = 0.51$ ) as expected, but much less so to OC ( $R^2 = 0.28$ ). Factors other than rainfall obviously strongly influenced the amount of organic matter at any pH. The secondary Fe content is low (~1%) until the pH falls below 6, from which point on there is a linear increase in Fe with decreasing pH. This is an indication that Fe becomes increasingly released from clay mineral structures only at pH < 6. The Al content in the secondary Fe structure is uniformly low (~0.2% or less than 10% of structural position) until the pH falls below 5.5. Then Al is increasingly incorporated into the Fe minerals, filling up to 39% of structural positions.

The CEC is positively associated with the percentage of swelling clay minerals ( $R^2 = 0.66$ ), as expected, but also with the clay content ( $R^2 = 0.65$ ) as a whole, a less expected finding as the soils were dominated by clay minerals of vastly different CECs like kaolinite, quartz, mica or swelling clays. Under similar rainfall conditions, the average OC content was considerably lower in soils with a clay-sized quartz content exceeding 40% compared to those with a quartz content of < 10%. This highlights the inability of quartz, which is chemically inert, to stabilize the organic matter fraction against decomposition.

**Keywords:** Borassus palm, soil erosion, clay mineral associations, organic matter, cation exchange capacity, swelling clay minerals

## **P49. TOWARDS A GLOBAL MAP OF SOIL AND WATER CONSERVATION ACHIEVEMENTS: A WOCAT INITIATIVE**

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While there are many global maps of negative human impacts on the natural environment, almost none show any positive efforts or achievements. WOCAT (World Overview of Conservation Approaches and Technologies) tries to counterbalance this shortcoming and produces a global overview of the achievements made so far in combating or preventing land degradation. The map will serve to raise awareness of the importance of soil and water conservation (SWC) on a global scale. Its purpose is not only to show the positive impacts made so far, but also to encourage and guide politicians and organizations to invest effectively in SWC.

WOCAT is inviting national experts to provide geographical information on the two to eight (depending on the size of the country) most important soil and water conservation technologies in their country. The selection should be based on territorial extent, effectiveness, and/or wide adoption by land users and may include both traditional and promising new technologies. After compiling the information, a small-scale world map (1:60,000,000) will be created and made available on the Internet ([www.wocat.org/worldmap.asp](http://www.wocat.org/worldmap.asp)). Different-sized symbols will indicate the area coverage, with colours and shapes of the symbols referring to land use type, degradation type, and type of conservation measure. On the map, each type of SWC measure will be illustrated by photos and a brief text located in the free space over the ocean, with arrows pointing to its location.

WOCAT provides the platform for the compilation and the global exchange of knowledge, but the information needs to come from the individual countries. All SWC specialists with a national focus and know-how are asked to fill in the requested form. The form is available on the internet ([www.wocat.net/ftp/worldteform.rtf](http://www.wocat.net/ftp/worldteform.rtf)) and should be returned to WOCAT ([wocat@giub.unibe.ch](mailto:wocat@giub.unibe.ch)) together with illustrative photographs of the technologies. Your contribution will be appreciated!

**Keywords:** WOCAT, Soil and water conservation, Soil and water management, Global map, Degradation



**P50. YIELD AND WATER USE RESPONSE UNDER VARIOUS IN-FIELD  
RAINWATER HARVESTING TREATMENTS ON THE FORT HARE-OAKLEAF  
ECOTOPE**

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South Africa is one of the semi-arid countries in the world with an average annual rainfall of 500 mm. About two-thirds of the country receives less than 500 mm of rainfall per year. Therefore, in order to farm successfully, one must know the extent to which natural resources (soil and climate) will influence crop production in a particular area. In most parts of the country, rainfall is low, leading to low precipitation use efficiency. The latter is also caused by runoff losses and soil surface evaporation (Es). Rainfall is mostly in the form of thunderstorms, thus leading to runoff losses. About 25 % of the country is classified as semi-arid. Crop failures are often reported in these semi-arid areas. To counteract these crop failures, rainwater harvesting techniques have been implemented to ensure higher soil water storage for crop use.

The ARC-ISCW developed a production technique termed the in-field rainwater harvesting (IRWH) technique. This technique combines the advantages of water harvesting, no-till, basin tillage and mulching and reduces total runoff to zero and Es considerably. The research was first done at Glen Agricultural Research Station and then expanded to Thaba Nchu (east of Bloemfontein) for several years. Recently, this production technique has been further expanded to Alice in the Eastern Cape Province. A trial is being conducted on the Fort Hare–Oakleaf ecotope. Maize (PAN 6480) was planted in the 2004/05 and 2005/06 growing seasons with different replicated treatments. The three treatments that will be discussed in this paper are conventional tillage (CON), IRWH and IRWH with mulch application. So far the technique has shown improvement in terms of yield, precipitation use efficiency and water use efficiency.

*Keywords:* Precipitation use efficiency, Water use efficiency, Yield

## **P51. IRRIGATION SCHEDULING WITH LONGSTOP WETTING FRONT DETECTOR - A UNDER FURROW IRRIGATION SYSTEM**

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Wetting front detectors (WFDs) are inexpensive and robust devices that are used for scheduling irrigation by giving a yes/no response as to whether a wetting front has reached a particular depth in the soil. There are two types of WFDs: the FullStop (FS) and the LongStop (LS). The FullStop WFD comprises a specially shaped funnel that distorts the downward flow of water through the soil, producing saturation (free water) from an unsaturated soil. Whereas the FS WFD has been found to work well under drip and sprinkler irrigation systems, its usefulness in furrow irrigation systems has been questioned. When fluxes are low, convergence by the FullStop funnel is less important than the need to counteract capillary emptying by the surrounding soil. In these cases, a pipe-like design is more appropriate than a funnel. Hence we developed the LongStop version of the wetting front detector. A LongStop is essentially two concentric tubes. The outer tube (50 mm diameter) is filled with a porous material and the inner tube (20 mm diameter) is filled with air, with the tubes connected via a screen filter near the base. This poster evaluates the effectiveness of the LS WFD in scheduling irrigation under a furrow irrigation system.

**Keywords:** Wetting Front Detector, Irrigation