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Abstracts Poster

ALLELOPATHY: PROTOCOL TO TEST Amaranthus cruentus L. ON LETTUCE SEEDLINGS

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Introduction

Allelopathy is the process where certain plants, weeds or crop species release phytochemicals affecting other species that are growing in the surrounding area. These chemicals may have a positive or negative effect on other plants germination, growth and yield of other plants. It is important to have an effective method to assess if a certain plant is allelopathic or not. Amaranth has been proven to have allelopathic properties. Amaranthus cruentus leaf extracts and leaf litter has proven to have a negative effect on lettuce germination and growth. The aim of this trial was to examine the best way to assess the allelopathic properties of A. cruentus on germination and growth of lettuce seedlings.

Materials and Methods

The allelopathic potential of plant residues and extracts from three varieties of A. cruentus (Anna, Arusha and Imbaya) were evaluated. Dried plant leaves were finely ground and extracted with dichloromethane (DCM), methanol and water. To assess the allelopathic properties of amaranth the ‘Sandwich Method’ was used. This method is used to test the allelopathic effect on lettuce seeds by using agar in two separate layers for the leaf litter. Using a modified method that was derived from, filter paper was used to hold the plant extracts. Each extract was dissolved in their own solvent DCM, methanol and water. The extracts were tested at concentrations of 0, 5, 10, 20 mg. Once the top layer of agar is set the five lettuce seedlings are vertically placed on each well. The plates were closed, placed in black plastic bags and then placed in a dark incubator for three days at 25°C, then are measured.

Results and Discussion

Seed germination was most markedly inhibited by residues of Arusha (26.7%). Radical growth was inhibited significantly by residues of all three varieties at 1mg mL-1, although Anna caused the most severe inhibition of 93%. Residues of cultivar Anna was also responsible for 86% inhibition of hypocotyl elongation at 1mg mL-1. All residues of the varieties inhibited radical and hypocotyl growth severely by up to 97% at 5mg mL-1. Even at the lowest concentration of extracts for all the varieties inhibited of seed germination (80-90%) as well as organ elongation. DCM and water extracts of Arusha and Anna were most inhibiting whereas the methanol extract of Imbaya caused the greatest reduction.

Conclusions

Results showed both the original and modified “Sandwich Method” proved to be the best way to assess the allelopathic properties of amaranth on lettuce seeds.

References

Keywords

Allelopathy, Amaranth, Lettuce, Germination, Seedlings, Leaf litter, Extracts

Suitability of Krwakrwa village for in-field rainwater harvesting

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Introduction

Krwakrwa village, in the Eastern Cape, is located in an area where rainfed agriculture has to cope with unreliable rainfall, high evaporative demand, marginal soils and recurrent droughts with subsequent production failures. In addition to this, production is low because of high unproductive water losses through runoff and evaporation. The in-field rainwater harvesting (IRWH) technique was developed to counteract these unproductive losses and thereby improve rainwater productivity and crop yields. A study was conducted to evaluate the suitability of Krwakrwa for the application of IRWH in homestead gardens and croplands. Criteria suggested by Botha et al. (2014) for IRWH are as follows: a) slope should not exceed 8% on non-erodable soils; b) effective soil depth at least 700 mm; c) annual rainfall between 450 – 700 mm; d) preferably clay (more than 10%) or duplex soils.

Materials and Methods

Long-term climate data was used to characterize the climate. A soil map was created from a soil survey that was conducted at 119 randomly selected points in homestead gardens, croplands and rangelands. Soil depth was identified through auguring and soils were classified according to the South African Soil Classification System. Soil samples were taken to determine clay contents.

Results and Discussion

Long-term climate revealed that the average rainfall is 569 mm per annum, of which 468 mm occurs between October and March. The area is characterized by warm summers and cold winters. This climate is typical for a semi-arid area with a low annual rainfall and high evaporative demand. A variety of soils occurs in the homestead gardens that range from very shallow Glenrosas to Clovellys, Westleighs, Oakleafs and Avalons to very deep Huttons. High potential soils are found in the eastern side, while abandoned croplands to the southwest of the community consist of very shallow Westleighs, Sepanes and Glenrosas. Croplands to the west of the community consist mainly of patches of 700 mm deep Avalons. Soils in the rangelands vary from deep Avalons and Oakleafs to very shallow Mispahs and Glenrosas.

Conclusions

In general, Krwakrwa village meets the requirements for the application of IRWH for crop production in homestead gardens and croplands. The soil map should be used for land use planning to ensure that only the high potential soils are utilized for crop production, medium potential soils for planted pastures, while the low potential soils should be used for grazing.

References

Botha, J.J., van Staden, P.P., Anderson, J.J., van der Westhuizen, H.C., Theron, J.F., Taljaard, D.J., Venter, I.S. & Koatla, T.A.B., 2014. Guidelines on best management practices for rainwater harvesting and conservation for cropland and rangeland productivity in communal semi-arid areas of South Africa. WRC Report No TT590/14.

Keywords

in-field rainwater harvesting, soil, climate, Krwakrwa village

Genotypic profile of selected South African wheat genotypes for traits influencing yield

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Introduction

Breeding crops, such as wheat (Triticum aestivum L.), for improved grain yield has been the goal of many research programmes. Grain yield is an important trait of interest to breeders and producers that is influenced by a number of traits. Flowering time, photoperiod, wheat lodging resistance, plant height and various parameters including the genotype by environment interaction can substantially influence grain yield. Thus, a good combination of selected genes or allelic variants controlling agronomic traits has been shown to improve desirable traits of importance such as lodging tolerance (Butler et al., 2005). However, there is little information on the genotypic profile of selected traits that influence yield of South African wheat genotypes. Consequently, there is a need to explore genes that may influence grain yield amongst South African wheat genotypes (Eagles et al., 2010). In this study we report the percentage distribution of different allelic variants including alleles controlling agronomic traits such as photoperiod response, vernalisation, reduced height, kernel weight and abiotic stress tolerance, as well as selected processing quality traits. This information will largely contribute to addressing the strategic objectives of many research programmes that are aimed at contributing to food security.

Materials and Methods

DNA was extracted from fresh leaf material of more than 200 South African wheat genotypes using a modified CTAB DNA extraction protocol. The DNA was screened with molecular markers for different agronomic traits such as, photo response (Ppd-1), vernalisation (VRN-1) and reduced height (Rht-1) etc., through polymerase chain reaction (PCR). The resulting amplified PCR products were then resolved on agarose gel electrophoresis.

Results and Discussion

More than 50% of the genotypes showed the presence of more than two photoperiod allelic variants such as (Ppd-A1, Ppd-D1). Different allelic distributions of various markers were also seen in more than 20% of the genotypes. More work involves screening the genotypes with other diagnostic molecular markers for other traits that may influence yield. Making cross combinations wit potential markers or allelic variants that may substantially improve grain yield is also envisaged.

Conclusions

The availability of a comprehensive genotypic profile of traits that influence grain yield will enable the possibility to select the best combination of allele variants. This will allow for the development of genotypes with high yielding potential using marker assisted selection.

References

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Keywords

grain yield, marker assisted selection, wheat

Agronomic performance of maize intercropped with various grain legumes

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Introduction

There has been an increase of the population in the Sub-Saharan Africa. This has resulted in reduced land size available for small scale farmers. Farmers are unable to grow a diversity of crops in their land. Therefore, to maintain crop diversity cultivation practices such as intercropping is suggested as a solution.

Materials and Methods

An experiment was conducted at Ukulinga research farm, with an objective to determine the optimum cropping system of maize intercropped with various grain legumes. The experiment was arranged in a randomised complete block design with three replicates. The treatments were maize intercropped with bambara groundnut, pigeon pea, cowpea and tepary beans. Data of the following parameters was collected: seedling emergence, days to 50% flowering, grain yield and pod mass. Competition indices were calculated to assess the efficiency of the intercropping system. These were land equivalent ratio (LER), competition ratio (CR), relative crowding, Aggressivity (A) and actual yield loss (AYL).

Results and Discussion

There was a significance difference ($P< 0.05$) between intercrops treatment means with regards to grain yield (kg ha^{-1}). Highest grain yield was observed in intercrops of maize-cowpea (2094.60), which was greater than of maize-tepary beans (2003.00), maize-bambara groundnut (1917.10) and maize-sole (1847.3. There was a significance difference ($P< 0.05$) with regards to crop competition indices (LER, CR, A). The LER of maize intercropped with cowpea (1.72) was greater than of maize intercropped with bambara groundnut (1.55), tepary beans (1.51) and sole maize (0.97). A similar trend to that of LER was observed in relative crowding.

Conclusions

Intercrops of maize-cowpea and maize-tepary beans were the best cropping systems. This implies that they were able to efficiently utilise resources such as nutrients, light and water. The reasons for their good performance needs further research

References

Keywords

Bambara groundnut, cowpea, pigeon pea, tepary beans

THE EFFECT OF SEASONAL DISTRIBUTION OF NITROGEN ON CANOLA PRODUCTION

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Introduction

Soil nitrogen (N) availability is frequently the most limiting factor for crop and especially canola (*Brassica napus*) production. However, increasing the N fertilisation rates often fail to result in increased plant production because only 30 – 50% of the applied fertiliser is taken up by crops. Applying fertilisers during periods of crop demand and at a lower rate, but more frequent applications, have the potential to reduce losses. The aim of this study was to evaluate the effect of seasonal distribution of N fertilisation on canola production in the Western Cape.

Materials and Methods

Rainfed trials were conducted at Langgewens Research Farm in the Swartland, Altona near Durbanville and Roodebloem in the Overberg area. The trials were laid out in a randomised block design, replicated four times. Canola (cv. Hyola 555 TT) was planted at 3 kg/ha during the first week of May 2016. Treatments, except the control (no added N), received 20 kg N/ha at planting. Three treatments received a total of 60 kg N/ha, whereas the remaining three treatments received a total of 150 kg N/ha. For each of these rates, N was applied at 30 days after emergence (DAE), or distributed at 30 and 60 DAE, or 30, 60 and 90 DAE. N was applied in the form of limestone ammonium nitrate (LAN). Biomass was determined at 30, 60 and 90 DAE, and at harvest. Plant density was determined at 30 DAE and leaf area index at 60 and 90 DAE, using a LI-COR 3100 area meter.

Results and Discussion

There were no differences ($p>0.05$) in biomass production at 30 or 60 DAE between treatments at all localities. An increase of at least 67% in biomass production between 60 to 90 days were observed on all three localities, which indicate high crop demand. Biomass production was decreased in the order Roodebloem>Langgewens>Altona. Although LAI increased from 60 to 90 days after emergence ($p<0.05$), there was no difference ($P<0.05$) between treatments irrespective of locality. Increased LAI is necessary to be photosynthetically efficient to support high numbers of flowers, pods and thus yield.

Conclusions

There were no significant effect of N fertiliser distribution throughout the season between treatments until 90 days after emergence. This trend will have to be validated with further analysis of yield data at harvest. This trial forms part of a bigger study to evaluate the effect of N fertilisation on soil microbes.

References

Keywords

Biomass, Brassica napus, Leaf area index, Nitrogen fertilisation

Effect of compost, mulch and fertilizer on Aloe ferox L. plant vigour and the Aloesin, Aloin A and Aloin B content of leaves

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Introduction

Aloe ferox L. is indigenous to southern KwaZulu-Natal, the Eastern Cape and drier parts of the Western Cape and has long been used for medicinal, herbal and cosmetic purposes associated with the phytochemicals found in the leaves. Unsustainable wild harvesting motivated studies investigating methods of promoting commercial cultivation by small-holder farmers.

Materials and Methods

A field trial of *Aloe ferox* seedlings was established on the ARC Research Farm at Addo, E. Cape, to evaluate the effect of management inputs on plant vigour and quality in terms of phytochemical content. Treatments included either compost, and/or mulch and/or organic fertilizer that were applied quarterly for two years. A randomised blocks design with 8 treatments was replicated four times. Leaves from treated plants and an untreated control were sampled each season and the content of Aloesin, Aloin A and Aloin B in the fresh (FM, mg/kg) and dry (DM, g/100g) matter determined using HPLC.

Results and Discussion

A significant interaction between sampling date and treatment was found for some of the compounds with similar trends for the seasonal effects across all treatments. During the first year, the Aloesin content (DM, g/100g) was higher during autumn and winter (~0.53) than during spring (0.39). The Aloin A and B DM content was higher during winter (0.40 and 0.36) than during autumn (0.20 and 0.20) or spring (0.27 and 0.20). Plants receiving only compost tended to be (16%) more vigorous than compost plus mulch after two years. The Aloesin DM content of the compost plus mulch treatment (0.90) was higher than of the mulch only (0.67) and the compost only (0.62). Treatments had no effect on Aloin A and B DM content.

Conclusions

Aloesin, Aloin A and Aloin B varied in aloe leaves with season, tending to be higher in the cooler, dryer winter months. Plants that received compost plus mulch tended to be less vigorous and to have higher Aloesin, Aloin B and Aloin A contents. The compromise between maximum growth, yield and quality may necessitate providing maximum inputs until harvest then restricting inputs and harvesting during cooler weather.

References

Keywords

indigenous crops, phytochemicals, sustainable harvesting

Near Infrared Reflectance Spectroscopic quantification of biochars in compost and soil

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Introduction

Biochar has been found to be very stable and resistant to degradation (Kuzayakov et al. 2014). Properties such as heterogeneity, chemical complexity, and the inherent recalcitrant nature of the C compounds have posed several challenges to quantifying biochar. Near infrared reflectance spectroscopy (NIRS) is a rapid and cost affective technique used for the quantification of many soil properties. Various chemometric methods of NIR spectra analysis are used to predict soil properties such as organic matter content. The partial least-squares regression (PLSR) method is the standard method used due to its simplicity and robustness (Nawar et al. 2016). This robust and all-encompassing nature of NIR combined with chemometrics could therefore allow for a sufficiently accurate and cost-effective method to measure the quantity of biochar and its stability of degradation over time.

Materials and Methods

NIR-based methods for quantifying biochar in compost and soil were created by constructing a calibration range of soils and compost mixed with pine and eucalyptus biochar. The spectra acquired were then used to create PLSR regression models that were used to predict biochar content in mature composts and field trial soils containing unknown quantities of biochar. The PLSR models were validated by comparing prediction results to proximate analysis (TGA) results of fixed C content in composts containing biochar.

Results and Discussion

PLSR models using NIR were successfully constructed to show strong correlations (R2 = 98.69 to 99.57) and prediction factors (RPD = 8.99 to 15.7) for quantifying biochar in soils and composts. The application of these models on compost and soils showed that predicted values were in general in the same order of magnitude as the proximate analysis results, but the values were generally 2-16% (compost) and 0.14-0.40% (soil) lower than the values estimated from proximate analysis.

Conclusions

The results showed that NIRS can be used as an estimate of biochar content, to within the same order of magnitude, in both composts and soils. This technique could be used for C stock audits and assessing biochar loss in soils over time.

References

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Keywords

Biochar, NIR, Quantification, Composts, Soils, C sequestration

WATER HARVESTING THROUGH IN-FIELD RUNOFF

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Introduction

In-field runoff refers to the transportation of water over the short distance of approximately 2 m representing the runoff strip in the in-field rainwater harvesting (IRWH) technique. Ex-field runoff occurs on areas of much greater size, i.e. cultivated lands on which conventional tillage (CON) is practised. Ex-field runoff has in general produced a negative attitude towards runoff amongst crop farmers, and rightfully so, because valuable water and soil are lost in the process.

Materials and Methods

To quantify the amount of water conserved by IRWH, runoff was measured with automatic tipping bucket runoff meters on separate runoff plots, each 2 m long and 3 m wide, on the Glen/Bonheim and Glen/Swartland ecotopes at Glen in the Free State Province of South Africa. The runoff plot treatments were: a) flat surface with minimum surface storage (bare); b) organic reed mulch on the flat surface (organic mulch); and c) inorganic stone mulch on the flat surface (stone mulch). Linear relationships that describe the precipitation/in-field runoff process on the different runoff strips were established and used to determine the water harvesting potential on a typical clay soil in a semi-arid area on a long-term basis.

Results and Discussion

The results indicate that organic mulch, stone and bare treatments have an 80% probability of harvesting 22 mm, 90 mm and 156 mm every year into the basins, respectively, compared to the CON tillage, which has a 80% probability of losing 40 mm of rainwater every year through ex-field runoff. This implies that the organic mulch, stone and bare treatments have resulted in estimated mean annual amounts of 62 mm, 130 mm and 196 mm, respectively, more rainwater being received in the 1 m basin area between crop rows than CON. This has been made possible by the total stoppage of ex-field runoff, and the in-field harvesting of rainwater.

Conclusions

It can be concluded that the application of the IRWH system and various mulching strategies has a high water harvesting potential on a typical clay soil in a semi-arid area through the stoppage of ex-field runoff and the in-field harvesting of rainwater. This contributes to higher soil water contents which in turn might result in higher crop yields as compared to CON tillage.

References

Keywords

in-field runoff, ex-field runoff, in-field rainwater harvesting and mulches

SOYBEAN (Glycine max L.) THE IMPORTANCE OF MAKING AN INFORMED CULTIVAR CHOICE

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Introduction

Soybean (Glycine max. L) production is currently the fastest growing grain commodity in South Africa. There are approximately 2000 commercial farmers, not counting developmental farmers that plant soybeans in South Africa. During 2015 season 657 300 ha soybean was planted and during 2016 planting season 502 800 ha. Making an informed cultivar choice is essential for producers to obtain optimum yield in their production area. The aim of this study is to compare agronomic and economic traits, to test the adaptability of cultivars to specific areas, collect data regarding the suitability of new cultivar releases.

Materials and Methods

Cultivar evaluation trials have been conducted at localities including warm, moderate and cool production areas. During the 2015/16 planting season 28 cultivars were evaluated. A total of 19 trials were planted at 18 localities. The trials were planted as randomized block designs as well as a Latinized row-column design using three replications with 28 cultivars. Each trial plot consisted of four 5m rows from which 4m of the middle two rows were harvested. All seeds were inoculated with Bradyrhizobium japonicum bacteria at planting. Observations that were done include: flowering date, harvest maturity, length of growing season, plant height, pod height, green stem, lodging, shattering, 100 seed mass, undesirable seed, protein and oil percentage and seed yield.

Results and Discussion

The average days to flowering was the shortest in the warm areas (43 days) and longest in the cooler areas (80 days), the choice of cultivars used in different climatic regions is very important. The longest average days to maturity was in the cool areas (149 days) and the shortest in the warm climatic area (113 days). It is advisable to use a cultivar with a shorter maturity grouping in the warm area vs a longer maturity grouping in the cooler regions. The effect of shattering is very important to prevent yield loss. It is advised to stagger the planting dates so that the capacity for harvesting per day will not be exceeded. A medium harvester has a capacity to harvest 20 – 25 ha per day. The percentage shattering was lower in the cool areas than the warmer areas and varied between cultivars planted.

Conclusions

Choice of cultivars to be planted in different climatic regions is very important when planting soybeans. Cultivars from different seed companies are evaluated yearly by the ARC and it is recommended to make use of the cultivar recommendations to make an informed decision.

References

Keywords

Keywords: Cultivar choice, climatic regions, maturity grouping, pod height

Breaking seed dormancy, improving germination and seedling growth in pecan [Carya illinoensis (Wangenh.) K. Koch]

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Introduction

Breaking the dormancy of seed through the use of chemicals is a general practice for many plant species. Although pecan is not a species with a high chilling requirement, methods of breaking dormancy may ensure more even and improved germination percentages. Stratification mostly involves the exposure of pecan nuts to low temperature (4-5°C), whereas improvement of germination involves different pre-soaking and temperature treatments (Goff et al., 1992; Dimalla and Van Staden, 1978). The aim of this study was to identify the best chemical treatment for breaking seed dormancy and also to investigate the effect of temperature on germination of pecan seeds in order to produce more uniform and vigorous seedlings.

Materials and Methods

Seeds were collected from a commercial orchard and stored in a refrigerator at 5°C for 4 months until used. All seeds were soaked in tap water for 24 hours in order to soften the hard seed coat. Seeds were then subjected to eight different chemical treatments: 2500 ppm KNO3; 5000 ppm KNO3; 500 ppm GA3; 1000 ppm GA3; 1% v/v HCl; and 2% v/v CH2N2 (Dormex) for 24 hours and 98% v/v H2SO4 for 2 hours. The control only received the cold and pre-soaking treatments. Seeds were sown in pots (1 L) containing a commercial growth medium. Pots were placed in the incubator in darkness for 14 days at two different temperatures namely 25°C, that is considered the ideal temperature of germination for most species in according to ISTA (International Seed Testing Association) and 28°C (De Villiers and Joubert, 2008). A complete randomized design, with 5 replications was used. Germination rates were recorded daily after sowing. Pots were removed from the incubator after 14 days and kept in the laboratory at room temperature (±24°C) for another 14 days. Stem length and leaf number of seedlings were recorded up to 28 days after sowing.

Results and Discussion

The best chemical treatments for breaking dormancy were 500 ppm GA3, 1000 ppm GA3 and 2500 ppm KNO3 and the fastest germination occurred at 28°C after 9 days. Seedlings showing the best growth, when shoot length and leaf number were considered, were those germinated at 28°C.

Conclusions

In conclusion, seed treated with 5000 ppm KNO3 and germinated at 28°C gave the best germination and most uniform seedlings, with more leaves than other treatments.

References

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Keywords

growth, germination, gibberellic acid (GA3), potassium nitrate (KNO3), hydrogen cyanamide (H2CN2) hydrochloric acid (HCl) and sulfuric acid (H2SO4),

WATER USE EFFICIENCY OF MAIZE INTERCROP SYSTEMS

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Introduction

Rural sub-Saharan Africa (SSA) faces the challenge of achieving food security under endemic poverty, high dependence on scarce natural resources, weak institutions, poor infrastructure, and more importantly water stress amplified by climate change and variability (Jayne et al., 2010). It was hypothesized that intercropping maize (M) with either bambara groundnut (B) or dry-beans (D) would result in better productivity and water use efficiency (WUE).

Materials and Methods

This was evaluated using a split–plot design with sub–plots arranged in a randomised complete block manner within the main plot and replicated three times. Water regimes [full irrigation (FI) and rainfed (RF)] were allocated to the main plots. Sub–plots comprised intercrop combinations, M (sole), B (sole), D (sole), MB (intercrop) and MD (intercrop). Data collected included soil water content (SWC), plant height (PH), leaf number (LN), leaf area index (LAI), stomatal conductance (gs), Chlorophyll flourescence (Fv/Fm), chlorophyll content index (CCI) as well as biomass accumulation and partitioning. Yield and yield components, water use (WU) and WUE for grain (WUEg) were calculated at harvest. Land equivalent ratio (LER) was used to evaluate productivity of the intercrop

Results and Discussion

Maize growth and development were unaffected by intercropping but its canopy size decreased ($P < 0.05$) (-6.7%, -10.6%, -19% and -16% for PH, LN and LAI, respectively) with decreasing water availability. Intercropping maize with drybeans improved gs (15%) and CCI (8.6%) of maize under low water availability. Productivity of maize across varying water regimes and cropping systems was stable with final biomass, yield and harvest index of 3.9 t ha-1, 1.98 t ha-1 and 38%, respectively. Overall, LER showed a 46% increase in productivity across all intercrop systems. Intercropping increased WU (15.64%). Improvements of WUEg were observed under MB and MD (54.65% and 46.98%, respectively) relative to maize monoculture. CONCLUSIONS

Conclusions

Intercropping maize with bambara groundnut or dry-bean is recommended for semi– arid environments since it can promote efficient use of water.

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Keywords

Intercropping; Land equivalent ratio; Water use; Water use efficiency

RESPONSE OF YELLOW QPM INBRED LINES TO DROUGHT STRESS TOLERANCE AT SEEDLING STAGE.

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Introduction

RESPONSE OF YELLOW QPM INBRED LINES TO DROUGHT STRESS TOLERANCE AT SEEDLING STAGE. N.E Chiuta * and C.S Mutengwa Department of Agronomy , Faculty of Science and Agriculture, University of Fort Hare, Private Bag X1314 Alice 5700, South Africa, nyashachiuta@gmail.com/201013391@ufh.ac.za and cmutengwa@ufh.ac.za Drought stress continues to be one of the most important abiotic stress factors that negatively affect growth and development of maize at all stages leading to immense reduction in crop yield. Naturally, plants undergo different morpho-physiological changes in a bid to resist detrimental effects caused by drought stress. The main objective of this study was to screen maize seedlings for tolerance to drought stress and to determine the relationship between proline accumulation and drought stress.

Materials and Methods

In this study, 18 yellow QPM inbred lines were screened for drought stress tolerance at seedling stage. The experiment was conducted in the growth chamber at the University of Fort Hare. The experiment was laid out in a 6 x 3 Randomized Incomplete Block Design (RCBD) and replicated three times. The experiment was run two times. Maize seedlings were exposed to drought stress treatment by growing them at 20% field capacity. As for the control, the seedlings were grown at 80% field capacity throughout the duration of the experiment, which was three weeks. Different morpho-physiological traits such as proline content, chlorophyll content, canopy temperature, photosynthetic yield, sub-stomatal carbon dioxide concentration, stem diameter and plant height were used to screen these inbred lines for drought stress.

Results and Discussion

Inbred lines exposed to drought stress differed significantly ($P<0.05$) for all recorded traits except for sub-stomatal carbon dioxide concentration. Generally, drought stress caused a reduction in all traits except for canopy temperature and proline content which increased under stressed conditions. Similar observations were observed by Mafakheri et al., (2010); Araus et al., (2011) and Ali et al., (2011). Proline content was the main factor used to screen these inbred lines for drought tolerance. Lines which showed a major increase in proline content compared to their control were depicted as tolerant. These include L34, L7, L24, L13 and L2.

Conclusions

Inbred lines L2, L7 and L17 performed better than other genotypes for most of the parameters measured under drought stress. Hence, these inbred lines were selected as drought tolerant genotypes. Additionally, results observed showed that plants accumulate high proline content under drought stressed conditions compared to well-watered conditions.

References

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Keywords

drought stress, proline, Quality Protein Maize (QPM), tolerant.

SCREENING OF YELLOW QUALITY PROTEIN MAIZE INBRED LINES FOR ACQUIRED AND BASAL THERMOTOLERANCE

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Introduction

Quality Protein Maize (QPM) has reportedly been demonstrated to have substantial nutritional benefits when used for human consumption and as feed for animals. However, abiotic stress factors such as heat stress and drought have indisputably become a huge threat in most maize producing areas, affecting the crop at different growth stages. Breeding for heat stress tolerance is still at an early stage and more work still needs to be done. In this study, inbred lines were screened for basal and acquired thermo-tolerance.

Materials and Methods

18 yellow QPM inbred lines were screened for tolerance to heat stress using the water bath and growth chamber techniques at the University of Fort Hare. In the water bath method, seeds were exposed to heat stress treatment by immersing them into a water bath set at 40.5oC for one hour (Setimela et al., 2007). Thereafter, the seedlings were placed into new petri dishes, covered with moistened germination towel and placed in the incubator set at 27.5oC to recover for three days. For the growth chamber experiment, seedlings were exposed to heat stress by increasing temperature by 5oC in every 24 hours (Kesic et al., 2013). Hence, day one (30oC day/27oC night), day two (350C day /32oC night), day three (40oC day /37oC night). After 3 days of acquired heat stress treatment, plants were exposed to a constant temperature stress of 40oC day /37oC night for three more days. A randomized incomplete block design with three replications was used for each of the experiment. Tolerance (TOL), heat susceptible index (HSI) and heat tolerant index (HTI) were used to identify tolerant genotypes.

Results and Discussion

Based on the water bath study, there was highly significant difference ($p < 0.001$) in coleoptile growth for basal thermotolerance and line 17, 24, 32, 33 and 12 proved to be tolerant. In a separate growth chamber study, line 3, 16 and 18 exhibited acquired thermo–tolerance. While basal thermotolerance is useful prior to emergency, acquired thermotolerance is effective after crop emergency. Combing these mechanisms of tolerance in single genotypes is highly recommended. Furthermore, these inbred lines should also be evaluated under field conditions to ascertain their thermotolerance at later stages of growth. Nevertheless, the thermotolerant genotypes identified in this study will be useful in plant breeding programs aimed at developing heat tolerant varieties.

Conclusions

Inbred lines 17, 24, 32, 33, 12, 3, 16 and 18 were depicted as thermo-tolerant.

References

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Keywords

heat stress, Quality Protein Maize (QPM), stress indices, thermotolerance

Rate and timing of nitrogen fertilisation for canola production in the Western Cape of South Africa

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Introduction

Canola (Brassica napus) is increasing in popularity as a cereal crop in the Western Cape. Nitrogen (N) is generally the most limiting nutrient to canola production. Nitrogen fertiliser guidelines for canola are currently adopted from international literature, and should be refined for the local environmental conditions. The aim of this study is to determine the optimal rate of N fertilisation, and the distribution thereof in the Western Cape.

Materials and Methods

Field experiments were conducted in 2015 at Langgewens and Altona in the Swartland, and Roodebloem (Southern Cape). The trial was laid out as a factorial arranged in a randomised block design, with six N rates (0, 20, 60, 90, 120 and 150 kg N ha-1), which was applied in one, two or three increments after planting, replicated in four blocks. Twenty kg N was applied at planting. The rest was divided in equal increments either 30 days after planting (DAP), 30 and 60 DAP or 30, 60 and 90 DAP. Soil mineral N, leaf area index (LAI) and biomass was determined at 30, 60 and 90 DAP. Yield and thousand kernel mass (TKM) was recorded.

Results and Discussion

Treatments had no effect ($P>0.05$) on soil mineral N content at any locality at any physiological stage with the exception of 90 DAP at Langgewens. Neither LAI nor biomass was affected by treatments ($P>0.05$) at any locality, at any physiological stage. Yield at Roodebloem was affected ($P<0.05$) by N fertilisation and treatments which had the highest yield were those who received 20 kg ha-1 at planting and 70 or 100 kg ha-1 at 30 DAP. These treatments did not differ ($P>0.05$) from treatments which received more than 60 kg N ha-1, regardless of the distribution. At Langgewens and Altona, N fertilisation had no effect ($P>0.05$) on yield, while TKM was not affected by treatments at any locality. The few differences observed, especially at Langgewens and Altona, could be ascribed to drought conditions, which may have prohibited efficient uptake of N during critical periods.

Conclusions

Preliminary results indicate optimum levels of 90-120 kg N ha-1, applied as 20 kg N ha-1 at planting and the remainder at 30 DAP at Roodebloem. No significant response to N applications was recorded in the Swartland. Due to lower N mineralization potential of Swartland soils, higher optimum levels are expected in normal and high rainfall years, than in the Southern Cape.

References

Keywords

Brassica napus, fertiliser distribution, fertiliser guidelines, Western Cape

EVALUATION OF FIVE VALENCIA CULTIVARS AT ARC-TSC ADDO

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Introduction

The citrus cultivar evaluation program at the Agricultural Research Council, Tropical and Subtropical Crops (ARC-TSC) in Addo fulfils an important role in evaluating Citrus scion cultivars. This program has been running since 1988 and evaluates various citrus scion cultivars, consisting of satsuma, clementine, mandarin, midseason, navel, valencia, lemon and pummelo cultivars. Information collected on these cultivars is an important source of knowledge that can be used by producers to make an informed selection of the best cultivar to plant for fulfilling their needs. The Valencia is a very important group of sweet oranges, with around 40 % of South Africa's citrus plantings consisting of valencias (CGA, 2015). Over the past few years there have been a variety of new valencia cultivars introduced into the market. However, even with the introduction of new valencia cultivars available for planting the standard varieties still seem to remain the most popular among producers (CFB, 2016), with 'Midknight', 'Valencia late' and 'Delta' being the most favored varieties.

Materials and Methods

Five valencia cultivars; 'Delta', 'Midknight', 'Du Roi', 'McClean' and 'Valencia late' were evaluated at Addo. Data was collected for internal fruit quality, as juice %, Brix %, acid % and the Brix:Acid ratio. At harvest, data was also collected on fruit size and yield.

Results and Discussion

'Midknight' had the highest Brix % and the best internal fruit quality. While 'Delta' and 'McClean' navels had a higher yield than 'Midknight', all the cultivars tested were shown to have a similar fruit size.

Conclusions

'Midknight' is the most popular Valencia with the greatest area planted of all the valencia cultivars. This can be attributed to its excellent internal fruit quality, which was found to be superior to all the other cultivars tested.

References

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Keywords

Citrus, Valencia, Midknight, fruit quality, yield

Growth, physiology and yield responses of selected sweet potato cultivars under different watering regimes

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Introduction

Food and nutrition insecurity remain prevalent in sub-Saharan Africa (SSA). Agriculture is the primary source of livelihood for rural communities in SSA and ultimately the primary solution to ensure food and nutrition security. Agricultural production is limited by water scarcity and recurring droughts. There is a need to identify crops that utilise less water while producing sufficient and nutritious yields. Sweet potato is considered to be a drought tolerant root crop with good nutritional value. The objective of this study was to determine growth, physiology and yield responses of three sweet potato cultivars to varying water regimes.

Materials and Methods

Sweet potato cuttings of three cultivars (A40, A45 and 199062.1) were sourced from ongoing trials at Ukulinga Research Farm (29°37’S; 30°16’E). A controlled environment trial (~33/18°C day/night and 65% relative humidity) was established under automated drip irrigation in tunnel beds at the university’s Controlled Environment Facility. The experimental design was a split-plot, arranged in a completely randomised design with water [30% and 100% crop water requirement (ETc)] as the main plots and cultivars as subplots replicated three times. Data collected weekly included growth (leaf number, vine number and length of the longest vine) and physiology (stomatal conductance, chlorophyll content and chlorophyll fluorescence). Yield and yield components were determined at harvest.

Results and Discussion

With respect to growth and physiology there were significant differences ($P<0.001$) between water treatments. Interestingly, plants produced under the water stress treatment generally performed better. Significant differences ($P<0.001$) were also observed among cultivars with respect to growth and physiology, with cultivar 199062.1 performing better compared to cultivars A40 and A45. No significant differences were observed with respect to yield and yield components between the different water treatments and among the sweet potato cultivars.

Conclusions

Plants produced under water stress performed better with respect to growth, physiology and yield. A similar experiment will be conducted to confirm these results.

References

Keywords

Food and nutritional security, Sub-Saharan Africa, Water stress

Busseola fusca moth flight patterns

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Introduction

Maize is the most important grain crop in South Africa, being the major feed grain and the staple food of the majority of the population. Busseola fusca, known as the African stemborer is the most damaging maize insect pest. This stemborer causes an average annual yield loss of 10% which can contribute to an annual yield loss of R 2.6 billion if 13 million tons are produced. Bt maize serves to alleviate the problem to a large extent, however since Bt resistance have be reported, insecticide applications again were highlighted. Therefore, the objective of this study was to re-evaluate B. fusca moth flight patterns to make an informed decision in when to apply insecticides.

Materials and Methods

The moth flight patterns of B. fusca were determined during the 2015/16 growing season for the first time since the 1980's by using pheromone traps. Six localities were selected for this study which included Bothaville, Middelburg, Ottosdal, Potchefstroom, Vaalharts and Vereeniging that are all situated in maize production areas of South Africa. At each locality three traps were placed 100m apart, to calculate the average number of moths per week. This gave an indication when the moth flights took place per locality. The percentage incidence damage at each field site were also determined.

Results and Discussion

The abundance of B. fusca moths recorded for 2015/16 growing season in Potchefstroom and Vereeniging were significantly higher than the other localities. The Vereeniging moth flight peaked at end January, start of February, and then again end March, start of April. The moth flight pattern for Potchefstroom had the same tendency. These flights differ from flights reported in the 1980's where peaks were end February and end April. Since this is the first season of monitoring and it was a dry season no clear conclusion can be made. The percentage damage recorded in Potchefstroom were significantly higher than the rest of the areas.

Conclusions

There are limited information on flight patterns of B. fusca and an update of new data can become of valuable use. If the flight patterns are well-known, the life stages of the majority of the population can be determined and the application of the insecticides optimised to control the maximum amount of stemborers. To fully comprehend and manage the suppression of B. fusca more effectively, further monitoring is being conducted.

References

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Keywords

Busseola fusca, moth flight pattern, pheromone traps, stemborer damage.

SENSITIVITY OF MELOIDOGYNE INCOGNITA JUVENILE MOBILITY TO PURE CUCURBITACINS AND PHYTONEMATICIDES

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Introduction

The Curve-fitting Allelochemical Response Dosage (CARD) computer-based model effectively explains the response of various biological entities to increasing concentration of allelochemicals in phytonematicides (Mashela et al., 2015). Sensitivity index (k) is one of the biological indices that is CARD-generated and provides the degree of sensitivity in biological entities to allelochemicals (Mashela et al., 2015). Due to limited information on the sensitivity of mobility in second-stage juveniles (J2) of nematodes, a study was initiated to investigate the sensitivity of Meloidogyne incognita J2 mobility to cucurbitacin A and B, which are pure active ingredients of Nemarioc-AL and Nemafric-BL phytonematicides.

Materials and Methods

Freshly hatched M. incognita J2 were exposed to pure cucurbitacin A and B concentrations at 0.00, 0.25, 0.50, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25 and 2.50 µg cucurbitacin.mL–1 distilled water and Nemarioc-AL and Nemafric-BL phytonematicides concentrations at 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 %. The treatments in separate cucurbitacin and phytonematicides experiments were replicated three times and arranged in a completely randomised design in an incubator set at 25 ± 2°C for 12, 24, 48 and 72 h. After the pre-alloted time intervals, each dish was emptied into a counting chamber, with the immobile J2 counted using a stereomicroscope. The data were subjected to analysis of varience, with the significant ($P \leq 0.05$) treatment means further subjected to the CARD model to generate the biological sensitivity indices.

Results and Discussion

The M. incognita J2 were sensitive to increasing concentrations of the four products, with J2 mobility having average sensitivity values of 4 units for both cucurbitacins, and 2 and 1 units for Nemarioc-AL and Nemafric-BL phytonematicides, respectively. The high sensitivity could be attributed to lipophilic properties of cucurbitacins that inherently disrupted the permeability of membranes, leading to uncontrolled efflux of ions and metabolites, resulting in paralysis, which was irreversible (Dube, 2016). Generally, the overall sensitivities of J2 to phytonematicides was higher than that of pure cucurbitacins, which suggested that the purification resulted in loss of efficacy in nematode suppression.

Conclusions

Generally, J2 mobility was highly sensitive to phytonematicides than the pure cucurbitacins. This, therefore, suggested that the products be used in crude extract forms.

References

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Keywords

active ingredients, cucumin, leptodermin, triterpenes

EVALUATION OF MORPHO-AGRONOMIC VARIABILITY OF CORCHORUS SPECIES

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Introduction

Introduction Corchorus species has a potential to improve food security and malnutrition status in rural households of South Africa. A number of Corchorus species have been collected in South Africa and conserved in a gene bank at ARC-VOP. In order to identify superior parental lines, the first step is to gather basic information on existing morphological variability of the cultivated species (Adebola and Morakinyo 2006). The objective of this study, therefore, was to characterise the Corchorus accessions in the ARC-VOP genebank to identify parental lines for a breeding programme.

Materials and Methods

Materials and Methods In November 2015 eleven Corchorus accessions were evaluated in a field experiment for morpho-agronomic traits using a randomized complete block design with three replicates. Genetic parameters were estimated for twelve quantitative traits such at plant height, leaf length, fruit length, the number of pods per plant, fresh mass, and dry mass. The experiment was conducted at ARC-VOP under rainfed conditions. However, supplemental overhead irrigation was applied if moisture stress was observed.

Results and Discussion

Results and Discussion Genetic parameters were estimated for 12 quantitative traits and showed considerable amounts of genetic variability. Maximum broad sense heritability was observed in fresh mass (93.79%), a number of pods (92.86%), fruit length (90.65%), and plant height (88.32%) suggesting additive gene effect in the expression of these characteristics. Significant variation was recorded among the yield traits. High values for the phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed in a number of traits. This suggests sufficient genetic variability to facilitate improvement through selection for these agronomic traits. Cluster analysis grouped the accessions into two major groups. Clustering the genotypes based on their genetic similarity will help in the identification of diverse parents for use in a breeding programme.

Conclusions

Conclusion The results from this study indicated the significant genetic variability among the Corchorus accessions studied. High broad sense heritability, the genotypic coefficient of variation and genetic advance in terms of different yield traits provide a good scope for identifying potential parental lines to be used in the Corchorus improvement programme in South Africa.

References

Reference Adebola P, Morakinyo J. 2006. Evaluation of morpho-agronomic variability of wild and cultivated kola in South Western Nigeria. Genetic Resources and Crop Evolution, 53: 687-694.

Keywords

Keywords: Corchorus, accessions, heritability, multivariate

Potential impact of climate change on extreme rainfall and agriculture over West Africa

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Introduction

This study examines impact of climate change on extreme rainfall events over West Africa and how this may affect agriculture (crop yield) over West Africa. The capability of RCA4 to reproduce the rainfall climatology, extreme rainfall events, characteristic of AEWs, and contribution of AEWs to extreme rainfall events over the region during the past climate (1971 – 2005) was examined and quantified using statistical analysis. The future changes (2031 - 2065) in these parameters were projected for RCP4.5 and RCP8.5 climate change scenarios.

Materials and Methods

Satellite observation (GPCP and TRMM), reanalysis (ERA-INTERIM), and regional climate model (RCA4) simulations (forced with eight global climate simulations) were analysed for the study.The study used 95th percentile of daily rainfall as a threshold to identify extreme rainfall events and applied spectral analysis to extract 3-5days and 6-9days AEWs from 700hpa meridional wind component over West Africa.

Results and Discussion

The results of the study show that RCA4 gives a realistic simulation of West African climate, including the annual rainfall pattern, AEWs, and the African easterly Jet that feeds AEWs. The bias in the simulated threshold of extreme rainfall is within the uncertainty in the observed values. The model also captures the link between the structure of AEWs and rainfall pattern over West Africa, and shows that the percentage contribution of AEWs to extreme rainfall events over the region ranges from 20 to 60% as depicted by reanalysis data. For RCP4.5 and RCP8.5 scenarios, the RCA4 ensemble mean projects a future increase in annual rainfall and in frequency and intensity of extreme rainfall events over the sub-continent, but the increase is generally higher for RCP8.5 scenario. It also projects a decrease in the frequency of rain days, no changes in the structure of the AEWs, and an increase in variance of the waves. However, the simulations from ensemble mean shows no substantial changes in the contribution of AEWs to the extreme rainfall events, suggesting that the increase in the frequency and intensity of the extreme rainfall events may not be attributed to the changes in AEWs.

Conclusions

The study show climate change impact will increase the frequency and intensity of extreme rainfall over West Africa may have negative effect on crop through flooding leading to soil erosion and crop damage. The study has application in reducing the impacts of extreme rainfall events over West Africa in the future on crop yield.

References

Keywords

Extreme rainfall events, African easterly waves, Agriculture, West Africa

GROWTH AND YIELD RESPONSE OF TWO GINGER SPECIES TO DIFFERENT IRRIGATION REGIMES

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Introduction

Ginger is well known for its medicinal properties and is also often used as a spice. Little information is, however, available on the effect of water availability on the growth and yield of ginger in South Africa. The aim of the study was to examine the growth, yield and water use of ginger species in response to water stress.

Materials and Methods

In November 2015, commercial (*Zinziber officinale*) and wild ginger (*Siphonochilus aethiopicus*) were planted under a rain shelter at the Hatfield Experiment Farm of University of Pretoria, South Africa. The experiment was laid out in a complete random block design with three blocks. Each experiment unit was 4 m2 with eight rows per treatment. The spacing was 0.25 m between the rows and 0.25 m in the rows. The irrigation treatments was as follows: Irrigation 1 (control): Soil brought to field capacity when 20-25% of available soil water (ASW) was depleted; irrigation 2: Soil brought to field capacity when 40-45% of ASW was depleted; irrigation 3: Soil brought to field capacity when 60-65% of ASW was depleted and irrigation 4: Soil brought to field capacity when 80-85% of ASW was depleted. Height, tiller and leaf number, LAI, FIpar, fresh and dry rhizome yield and water use were measured.

Results and Discussion

Under well watered conditions, height, tiller and leaves increased as compared to the stressed treatments. LAI and FIpar was increased under well watered conditions for both ginger species. Wild ginger showed the highest LAI and FIpar as compared to commercial ginger. Fresh and dry rhizome yield were increased with less water stress. Fresh and dry yield differences amongst species were significant ($P<0.05$) with both being higher for commercial ginger as compared to wild ginger.

Conclusions

The experiment shows that the growth and yield of the ginger species studied respond positively to irrigation. Wild ginger tend to have higher LAI and FIpar values than commercial ginger, but the yield of commercial ginger was higher.

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Keywords

Dry yield, Ginger, fresh yield, growth yield, species, water use.

Acknowledgements

The Oppenheimer Memorial Trust, The National Research Foundation (NRF), Department of Science and Technology, European Union and Agricultural Research Council (ARC) for funding this study.

Diversity analysis using phenomic markers in Amadumbe (Colocasia esculenta (L.) Schott) genotypes in South Africa

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Introduction

Amadumbe is one of the most important staple food crops in the world. In South Africa, it is especially popular among farmers with limited resources. Amadumbe is used as a staple food and is rich in carbohydrates, protein, minerals and vitamins. Information on genetic variability among the existing Amadumbe genotypes will increase the efficiency of the Amadumbe improvement production program.

Materials and Methods

The field experiments were conducted at two sites (Roodeplaat research farm, and Umbumbulu at farmers field) in South Africa in 2013, 2014 and 2015 cropping season to estimate the level of genetic variability and yield stability among a collection of 29 Amadumbe genotypes. The experiment was laid out in a randomised complete block design, with three replications. Data was analysed using Agrobase Generation II computer software (2008).

Results and Discussion

Nine quantitative morphological traits were recorded. Analysis of variance for the traits revealed that differences among Amadumbe genotypes were highly significant for all traits. This indicated that there was a high level of genetic variability among the genotypes studied. Genetic and phenotypic coefficient of variation, and broad sense heritability were estimated for all phenotypic traits. The principal component analysis also showed the total variability among the genotypes. Cluster analysis of the phenotypic traits resulted in different distinct groups of genotypes.

Conclusions

The quantitative traits provided a useful measure of genetic distances among the Amadumbe genotypes and will enable the identification of potential parental materials for future breeding efforts for increased production, which will contribute towards a direct economic benefit for the community and an increase in the status of the crop. The Amadumbe genotypes AM-43, UM-3, Amzam3053/5118, UM-1, and Um-2 provided the highest yield compared to the rest of the genotypes and are recommended as suitable parental lines for crop procution improvement in South Africa.

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Agronomix. 2008. Agrobase Generation II. Agronomix Software, Inc. 71 Waterloo St. Winnipeg, Manitoba, R3N054, Canada.

Keywords

Amadumbe, genotypes, heritability, phenotype, principal component analysis

Effect of different calcium application levels on the quality, growth, development and yield of potato tubers.

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Introduction

Calcium is one of the most abundant elements in soil and this element contributes to the maintenance of cell membrane stability and cell wall structure of plants. Recent studies have provided evidence that by improving the potato (Solanum tuberosum) tuber Ca level, quality is improved through a reduction in tuber internal defects and an improvement in storability. The purpose of the present study was to determine the influence of Calcium (Ca) application rates on the growth, yield, development, tuberization and tuber quality of potatoes.

Materials and Methods

The experiment was conducted in a greenhouse and it was a laid out in a factorial design with each treatment combination repeated four times. Potato seed tubers (G1/G2) of four cultivars (Mondial, Sifra, Lanoma and Innovator) were used in this study. Seedlings were transplanted to 20L bags containing silica sand. Plants were drip irrigated with a nutrient solution containing 4 different concentrations of Calcium (1.1, 3.2, 6.6 and 9.8 meq L-1).

Results and Discussion

Tuber weight, shoot fresh weight and shoot dry weight was affected by the Ca application levels and also differed between the cultivars. Lanorma cultivar yielded tubers which had a good visual quality with and fewer number of observations was recorded for tubers which did not have good visual quality. The shoot: root ratio was affected by the Ca application level and also differed between the cultivars. Applying medium levels of Calcium (3.2 meq L-1) significantly increased tuber yields, however, further increases in calcium levels (9.8 meq L-1) did not have a positive effect.

Conclusions

Mondial performed better in terms of tuber yield. Application of 3.2 meq L-1 Ca through drip irrigation therefore was most beneficial to yield parameters (tuber yield, shoot fresh weight and harvest index) in the selected cultivars.

References

Keywords

calcium, cultivars, potato, tubers, yield

SHORT-TERM EFFECTS OF CROP ROTATION AND CROP RESIDUE MANAGEMENT ON SELECTED SOIL CARBON FRACTIONS IN TWO EASTERN CAPE ECOTOPES

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Introduction

Soil organic carbon (SOC) is a major indicator of soil quality and its low short-term response to management changes has prompted the search for more sensitive indicators to monitor short term changes in soil quality. The objective of this study was to investigate the short-term effects of crop rotation and residue management in a no till system on selected soil carbon fractions of the Alice Jozini and the Phandulwazi Jozini ecotopes in the Eastern Cape.

Materials and Methods

The study made use of plots from a larger field trial laid out in a split split-plot design at the two ecotopes to investigate the interactive effects of tillage, crop rotations and residue management on soil health and crop productivity. Two sampling depths of 0-5cm and 5-10cm were considered. Four carbon fractions were measured namely SOC, microbial biomass carbon (MBC), mineralized carbon (CO_2-C) and particulate organic matter carbon (POM-C).

Results and Discussion

Crop rotations had no significant effect on almost all of the selected carbon pools except on microbially respired C. Significantly more CO_2-C was respired in maize-fallow-soybean and maize-wheat-soybean rotations than in maize-wheat-maize and maize-fallow-maize rotations, indicating greater microbial activity in the rotations which included soybean. Residue management significantly affected all of the selected carbon pools. Crop residue retention as opposed to its removal enhanced all carbon pools indicating its importance in microbial optimization and overall SOM build-up. The fine POM-C and mineralizable soil C fractions were found to be more sensitive to short-term treatments of combined CA components than soil organic carbon and microbial biomass carbon, therefore they can be used as short-term indicators of SOM changes and microbial activities in the two ecotopes.

Conclusions

The study demonstrated that retaining crop residues on the soil surface after crop harvest had positive influence on soil carbon fractions. The crop rotations did not significantly influence most of the soil carbon fractions. These findings suggest that in the short term soils respond faster to residue management interventions than crop rotations. Mineralizable CO_2-C and fine POM-C were more sensitive to combined CA components than other soil carbon fractions.

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Keywords

Conservation agriculture (CA); Soil carbon fractions Acknowledgements National Research Foundation (NRF) for funding the research

AGRICULTURAL SYSTEMS AND SOIL MICROBIAL COMMUNITIES

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Introduction

Soil has traditionally been seen as a “dead” agricultural medium, being injudiciously ploughed, drenched in herbicides and pesticides, crop residues were burned, and fields were left bare and vulnerable to nature’s elements, with precious fertile topsoil being blown or carried away during wind and rainstorms. The vital role of soil microorganisms in agriculture have only recently gained popularity with South African farmers after they experimented with various agricultural practices in an effort to increase their yields and soil’s health/quality in a sustainable way. The aim of this study was to develop a better understanding of the effects of locality, cropping sequence, soil mulch cover, and tillage practice on microbial diversity and activity.

Materials and Methods

The Soil Microbiology Laboratory has been analysing soils collected from various localities at different long-term trials aimed at studying the effects of different agricultural management practices on soil microbial communities since 2006. Soil sub-samples were collected aseptically at a depth of 150mm per treatment combination, pooled, and stored at 8 ºC until analysis. Collected soil samples were split into two batches. Carbon source utilisation profiles were determined from one batch by inoculating soil suspensions into Biolog EcoPlatesTM. Soil microbial diversity was determined using the amount and equitability of 31 carbon sources metabolised as indicators of richness and evenness, respectively. The second batch was air-dried at 40 ºC, sieved (2mm), stored at 8 ºC and soil microbial enzyme activity determined. ß-glucosidase, acid- and alkaline phosphatase and urease activities were calculated with reference to applicable calibration curves.

Results and Discussion

Soil microbial diversity and activity (dynamics) differed between localities. Cropping systems greatly influenced microbial dynamics, with maize monoculture and bare soils exhibiting the lowest microbial diversity and activity. Conventional tillage greatly reduced microbial dynamics, contrary to minimum soil disturbance. Soil mulch cover increased microbial dynamics.

Conclusions

Due to the sensitivity of soil microbial communities used as “early warning systems” of a soil’s health status, agricultural management practices greatly affected soil microbial dynamics. Variation in microbial dynamics between different cropping systems demonstrated the ability of different crops to recruit different microbial communities. These analyses could be implemented by farmers and researchers to monitor the impact of agricultural practices on soil microbial populations, agricultural sustainability, soil health, and crop yield.

References

Keywords

cropping systems, microbial activity, microbial diversity, soil disturbance, soil mulch cover, soil quality.

Characterisation of hybrid yeast strains used for aromatic Sauvignon blanc wine production

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Introduction

The wine yeast *Saccharomyces cerevisiae* varies in its ability to develop the full aroma potential of Sauvignon blanc wine due to an inability to release bound aroma-inactive metabolites which impart fruity and tropical aroma notes during fermentation. Furthermore, anecdotal data suggests that some wine yeast strains commercially available intermittently exhibit undesirable characteristics e.g. volatile acidity (VA) formation which imparts vinegar-like aromas. Therefore, a trial was undertaken to select and evaluate novel ARC hybrid yeast strains for the production of Sauvignon Blanc wine with enhanced fruity and tropical aromas, but lower VA.

Materials and Methods

Residual glucose/fructose, ethanol, VA, titratable acidity (TA) and pH of final wines were determined using Fourier transform infrared (FTIR) spectroscopy. Fruit aroma-enhancing metabolite (e.g. esters) and total acid (e.g. acetic acid) levels that are associated with VA in final wines were determined using GC-MS. Tropical fruit, passion fruit and grapefruit aroma-enhancing metabolite (e.g. 3-mercaptohexanol [3MH] and 3-mercaptohexylacetate [3MHA]) levels in final wines were determined using SPE GC-MS/MS. Final wines were also subjected to sensory description by an expert panel consisting of 14 members who were requested to indicate the perceived aromas normally associated with Sauvignon blanc wines.

Results and Discussion

Most hybrids produced wines with a negative association with VA. Despite some reference yeasts producing wines with a closer association with VA, Hart et al. (2016) reported that VA levels comply with legislation. All yeast strains included in this study produced wines with pH 3.3 ± 0.05. Said pH is desirable, since wine aroma and complexity are optimal. Most hybrids on average had sugar to alcohol (%) conversion factors in the range of 0.51 – 0.60, which is lower than that of a moderate fermenting reference yeast i.e. WE 14 (Anchor Wine Yeast). This is a positive observation as consumers globally are becoming more health conscious and prefer wines with a lower alcohol percentage. Some hybrids produced wines with a positive and negative association with esters and acetic acid, respectively. Furthermore, some hybrids produced wines with prominent tropical and floral aromas. This can be attributed to the fact that said hybrids also produced wines with higher volatile thiols levels.

Conclusions

It is envisioned that promising hybrids will be evaluated on a larger scale for production of aromatic Sauvignon blanc wines.

References

Keywords

Hybrid yeasts, CHEF, MALDI-TOF/TOF MS Biotyping, Sauvignon blanc, tropical fruit aroma, volatile acidity

Physiological, morphological variation and genetic diversity of cowpea (Vigna unguiculata L. Walp) landraces from Northern Ghana, revealed by RAPD and SSR markers

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Introduction

Cowpea (Vigna unguiculata L. Walp) is valued as a major source of essential amino acids in most tropical diets which consist predominantly of starchy cereals, roots and tubers. Despite the important role of cowpea in the socio-economic livelihood of northern Ghana, average yield on farmers' fields is low (0.4MT ha). Among the several factors that account for low on-farm yield includes; poor soil fertility especially nitrogen (N) and phosphorus (P) deficiency, insufficient moisture during crop growth periods due to short duration and/or low quantity of precipitation

Materials and Methods

Materials for the study were 50 cowpea genotypes/varieties, collected from farmers' fields in northern Ghana and elite lines from CSIR-SARI, Ghana. Field trials were conducted in each of the three agro-ecological zones of northern Ghana for two seasons in June, 2014 and 2015 for characterisation. Treatments were 50 cowpea genotypes planted in a RCBD with four replications (50 x 4 x 3). Treatment plots consisted of four-rows. Plots were 4.0 m long and 1.80 m wide. Spacing between rows was 60 cm and within rows spacing of 20 cm with two plants per hill. The N-difference, ureides assay and N natural abundance techniques were used to assess N fixing ability of the test genotypes. Five seeds of each cowpea accession were grown in pots and leaf samples collected at seven days old and crashed using liquid nitrogen (-196) for DNA isolation.

Results and Discussion

Results showed genotypic variation in trifoliate leaf shape and colour. Based on %Ndfa, 69% of the test genotypes were high N fixers. Among the eight RAPD primer combinations, six distinguished the genotypes into three clusters with 0.00 to 0.5 Jaccard's similarity coefficient. Twenty-nine of the 33 SSR primer combinations yielded polymorphic bands. A total of 59 alleles with an average of 2.03 alleles per locus were detected. Eleven most polymorphic SSR primers successfully distinguished all 49 varieties of cowpea tested. Primers SSR25 and CLIM30 formed the highest number of alleles, 5 in total. The dendrogram generated from SSR data grouped the test accessions into 21 clusters with 0.72 to 0.96 Jaccard's similarity coefficient. The cluster, ormondow", showed highly significant genetic diversity among all accessions. The polymorphic information content (PIC) ranged from 0.04 to 0.48 (mean = 0.15).

Conclusions

These results showed that molecular markers can be used to select and identify elite cowpea varieties for improvement and germplasm management in Ghana

References

Keywords

Morphological variability, N fixation, polymorphism, Vigna unguiculata

DETERMINING THE QUALITY OF FIRST GENERATION DRY BEAN SEED LOT IN RESPONSE TO PLANT DENSITY AND WATER REGIME DURING FIELD PRODUCTION

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Introduction

The aim of this study was to determine the quality of first generation dry bean seed following a certified seed lot. The hypothesis was that the cropping season can be extended by planting the saved seed if the environmental and management conditions permit.

Materials and Methods

Certified seeds were purchased and tested the International Seed Testing Association (ISTA) rules were used to test for germination using three replications. A field trial was designed as a split plot where rain-fed and irrigation as the main plots within which the three cultivars (Mtata, Malelani, and Gadra) were planted at three densities, 40 000 plants/ha, 67 000 plants/ha and 100 000 plants/ha, respectively. Seed germination quality of harvested seeds was determined using the same method as described for certified seed.

Results and Discussion

Seed quality of the certified seed lot showed a significant difference between cultivars. Mtata had an average of 93% germination, while the other two cultivars averaged at 82% each. However, there were no significant differences with respect to germination vigour index GVI. Field crop establishment was not significantly different among cultivars. There were significant differences between cultivars with respect to germination after harvest. Germination Velocity Index showed that there was a significant difference ($P<0.05$) for the interaction of water regime x density x cultivar. Across all densities and for all cultivars GVI was higher under irrigation compared with dry land conditions.

Conclusions

The first seed quality of dry beans can be maintained in the first generation of certified seed. However, water availability and plant density have interactive effects on seed quality.

References

Keywords

Germination, plant density, water regime

Influence of temperature and photoperiod on the germination of two endemic Aloe species

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Introduction

The growing trade of Aloe for medicinal and cosmetic properties has led to the decline of many Aloe species. Among the endemic and rare or threatened Aloe species in South Africa are Aloe peglerae and Aloe reitzii. Developing propagation techniques for the sustainability of these species has become a necessity to safeguard the species against extinction. Although propagation of rare Aloe species is relatively inexpensive, scientific information on seed biology that is crucial for their subsequent cultivation is still lacking for these Aloe species. This study investigated the effects of temperature and photoperiod on seed germination of these two endemic Aloe species.

Materials and Methods

Germination trials were carried out in Petri dishes lined with a double layer of filter paper and moistened with distilled water. The effect of temperature was evaluated by incubating the seeds of each species at constant temperatures of 15°C, 20°C and 25°C under a 16 h photoperiod. In order to determine the effect of photoperiod on seed germination, seeds were incubated under continuous dark, continuous light and alternating light (16 h light) conditions at a fixed temperature. Each treatment had four replicates of 25 seeds/petri dish. Seed germination was recorded daily. Mean germination time (MGT), mean germination rate (MGR) and germination percentage (GP) were calculated. The chlorophyll and carotenoid contents of germinated seed were quantified.

Results and Discussion

Although there was no significant difference in MGR and GP, temperature significantly affected the MGT in both species. There was a decrease in MGT with an increase in temperature. Furthermore, both total carotenoids and total chlorophyll significantly increased with an increase in temperature. Photoperiod significantly influenced the MGT in both species. The lowest MGT was recorded with seeds placed under constant dark condition.

Conclusions

An optimum temperature of 25°C is recommended for the germination of both species. For the purpose of resultant seedling vigour, the use of alternating photoperiod may be more advantageous. Variability in germination period as influenced by temperature and photoperiod can affect seedling vigour and cultural practises for subsequent cultivation of these species.

References

Keywords

Aloe peglerae, Aloe reitzii, mean germination time, mean germination rate, germination percentage

A 2DS Chromosome Carries a Complex of Leaf Rust Resistance Alleles in Wheat

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Introduction

Leaf rust (Lr) caused by Puccinia triticina Eriks affects most wheat (Triticum aestivum L.) production areas in South Africa. It is more prevalent in the winter rainfall and irrigation areas (Pretorius and Le Roux 1988; Pretorius et al. 2007; Terefe et al. 2009). P. triticina has the potential to cause significant yield losses up to 50% and can negatively impact food security and quality (Boshoff et al. 2002). Leaf rust is currently managed by the application of fungicides and/or by growing resistant cultivars. More than 70 Lr resistance genes (McIntosh et al. 2013) and numerous quantitative trait loci associated with Lr resistance (Li et al. 2014) have been mapped to chromosome locations in wheat. However, the characterized resistance genes do not give effective resistance owing to changes in the pathogen population. Consequently, constant search for the novel resistance genes is essential in order to manage the dynamic and rapidly evolving pathogen population. Moreover, most Lr resistance genes are inherited independently of each other. Nonetheless, two or more genes on the same chromosome may show varying degrees of linkage. The Lr15 gene was recently mapped in the vicinity of Xgwm4562 and Xgwm102 by Dholakia et al. (2013) and the Lr2 locus was also mapped within the similar vicinity (Tsilo et al. 2014). The Lr2 locus on 2DS has three known resistance alleles, Lr2a, Lr2b and Lr2c. Thus, the objective of the study was to determine if the two genes (Lr2 and Lr15) are either tightly linked or allelic through carrying out an allelism test.

Materials and Methods

A cross between RL6019 (Lr2b) and RL6052 (Lr15) was created and more than 1600 F2 lines were inoculated with race 3SA115. DNA was also extracted from the leaves using a modified CTAB DNA extraction protocol, followed by PCR screening with molecular markers (Xgwm102 and cfd43). The PCR products were then resolved on certified low melting agarose gel.

Results and Discussion

Both parents and 1670 F2 lines showed resistance to 3SA115 with infection types of ;1 and 1. A lack of observing susceptible individuals out of that large number of lines suggested that the Lr15 gene is another allele of Lr2, adding to Lr2a, Lr2b, and Lr2c. Because these alleles provide resistance against a larger number of races in South Africa and elsewhere in the world, molecular markers linked to these alleles, reported in 2013 and 2014 studies, should facilitate the deployment of these alleles in wheat breeding programmes.

Conclusions

An allelism test revealed that the Lr15 gene is another allele of Lr2, adding to Lr2a, Lr2b, and Lr2c.

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Keywords

allelism, leaf rust, 2DS chromosome, resistance, wheat

EFFECT OF GLYPHOSATE APPLICATION IN COMBINATION WITH FOLIAR PLANT NUTRITIONAL PRODUCTS ON THE LEVELS OF MACRO- AND MICRO ELEMENTS IN MAIZE

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Introduction

Glyphosate is a broad spectrum herbicide applied post-emergence to transgenic Roundup Ready (RR) crops. In addition to its herbicidal properties glyphosate is a strong broad-spectrum chelator to macro- and micronutrients. Studies have indicated that the nutrient availability of micro-nutrients may decrease where glyphosate have been applied. The aim of this study was to screen RR hybrids to determine if there is any effect on macro- and micro elements when nutritional products are applied alone or in combination with glyphosate.

Materials and Methods

Field trials were planted at Potchefstroom during 2014/15 and 2015/16 seasons to determine the effect of nutrient uptake when glyphosate was applied alone or in combination with foliar applied nutrient products. Four Roundup Ready® maize cultivars were planted (DKC73-76R, KKS4479R, BG5685RR, PHB32Y86BR) and four products were applied (NutriVo, Molboro, Functional, Stimulant) at the V6 growth stage of maize. The leaf opposite the ear was sampled for leaf analysis and several yield parameters were recorded at physiological maturity of the crop.

Results and Discussion

Results regarding macro- and micro elements were inconclusive across treatments and seasons, but some tendencies were observed. The macro element levels of phosphorous (P) and potassium (K) were reduced in most of the treatments when compared to control treatments for both seasons for the hybrid DKC73-76R. This tendency was also observed for levels of the micro elements, Fe, Cu and Zn with regard to DKC73-76R.The cultivar x treatment interaction was significant with regard to mass ear-1 for the 2015/16 season. DKC73-76R showed the highest decrease in ear mass where NutriVo and Molboro were applied alone or in combination with glyphosate, respectively. Ear mass was lower in all the treatments when compared to control treatments for PHB32Y86BR.

Conclusions

The variation in results could be ascribed in part to the extreme drought conditions that prevailed during 2015/16 season. The differences observed were more cultivar related, exceeding treatment effects. Research has shown that the application of glyphosate may act as an additional stress during drought conditions for certain soybean cultivars and may be the case with glyphosate applied to maize cultivars tested in this study. Future research should be done under more controlled conditions and leaf analysis should rather be taken over time to elucidate variation in especially micro-element levels.

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Keywords

Chelator, glyphosate, micro elements, maize, yield

EFFECT OF GAMMA IRRADIATION ON YIELD AND FRUIT CHARACTERISTICS OF NAVEL ORANGES

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Introduction

Mutation breeding is used complementary to the conventional citrus breeding programme at the ARC-TSC. The main approach in mutation-based breeding has been to improve the well-adapted plant varieties by altering one or two major traits (Ahloowalia et al., 2004). Although negative mutations can be induced, the benefit from a single positive mutation can have a huge impact. Although the most common characteristics citrus mutation breeding is used for are seedlessness, improved internal and external pigmentation and fruit rind thickness there is always a probability that other attributes not clearly visible to the eye, have also been mutated. The aim was thus to see what the influence of the radiation dosage (40 Gy) aimed at seedlessness, improved internal and external pigmentation and fruit rind thickness was on attributes such as yield, fruit size distribution, juice percentage and sugar content.

Materials and Methods

Two early maturing navel cultivars ‘Bahianina’ and ‘Washington’ were irradiated at 40 Gy to induce mutations. The irradiated buds were grafted on Carrizo rootstocks and field planted at Addo research station. The trees were evaluated for yield and the distribution of fruit size on the trees as yield on its own may give an indication of the performance of the tree but does not give a clear indication of the profitability as dictated by specific markets.

Results and Discussion

Yield per tree varied from 11.51 to 35.48 kg amongst the ‘Bahianina’ mutated trees and from 1.67 to 23.79 kg amongst the ‘Washington’ mutated trees. There was no difference with regard to the variance in average fruit mass. With regard to fruit size distribution both Washington navel and Bahianina peaked at a fruit size of 75mm diameter. However, in Washington four of the trees deviated from this with equal spread of fruit in all size classes. The ratio of Total Soluble Solids (TSS) to Titratable acidity (TA) in Washington navel varied from 6.3 to 9.6 and in Bahianina varied from 5.2 to 8.2. This variation is higher than in a clonal population of the same age that have not been subjected to a mutagen

Conclusions

Mutation breeding is aimed at specific attributes such as seedlessness and improved internal and external pigmentation which presumably involve a small number of genes. However, from the current study it is evident that irradiation also had a great influence on complex inherited attributes such as yield.

References

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Keywords

Mutation, breeding, Citrus, cultivar, Navel, internal quality, yield

YIELD AND GROWTH OF NON-HEADING CHINESE CABBAGE (BRASSICA RAPA L. SUBSP. CHINENSIS) AS AFFECTED BY DIFFERENT IRRIGATION WATER APPLICATION REGIMES

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Introduction

Non-heading Chinese cabbage (Brassica rapa L. subsp. chinensis) is an important indigenised leafy vegetable in rural areas of South Africa, where it is primarily grown during the dry winter months, making it reliant on irrigation for its water requirements. Since water is becoming a very scarce resource in South Africa, there is a need to optimize crop water productivity through the application of limited amounts of irrigation water, while stabilizing the crop yield. Thus, the objective of this study was to determine the effect of different irrigation water application regimes on yield and growth of non-heading Chinese cabbage in order to identify the best irrigation scheduling practice for maximum irrigation water use efficiency.

Materials and Methods

A trial was carried out under a rain-out shelter during the 2015 winter season at Agricultural Research Council-Vegetable and Ornamental Plant (ARC-VOP) in Roodeplaat (25°35' S; 28°21' E; 1164 masl), Pretoria, South Africa. The trial was laid out in a completely randomized block design, with four management allowable depletion levels (MAD) applied through drip irrigation: 20, 40, 60 and 80% depletion from the available water capacity. Irrigation water management within the root zone was monitored using a neutron probe and tensiometers. Crop performance was analysed in terms of variability in yield, canopy growth and physiological responses using GenStat statistical software, version 14. Treatment means were compared using Duncan’s multiple range test at the 5% level of significance.

Results and Discussion

Results demonstrated that non-heading Chinese cabbage at the experimental site needed to be irrigated at least twice per week to maintain the water of the rooting zone close to field capacity (20% allowable depletion level) in order to achieve maximum fresh marketable yield (39 t ha-1). Increased soil water stress significantly reduced yield, growth and physiological attributes (leaf stomatal conductance and leaf chlorophyll content) of the crop. Consequently, considerable reductions in irrigation water use efficiency were observed (from 0.08 t ha-1 mm-1 at 20% MAD to 0.03 t ha-1 mm-1 at 80% MAD).

Conclusions

Based on experimental results from this study, non-heading Chinese cabbage is not an efficient user of water, which suggests that the implementation of deficit irrigation may not be an adequate strategy to maximize water use efficiency, since it significantly reduces crop yield and growth, with possible negative impacts on crop quality as well.

References

Keywords

deficit irrigation, indigenised leafy vegetable, water use efficiency.

DETERMINING PLANTING DATE OF SHORT DAY ONION CULTIVARS FOR THE PRODUCTION OF OUT OF SEASON ONIONS AT ADELAIDE (EASTERN CAPE, SOUTH AFRICA), USING DIFFERENT PLANTING DATES

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Introduction

Out of season onion production is used to produce onions for the early winter market (April to September) when onion prices peak (Directorate of Statistics and Economic Analysis 2011). According to Jordaan *et al*. (2016) 'Z516' is currently the only short-day onion cultivar recommended for out of season onion production in Adelaide and a larger variety of suitable cultivars needs to be identified. According to Okporie and Ekpe (2008) photoperiod and temperature are the most important environmental factors that influence growth and development of onions. Van der Merwe (2006) states that slight deviations from optimum can have dramatic effects on an onion crop. Bulb initiation and development are regulated by photoperiod and cultivars differ with regard to the minimum photoperiod required for bulb formation. Planting dates should enable suitable climatic conditions for the obtainment of high marketable yields. A trial was designed to determine the most suitable planting date for out of season onion production at Adelaide (Eastern Cape, South Africa), using two short day cultivars and different planting dates.

Materials and Methods

A field trial was planted at Adelaide with 'Z516' (early maturing cultivar) and 'Star 5504' (medium maturing cultivar). The trial was established with sets (bulbs 10-12 mm diameter) on five planting dates (late January, mid February, late February, mid March and late March) in a complete randomized block design with four replications. Marketable and unmarketable yields were recorded and percentage marketable yield of total yield calculated.

Results and Discussion

The highest marketable yields for the early maturing 'Z516' were recorded when sets were planted during mid February (43.65 t ha-1) and late February (46.93 t ha-1). 'Star 5504' also yielded the highest marketable yields for these planting dates (44.55 t ha-1 and 53.77 t ha-1, respectively). There were no significant differences between these yields. 'Z516' produced the highest marketable percentage for the mid February (72%) and late February (83%) planting dates, while 'Star 5504' produced lower marketable percentages for these planting dates (61% and 64%**,** respectively). Although 'Star 5504' yielded more marketable bulbs than 'Z516' for the late February planting date, 'Z516' had a much higher marketable yield percentage (83%) compared with 'Star 5504' (64%), indicating that 'Z516' is more resilient to changes in climate that cause bulb defects.

Conclusions

Cultivar selection for out of season production should be limited to short day onions that are early maturing and sets should be planted from mid to late February in Adelaide.

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Keywords

day length, marketable yield, onion cultivar, planting date, sets

Impact of Growth Habit and Architecture Genes on Adaptation and Performance of Bread Wheat

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Introduction

In bread wheat (Triticum aestivum L.), flowering time and plant stature are important phenological and agronomic traits for season adaptation, yield potential and yield stability. Timely heading is critical for production, and the flowering window has to be late enough to avoid early season frosts but early enough to avoid late season stresses such as heat and terminal drought. Extensive research to dissect the quantitative nature of flowering time in bread wheat (and other cereal crops) using model crop species revealed that the trait is controlled mainly by vernalization, photoperiod response and earliness per se genes. Consequently, a number of these genes have been successfully identified, cloned and their functions predicted in wheat and closely related species. Flowering time is also affected by plant height. Shorter or semi-dwarf genotypes are reported to flower earlier than the taller or normal ones. However, the negative correlation between earliness and yield remains a challenge in wheat breeding programmes, posing a need to modify flowering time to suit local climatic conditions while maintaining or even increasing yield potential.

Materials and Methods

Vernalization, photoperiod response, earliness per se and height-reducing genes can be exploited to fine-tune growth and development and tailor flowering time for the production of desirable wheat cultivars. Tailoring flowering time could help reduce pre-harvest sprouting problem in summer rain-fall regions by escaping high temperatures and late rainfall seasons which promote pre-harvest sprouting hence, yield loss. Discovering genes that control flowering time in wheat has been one of the key research goals for decades and is increasingly gaining importance due to the impact of projected climate change. Reviewing and concisely summarising currently available genetic and genomic resources for flowering time and the progress made so far towards introgressing known genes in elite germplasm is vital to guide future research.

Results and Discussion

This chapter therefore, discusses (i) the progress made in discovering genes involved and the impact of their extensive allelic variation on flowering time, (ii) the potential benefits of tailoring wheat’s flowering time to improve yield and, (iii) the benefits of introgressing genes for other complimentary traits, such as semi-dwarf and pre-harvest sprouting resistance on advanced lines to achieve higher yield thus, sustainable food security.

Conclusions

The information provided in this chapter will, therefore, be helpful in the current and future breeding programmes when breeding for adaptation and improved yield in wheat. Yield improvement will help to meet the ever-increasing demand, which will mean sustainable food security.

References

Keywords

earliness per se, flowering time, photoperiod response, pre-harvest sprouting, semi-dwarf, vernalization, yield

ASSESSING THE EFFECT OF CONTOUR BUNDS ON SELECTED SOIL PHYSICO-CHEMICAL PROPERTIES AND CROP YIELDS IN COMPARISON WITH TRADITIONAL FARMING PRACTICES

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Introduction

Low and erratic rainfall are major limiting factors to food production in South Africa, particularly for communal farmers who rely on rainfed agriculture. It is therefore important that rural farmers optimise the utilisation of their limited water resources. Rainwater harvesting and conservation (RWH&C) technologies offer alternatives to improve agricultural production. The aim of this study was to assess the effect of micro catchment rainwater harvesting (contour bunds) with organic mulch on top of the bunds on selected soil physico-chemical properties and crop yields.

Materials and Methods

The study was conducted in a homestead at Quvile during 2013/14 and a homestead at Madosini during 2014/15 growing seasons. Both sites are in the Eastern Cape province close to Tsolo. Two treatments were used. The treatments were: a) contour bunds with organic mulch on top of the bunds with a bare runoff area. Rows of maize were planted on both sides of the contour bund. b) Traditional farming practice where farmers were allowed to use their preferred farming practice where in both sites they have considered broadcasting of maize seeds. Key soil parameters were assessed over two growing seasons (2013/14 and 2014/15). Soil samples were collected at 0 - 100, 100 - 200 and 200 - 300 mm depths and subjected to chemical analysis (exchangeable bases, micro-nutrients, pH, electric conductivity and available phosphorus) and physical analysis (bulk density and aggregates stability at planting and harvesting). Gravimetric soil moisture content (GMC) was assessed at different stages of maize growth (planting, early vegetative growth, late vegetative growth, tasselling and harvesting). Plants were also analysed for above-ground biomass and grain yield.

Results and Discussion

The RWH&C treatments had higher micro-nutrient concentrations, higher soil GMC and aggregate stability when compared with the controls. Additionally, bulk density was found to be lower in the RWH&C treatment. Soil pH, however was lower in the RWH&C treatment, with an associated decrease in exchangeable bases. Compared with the control, the RWH&C treatment improved grain yield and biomass yield at both sites.

Conclusions

RWH&C improves some soil physico-chemical properties and overall has a positive effect on grain and biomass yields.

References

Keywords

rainwater harvesting and conservation, soil physico-chemical properties, maize yield, water productivity

PRELIMINARY INVESTIGATION OF IN VIVO VEGETATIVE PROPAGATION METHODS FOR ORNITHOGALUM BULBS

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Introduction

Ornithogalum is a genus in the asparagaceae (previously hyacinthaceae) family, well known as the **S**tar of Bethlehem. Cut flowers and pot plants are produced from the bulbs commercially and various hybrids are available. The Agricultural Research Council (ARC) has developed yellow flowering hybrids from indigenous South African species of the genus. Local production of these hybrids could benefit the country in terms of job creation and foreign revenue generation for export. In vitro plantlets are, however, expensive and small-scale farmers in South Africa need an alternative over and above in vitro propagated plantlets to bulk up material. The aim of the study was thus to investigate three well known vegetative bulb propagation methods to determine if these could be viable options for multiplication of material.

Materials and Methods

Bulbs of a yellow**-**flowering Ornithogalum hybrid were obtained from the ARC. Bulbs were sorted into three different sizes and a 3x2 factorial (3 propagation methods and 2 temperatures) **experiment was** laid out in a randomized complete block design with three replicates **with** 5 bulbs per treatment combination as experimental unit. The three propagation methods included scooping, cross cutting and chipping and surface sterilized bulbs were incubated in moist vermiculite in plastic ZiplocTM bags in Labcon growth chambers at either 20°C or 25°C.

Results and Discussion

Significantly more bulb rot were observed at 25°C than at 20°C**;** furthermore**,** 20°C produced significantly more bulblets. Propagation method did not affect the rotting, but chipping produced significantly more bulblets than the other two methods. All three methods used rely on the destruction of the apical bud to break the apical dormancy and stimulate the development of adventitious buds. Scooping and cross cutting are technically more difficult to execute and require specific skills. The chances of destroying the apical bud through the chipping methods is easier and thus contributed to the higher number of bulblets formed. The highest number of bulbets was formed at 20°C for the chipping method. Rotting had an effect on the bulblet production and**,** if this can be minimized, better results will be possible.

Conclusions

The chipping method of vegetative propagation combined with 20°C incubation resulted in the highest number of bulblets. Chipping is an easy method that could be used for vegetative production in vivo. Methods to minimize rotting must, however, be addressed to improve the multiplication rate to commercially acceptable numbers.

References

Keywords

Chipping, cross-cutting, Ornithogalum, scooping, vegetative propagation

RESPONSES OF BRADYRHIZOBIUM NODULATION ON COWPEA TO PHYTONEMATICIDES

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Introduction

The existence of the three phases, namely, stimulation, saturation and inhibition in context of the density-dependent growth (DDG) patterns, had since resolved a large number of issues in biology (Mashela et al., 2015). The objective of this study was to investigate the influence of Nemarioc-AL and Nemafric-BL phytonematicides on nodulation of Bradyrhizobium species in cowpea (Vigna unguiculata).

Materials and Methods

Five seeds of cowpea cv. 'Bechuana White, inoculated with Bradyrhizobium species, were sown in 30-cm-diameter plastic pots, containing steam-pasteurised loam soil and Hygromix-T at 3:1 (v/v) ratio under greenhouse conditions. Seedlings were thinned to one at two true-leaf stage and fertilised using half-strength Hoagland solution. Nine treatments, namely, 0.0, 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8 and 25.6% Nemarioc-AL or Nemafric-BL phytonematicide, were arranged in randomised complete block design, with 10 replications. At 56 days after initiating the treatments, plant and nodulation variables were assessed and subjected to analysis of variance using SAS software.

Results and Discussion

At the concentrations used, the treatments had no significant effects on plant and nodulation variables. The observation confirmed those of certain phytonematicide concentrations and various plant species (Mashela et al., 2015). Also, such saturation effects were observed rhizobium-nematode interaction on a wide range of crops, whereas all the phases of the CARD model were reported (Huang, 1987), which further explain the issue of inconsistent results (Mashela et al., 2015). Apparently, the reporting of results falling within any of the three phases is common in biological sciences. Bradyrhizobium species and cowpea plants were saturated by Nemafric-BL phytonematicide, resulting in observed effects that were not significant. However, it is well-established prior and beyond saturation concentrations organisms are stimulated and inhibited, respectively.

Conclusions

The current study provided preliminary information that could allow the generation of stimulation concentrations of nodulation by lowering the treatment concentrations

References

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Keywords

Curve-fitting Allelochemical Response Dosage, Nodulation, sustainable crop production

THE EFFECT OF SOIL DISTURBANCE, CROP ROTATION AND MAXIMUM STUBBLE RETENTION ON RESIDUE COVER IN THE SWARTLAND AND RûENS SUB-REGIONS OF THE WESTERN CAPE

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Introduction

Stubble retention is regarded as one of three cornerstones of conservation agriculture. To qualify as conservation agriculture, the FAO recommends a residue cover of at least 30% after seeding. The aim of this study was to quantify residue cover of the soil surface as influenced by soil disturbance within different cropping systems.

Materials and Methods

The current study is a component study within a long-term tillage/cropping system trial. Three crop rotations, continuous wheat (WWWW), wheat/medic/wheat/medic (WMcWMc) and wheat/canola/wheat/lupin (WCWL) were allocated to main plots replicated four times at the Langgewens (Moorreesburg) and Tygerhoek (Riviersonderend) Research Farms. Each main plot was subdivided into four sub-plots allocated to four tillage treatments, namely: zero-till – soil left undisturbed, no-till – soil left undisturbed until planting and then planted with a tined, no-till planter, minimum till – soil scarified March/April and then planted with a no-till planter and conventional tillage – soil scarified late March/early April, then ploughed and planted with a no-till planter. During 2015 data were recorded immediately after seeding, using the line-transect method to determine residue cover.

Results and Discussion

Mean residue cover in the wheat, canola and lupin phases at Langgewens decreased (P=0.05) as degree of soil disturbance increased. WWWW resulted in significantly the highest mean cover (67.4%) and wheat after lupin (CWLW) the lowest at 46.6%. As no tillage treatments were done during the medic phase, cover percentage varied between 99.0 and 99.5%. Similarly to Langgewens, mean residue cover in the wheat, canola and lupin phases at Tygerhoek decreased (P=0.05) as degree of soil disturbance increased. WWWW also resulted in significantly the highest mean cover (64.0%) and wheat after lupin (CWLW) the lowest at 49.1%. Cover in the medic phase was not influenced by tillage and varied between 99.0 and 99.5%.

Conclusions

Increased disturbance of soil by tillage reduced soil cover at both Langgewens and Tygerhoek. The use of conventional tillage practices during the wheat phases in the McWMcW, CWLW and LWCW sequences at Langgewens is questionable as the residue cover was reduced to less than 30%. In terms of residue cover wheat as previous crop was superior to medic, lupin and canola.

References

Keywords

canola, crop rotation, lupin, medic, soil tillage, wheat

EFFECT OF NITROGEN FERTILISER APPLICATION RATE ON SOIL MINERAL N CONTENT IN THE SWARTLAND AND RûENS SUB-REGIONS OF THE WESTERN CAPE

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Introduction

Adoption of conservation agricultural practices will influence, amongst others, the mineral nitrogen content of soils. Using mineral nitrogen content as aid to calculate final nitrogen topdressing requirement has become a popular management tool worldwide. The aim of this study was to establish the relationship between nitrogen application rate and soil mineral N test value.

Materials and Methods

Canola Hyola 555 was planted at a rate of 4.3 kg ha-1 at Riversdale, Riviersonderend, Moorreesburg, and Darling. Canola followed wheat at all sites included in the study. A randomised block design with four replications was used. At planting 25 kg N ha-1 was applied (15 kg N ha-1 band placed and 10 kg N ha-1 broadcast). Eight nitrogen application rates (0, 25, 50, 75, 105, 135 and 165 kg N ha-1), were broadcast as top-dressing at stem elongation. A control (C) treatment was planted without any N and received no further N. Soil samples to a depth of 300 mm were collected ± 10 days after application. Ammonium- and nitrate-N were determined colorimetrically on a SEAL AutoAnalyzer 3. Mineral N was calculated as the sum of ammonium- and nitrate-N.

Results and Discussion

Although 25 kg N ha-1 was applied at planting at all sites, soil mineral N content at top-dress differed between sites. At Riviersonderend, Riversdale, Moorreesburg and Darling mineral N content before top-dressing was 54.77, 25.64, 18.73 and 11.25 mg kg-1 respectively. Preliminary data shows a linear relation between soil-mineral N and fertiliser-N applied. Relative good correlations (R2 = 0.6243, 0.7622, 0.632 and 0.5762) were found between top-dressed fertiliser N and soil mineral N test value for Riviersonderend, Riversdale, Moorreesburg and Darling respectively.

Conclusions

Preliminary data from the first year predicts that for each kilogram of N applied as top dressing, the soil test mineral N value will be raised by 0.3874, 0.4694, 0.2399 and 0.1127 mg kg-1 at Riviersonderend, Riversdale, Moorreesburg and Darling respectively ± 10 days after N application.

References

Keywords

mineral N, soil-N, top-dress

PERFORMANCE OF AN EXCHANGEABLE TINE AND DISC PLANTER THROUGH RESIDUE FOR CANOLA PRODUCTION

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Introduction

Conservation agriculture (CA) has been widely adopted in canola producing areas of the Western Cape. Conservation agriculture is based on three principles, namely minimum soil disturbance, soil cover and crop rotation. Due to residue of the previous crop that has to be retained as cover, planting procedure becomes more challenging. Tine planters are often obstructed by stubble, which may be pulled into heaps, leading to uneven establishment of crops. Farmers believe that disc planters may perform better in CA systems as discs can cut through stubble and place seed at a uniform depth, regardless of the level of stubble. However, effectiveness of disc planters in creating a proper seedbed is scrutinised. The aim of this study was to compare establishment of canola with a tine and disc planter under low, medium and high residue levels.

Materials and Methods

Trails were conducted at Langgewens Experimental Farm in the Swartland were crop rotation have been implemented for the past 20 years. Two factors were assessed in a split plot design, i.e. planting method (tine or disc as split plots) and residue level (low, medium and high), replicated in four blocks. Canola was planted at 4 kg ha-1. Best practice for canola production in terms of fertilisation, weed and pest control were followed. Before planting and directly thereafter, soil disturbance was measured with a pin profiler measuring microrelief. Plant density was determined 30 days after emergence and biomass production per m2 was recorded at 30 and 60 days after emergence.

Results and Discussion

Tine and disc planters disturbed soil to an equal ($p>0.05$) degree, if only aboveground disturbance is considered. There was a higher ($p<0.05$) plant density observed for the tine planter over all three residue levels, which indicated more effective establishment. At 30 days after emergence, there were no differences ($p>0.05$) recorded in biomass production. At 60 days after emergence a tendency ($p<0.1$) was observed for more biomass produced on low residue level plots than on high residue level plots, but the planter had no effect ($P>0.05$).

Conclusions

There was no difference in aboveground soil disturbance for tine or disc planters and both is suitable for CA systems (disturbance <30%). The tine planter established canola better than the disc planter, regardless of residue level. However, even at 30 days after emergence, no differences in biomass production were recorded. Yield is yet to be measured, and the trails will be repeated for three years before solid conclusions could be drawn.

References

Keywords

conservation agriculture, planting method, stubble, Swartland

TOMATO YIELD AND EARLY BLIGHT INCIDENCE IN RESPONSE TO CULTIVAR AND IRRIGATION MANAGEMENT PRACTICES IN THE GIYANI MUNICIPALITY

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Introduction

Early blight caused by Alternaria solani is the most economically important tomato disease worldwide under varying farming systems. Managing plant stress conditions is expected to improve plant tolerance to this disease, thus reducing disease incidences and increasing crop yield. The aim of the study is to investigate the prevalence of early blight incidence and the effectiveness of applying various irrigation management practices on crop yield.

Materials and Methods

Field experiments were conducted at two farms in Limpopo, Giyani Municipality, namely A hi tirheni Mqekwa farm and Duvadzi farm. The experiments were laid out in a randomized complete block design (RCBD) in a split plot arrangement, with irrigation as the main plot treatment and tomato variety as the subplot treatment, and treatments replicated four times. The irrigation treatments consisted of full irrigation up to field capacity and deficit irrigation. The tomato varieties were HTX14, Rodade, STAR9006 and Commander, and were irrigated with a drip irrigation system. The following measurements were done for all treatments: soil water content with a HydroSense II probe; leaf area index with an LAI-2000 leaf area meter; leaf chlorophyll content with a CCM-300; fresh yield; irrigation volumes with a water meter. Diseased leaves were categorized as per scale given by Pandey et al. (2003) with modifications.

Results and Discussion

The two water treatments (full and deficit irrigation) in both farms have shown no significant pairwise differences among the means. There was no significant difference ((P>0.001) in early blight disease severity in both farms. Yield average at Duvadzi farm was between 9.2 and 10.6 t/ha due to a heat wave in the early part of the season. Average yields at A hi tirheni Mqekwa were between 47.1 and 59.7 t/ha in the season March-August 2016, comparable to optimal yields recorded in the area for these varieties.

Conclusions

Deficit irrigation can be used effectively to produce high yields in tomato production provided the cropping season window does not coincide with the hottest time of the year. Full and deficit irrigation did not have influence on the prevalence of early blight disease on tomato plants.

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Keywords

YIELD POTENTIAL OF CASSAVA IN AN INTERCROP WITH LEGUMES

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Introduction

The success of cassava as food security crop in Africa is largely because of its ability and capacity to yield well in drought prone areas and marginal wasteland under poor management where other crops would fail. The incorporation of cassava into the existing cropping systems could be beneficial. Inclusion of legumes in cassava legume intercropping systems not only helps in improving soil fertility through biological nitrogen fixation and solubilisation of phosphorus but also provides compensation for food security and income generation as cassava reaches maturity. Therefore, this study aimed at evaluating the effect cropping systems on the productivity of cassava-legume intercrop.

Materials and Methods

Field experiments were conducted during 2014/2015 cropping seasons in Thohoyandou, Limpopo Province. The experiments were laid out in a split-plot design with legume planting dates as the main plots replicated 3 times and five cropping systems (cassava sole, chickpea sole, cowpea sole, cassava-chickpea and cassava-cowpea) as the subplots. Yield and yield components for cassava such as, number of tubers per plant, tuber diameter and tuber length, shoot weight and tuber weight (kg/ha) were measured. All data sets were subjected to analysis of variance (ANOVA) using Genstat (Vers. 17), followed by mean separation using LSD at 5% probability levels.

Results and Discussion

Cropping systems had no significant effect on cassava Tuber diameter and Shoot weight but were significantly different on the Number of tubers, Tuber length and tuber yield. Cassava had the highest number of tubers (10.50), tuber length (43.84) and yield (61155 kg/ha) when was planted alone followed by cassava-chickpea and cassava-cowpea. This could be due to the lesser resources completion on the sole crop compared to when cassava is planted as an intercrop.

Conclusions

The decrease in the yield of cassava in an intercrop could be due to the resources competition amongst cassava and legumes. The results of the study showed that cassava-legume could improve yield and yield components of cassava.

References

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Keywords

Cassava, legumes, intercropping, yield.planting dates

Canola yield progress in the Western Cape

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Introduction

Canola cultivars used in the Western Cape originated from crosses with 11 varieties. The effect of inbreeding, over five cycles, caused a loss in genetic diversity which lead to a slow decay in blackleg resistance and weaker adaptation to drought prone areas (Cowling, 2007). Since 2000 new germplasm was introduced into the existing Australian breeding programme and this study aims to answer the question if this has made any difference to local production.

Materials and Methods

Data from the cultivar evaluation programme in the Western Cape was used to answer the question raised. Linear regression over years was used to determine progress in yield. The Tret method (Trethowan et al.,2002), was used to regress mean yield of the three highest yielding genotypes per site and year as a ratio of the trial mean (%TM) for 2002 to 2015. The regression of %TM against time could be misleading, for this reason TM and commercial yield were included. No cultivar was tested for more than eight years due to the decay in blackleg resistance. No control could be used.

Results and Discussion

In the Western Cape the rate of yield increase for commercial production and trial means (TM) were 45.8kg and 41.3kg ha-1 year-1 (2002 - 2014). The mean increase of the three highest yielding cultivars over the TM was 0.36% year-1 (%TM). The yield increase year-1 for the localities in the Swartland was 79.9 kg ha-1 (Langgewens early planting), 52.3 kg ha-1 (Langgewens late planting) and 35.4 kg ha-1 (Porterville). There was a marginal response in the %TM per locality year-1 of -1.0%, -1.3% and 0.3%. The yield increase in the Rûens was 73.1 kg ha-1 (Klipdale), 14.6 kg ha-1 (Riversdale) and 47.8 kg ha-1 (Tygerhoek). There was a marginal decrease year-1 in the %TM for each locality of -0.66%, -0.55% and -0.56%.

Conclusions

The linear regression over time shows progress in yield for both commercial and trial data of 45.8 and 41.3 kg ha-1 year-1. Small increases in %TM are due to the selection of well adapted cultivars from elite trials. The cultivar trials consist out of a group of high yielding cultivars.

References

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Keywords

Linear regression, Trethowan method

NUTRITIONAL WATER PRODUCTIVITY OF SELECTED SWEET POTATO CULTIVARS (IPOMOEA BATATAS L.)

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Introduction

Versatile crops such as sweet potatoes have potential to assist in addressing food and nutrition security under water scarcity. The objective of this study was to determine nutritional water productivity (NWP) of three locally bred sweet potato cultivars (A40, A45 and 199062.1) in response to varying water regimes.

Materials and Methods

The experiment was conducted under controlled environment conditions (~33/18°C day/night and 65% relative humidity). The experimental design was a split-plot with water regimes [30% and 100% crop water requirement (ETc)] as main plots and cultivars (A40, A45 and 199062.1) as sub-plots arranged in randomised complete blocks, replicated three times. Cultivars A45 and 199062.1 are orange-fleshed sweet potato varieties (OFSPs) and A40 is cream-fleshed. Yield and water productivity (WP) (Molden et al., 2003) were determined at harvest. Thereafter, samples were analysed for nutrient (energy, protein and fat) and micro-nutrient (β-carotene, calcium, zinc and iron) content. Results of nutrient content and WP were used to calculate NWP.

Results and Discussion

Yield did not vary in response to water regimes nor were there differences ($P>0.05$) among cultivars. Cultivars 199062.1 (26.4 t ha-1) and A45 (16.7 t ha-1) out-yielded A40 (14.9 t ha-1). Similar to yield, WP did not differ significantly between water regimes and among cultivars. Based on mean values, WP was higher under 30% ETc relative to 100% ETc. This was attributed to yield maintenance under low water availability. Consistent with results of yield, 199062.1 (13.4 kg m-3) and A45 (8.8 kg m-3) had higher WP than A40 (7.5 kg m-3). Results of NWP for energy (E), protein (P) and fat (F) showed no significant differences between water regimes and among cultivars. The trend for NWP(E, P, F) was such that 30% ETc > 100% ETc and 199062.1 > A45 > A40 for water regimes and cultivars, respectively. NWP for calcium, zinc and iron mirrored this trend. However, NWPβ-carotene varied significantly ($P<0.05$) between water regimes and among cultivars. Consistent with other variables, NWPβ-carotene was higher at 30% ETc than 100% ETc. Cultivars A45 and 199062.1 had significantly higher NWPβ-carotene than A40.

Conclusions

OFSPs are nutritious and offer diversity in areas where Vitamin A deficiency is a problem. The fact that NWP did not vary significantly across water regimes implies that OFSPs have potential to contribute to human nutrition in water scarce areas. The use of NWP as a metric allows for an analysis of how agriculture can contribute to food and nutrition security under water scarce conditions.

References

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Keywords

Food security, nutritional water productivity, water stress

Influence of planting density and irrigation interval on nutritional water productivity of nightshade (Solanum retroflexum)

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Introduction

Integrated Drip Irrigation System (IDIS) and a 3S planter were developed to save water in the semi-arid regions of Limpopo Province. The IDIS has a number of capabilities, whereas the 3S planter can be used to plant up to nine seedlings per hole of drip irrigation. Currently, the efficacy of the system is being tested for use in the production of indigenous vegetables such as nightshade (Solanum retroflexum). Nightshade is among the most important indigenous vegetable in Vhembe District, Limpopo Province, containing high beta-carotene and minerals (Van Averbeke and Juma, 2006). The plant also has some medicinal values and is widely used in treating cancerous sores and wounds (Duke and Ayesu, 1985). Due to repeated incidents of drought, the IDIS and 3S planter would be ideal in the production of this crop. However, it has not been subjected to the system.

Materials and Methods

Planting density/hole and irrigation interval were arranged in a split-plot experimental design, with eight replications. The first factor was the irrigation interval and second factor was planting density. An IDIS with 7 sub-systems was used for irrigation with the 3S planter used to establish the planting density/hole of drip irrigation. First harvest was done at 6 weeks after transplanting, with the second harvest being done six weeks thereafter. The top shoots were cut off and placed in brown paper bags, according to planting density per irrigation intervals. Fresh shoots were oven-dried at 60°C for 72 h. Dry shoot mass was subjected to analysis of variance (ANOVA) through the SAS software (SAS Institute, 2008). Treatment means were achieved through the Waller-Duncan Multiple Range test.

Results and Discussion

Highly significant effects occurred in planting density/hole, irrigation interval and interaction for the first harvest, whereas irrigation interval had no significant effect in the second harvests. According to plant densities, 9 plants/hole of drip irrigation had the highest yield which was significantly different from all other densities. The lowest yield occurred in one plant/hole drip irrigation. The continued worsening of water supply and demand for irrigation is increasing daily, water scarcity could become a fully-fledged crisis with severe impacts on food production. It is important to identify the best irrigation practice that will allow the vegetable industry to develop into the future.

Conclusions

The results of this study suggested that using this system water use efficiency could be achieved when raising nine plants per hole of drip irrigation. The system could be suitable for use in the semi-arid areas.

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Keywords

Drought, semi-arid, water-use efficiency.

RESPONSES OF ACCUMULATION OF ESSENTIAL NUTRIENT ELEMENTS IN BUTTERNUT SQUASH TO FOLIAR SPRAYS OF POTASSIUM PHOSPHATE

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Introduction

Alternative biocompatible products are being researched and developed to control powdery mildew. Phosphate salts have been identified to have antifungal effects on plant diseases (Rueveni et al., 1996). The objective of this study was to determine whether potassium phosphate, when combined with sodium bicarbonate and the conventional fungicides benomyl, tebuconazole and wettable sulphur, would affect the accumulation of selected essential nutrient elements in leaves and fruit of butternut squash (*Cucurbita moschata*).

Materials and Methods

Seeds were sown on mounds under field conditions using industry-based agronomic cultural practices for butternut squash. Treatments comprising potassium phosphate, sodium bicarbonate, tebuconazole, wettable sulphur, benomyl alternated with tebuconazole, potassium phosphate tank mixed with sodium bicarbonate, potassium phosphate tank mixed with wettable sulphur, potassium phosphate tank mixed with tebuconazole alternated with potassium phosphate tank mixed with benomyl and wettable sulphur tank mixed with tebuconazole alternated with wettable sulphur tank mixed with benomyl were arranged in a randomised complete block design, with four replications. Treatments were applied weekly until 95 days after sowing. Leaves and fruit were harvested and dried in ovens at 60ºC for 3 days, separately ground and quantified for calcium, magnesium, potassium and sodium using a spectrophotometer.

Results and Discussion

Relative to potassium phosphate, treatments either increased or reduced Ca, Mg, K and Na in the leaves of *Cucurbita moschata*. All the treatments except benomyl tank mixed with tebuconazole increased Ca in the leaf. Wettable sulphur, potassium phosphate tank mixed with sodium bicarbonate and potassium phosphate tank mixed with wettable sulphur increased Mg in the leaf. Tebuconazole and potassium phosphate tank mixed with wettable sulphur reduced K in leaves. Only potassium phosphate tank mixed with sodium bicarbonate reduced Na in leaves. Similarly, relative to potassium phosphate, the treatments either increased or reduced Ca, Mg, K and Na in fruit. Only wettable sulphur reduced Ca in fruit. Benomyl tank mixed with tebuconazole and potassium phosphate tank mixed with sodium bicarbonate reduced Mg in fruit. Tebuconazole, benomyl alternated with tebuconazole and potassium phosphate tank mixed with tebuconazole alternated with potassium phosphate tank mixed with benomyl increased K in fruit. Wettable sulphur, benomyl alternated with tebuconazole and wettable sulphur tank mixed with tebuconazole alternated with wettable sulphur tank mixed with benomyl increased Na in fruit. Treatments including potassium phosphate or the products alone, were better than potassium phosphate alone.

Conclusions

For the most part, potassium phosphate combined with non-conventional and conventional fungicides improved the accumulation of selected nutrient elements in *C. moschata*.

References

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Keywords

Antifungal compounds, benomyl systemic fungicide, biorational products, sodium bicarbonate, tebuconazole, wettable sulphur

Morpho-agronomic evaluation of sweetpotato [Ipomoea batatas (L.) LAM] landraces for cultivation in Limpopo province

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Introduction

Sweetpotato production has declined over the past years in Limpopo province because of water shortages and poor crop adaptability. Although landraces are the most important source of variability with regard to adaptive traits, sweetpotato landraces still remain underutilised. This study aimed to evaluate sweetpotato landraces for morphological variation, agronomic performance and taste acceptability when compared to registered cultivars.

Materials and Methods

A randomised complete block design experiment with fifteen genotypes replicated three times, was planted under rain-fed conditions in Polokwane during 2015/16 season. Genotypes included six ARC cultivars; one breeding line from CIP; together with two non-identified varieties and six landraces collected from local farmers. Both vegetative and storage root characteristics were evaluated for morphological characterisation. Storage root yield data was collected from all plants and dry mass content determined from sampled roots per plot. Data for yield and dry mass content were separately subjected to ANOVA using Genstat version 14.1. Fisher's protected LSD test was used to separate the means at P=0.05. Cooked roots were evaluated by a panel of respondents for taste and appearance.

Results and Discussion

The predominant leaf-shape for landraces and the CIP line 199062.1 was lobed/finger-like while other varieties had a cordate/triangular/heart shape. None of the evaluated landraces had an orange flesh colour, but Landrace 4 had a pale yellow colour indicating a slight presence of beta carotene. Plant establishment was poor and resulted in total average yield of 17.16 tha-1. Significant differences were observed between genotypes for both marketable and total yield. Landraces produced lower yield when compared to other varieties. Means for total yield ranged from 5.27 tha-1 (Landrace 3) to 34.28 tha-1 (199062.1). Landrace 6 produced above average total yield of 19.30 tha-1 which was not significantly different to that obtained from the six ARC cultivars. Significant differences were also observed between genotypes for dry mass content ($P<0.001$). The CIP line 199062.1 had the highest dry mass content of 31.79%, but not significantly different to Landrace 2 (30.47%) and Landrace 4 (29.93%). Results from taste evaluation identified Variety 1 (non-identified variety) as excellent and Landrace 6 as having a bad taste.

Conclusions

Landraces with good yield potential and unique morphological characteristics were identified. However, none of the evaluated landraces had a combination of all desired traits. Landraces will be further evaluated for drought adaptation to promote their continuous cultivation and improve food security in Limpopo province.

References

Keywords

Morphological characterisation, dry mass, root yield, Ipomoea batatas

ASSESSMENT OF DRY MATTER ACCUMULATION IN LEAVES AND PODS OF BIO-FORTIFIED COMMON BEAN GENOTYPES GROWN IN SWAZILAND

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Introduction

Common bean (Phaseolus vulgaris L.) is an important grain legume mainly cultivated for the edible grains that are high in protein (Broughton et al., 2003). In order to address micro-nutrient deficiencies also known as ‘hidden hunger’, the government of Swaziland is considering distributing bio-fortified seeds of dry beans to smallholder farmers for cultivation. The bio-fortified micro-nutrients on these seeds were Fe and Zn and the ultimate goal is developing grains with better nutritional value. However, before these seeds are released, their adaptation to various soil and climatic conditions need to be evaluated. The aim of the current study was to assess mineral nutrient accumulation in leaves and edible grains of bio-fortified common bean genotypes grown in Swaziland.

Materials and Methods

A field experiment involving seventeen common bean genotypes (NUA35, NUA706, NUA740, NUA735, NUA746, NUA730, NUA645, NUA745, NUA734, NUA708, NUA721, NUA705, NUA720, NUA734, NUA674, NUA640 and NUA59) was established at the Malkerns Research Station in Swaziland in the 2015 cropping season. The common bean genotypes were planted in a randomized complete block design with three replicate per variety. At the pod-filling stage of the dry beans, three trifoliate leaves with no visible signs of virus infections were randomly sampled from three plants from each plot and oven dried (60oC) till constant weight for dry matter determination. Similarly, fresh and dry pods were sampled, separately oven dried at 60oC till constant weight and weighed for dry matter determination. The raw data gathered was analysed using the STATISTICA version 1 software. where means were significant different Duncan Multiple Range Test was used to separate the means.

Results and Discussion

Preliminary results on leaf and grain dry mean weights showed significant differences amongst the test genotypes. where means were high were recorded in genotype NUA674 (0.37g.plant-1) on leaf dry weight, while the least leaf dry weight was recorded in NUA720(0.11g.plant-1) among others. Green pod weights ranged from 0.6g.plant-1 in the genotype NUA720 to 2.8g.plant-1 in the genotype NUA706. While the weight of dry pods where mean was (1.1g.plant-1) was recorded in genotype NUA734 and (2.2g.plant-1) in NUA645. Although with some exceptions, some common bean genotype that exhibited greater leaf mass were found to also show higher green and dry pod weights .

Conclusions

The conclusion from this preliminary results, it is shown that some varieties (NUA674, NUA706) had exhibited high dry matter on both leaf and pod weights. They are the promising varieties for the farmers to grow.

References

Broughton WJ, Hernandez G, Blair MW, Beebe SE, Gepts P, Vanderleyden J (2003) Beans (Phaseolus spp.) – Model Food Legumes. Plant and Soil 252: 55-128.

Keywords

Keywords: Dry matter, Common bean, Growth, Nutrients

Growth and yield of Okra (Abelmoschus esculentus L.Moench); comparison of winter- and summer-sown crop in the high tunnel and the field, respectively

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Introduction

Okra (Abelmoschus esculentus (L) is a semi-woody, herbaceous annual plant belonging to the family Malvaceae. Okra originated in Ethiopia and currently cultivated in the tropical and sub-tropical regions worldwide. Okra is valued worldwide for its young, tender and delicious edible pods/fruits which are eaten as a vegetable. The production of okra proceeds all year except the cold periods (winter) due to its sensitiveness to low temperatures. A High tunnels is low cost version of a greenhouse that provides environment favourable to crops, improves yield and quality of crops and enables better management of pests and diseases. The objective of this study was to evaluate the growth and market yield response of okra in high tunnel during the winter season and in the field during the summer season.

Materials and Methods

The experiment was conducted at the University of Venda, Thohoyandou in the Limpopo province. The study consisted of two experiments, experiment 1 was conducted during the winter season in a high tunnel and experiment 2 was conducted in the field during the summer season in the year 2015.
Both experiments consisted of six okra varieties: Tz, RCA, Tangera, Clemson, ML-3 and ML-35 arranged in a Randomly Complete Block Design (RCBD) replicated six times. The parameters measured were plant height, number of leaves/plant, stem diameter, fruit weight, fruit length, fruit girth and fruit yield/ plant. Data was analyzed using Genstat version 17; mean separation was done by using the Least Significance Difference test (5%).

Results and Discussion

There was no significant difference in the growth parameters and yield of okra varieties in the tunnel. however, there was a significant difference in the growth parameters and yield of okra varieties in the field. There were no significant differences in the number of fruits amongst the varieties in the tunnel , however, there were significant differences in the number of fruits amongst the varieties in the field. Growth and yield of okra cultivated in the tunnel during the winter season was as effective as okra in the field during summer.

Conclusions

okra cultivated inside the high tunnel during the winter season can thrive and productive to optimum levels

References

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Keywords

okra, field, high tunnel, season

EFFECT OF 6-BENZYLAMINOPURINE (BAP) ON IN VITRO SHOOT MULTIPLICATION OF EUPHORBIA GROENEWALDII

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Introduction

Euphorbia groenewaldii R.A. Dyer has horticultural and medicinal potential. It is found in only a few localities in Limpopo province, South Africa and is critically endangered (Raimondo et al., 2009). Micropropagation is an alternative method for rapid multiplication and *ex situ* conservation of such plant species. The effect of 6-benzylaminopurine (BAP) on *in vitro* multiplication of *E. groenewaldii* through shoot culture was studied.

Materials and Methods

Shoot cuttings were obtained from *in vivo* propagated *E. groenewaldii*. Cuttings were surface sterilised using 70% ethanol, 1.75% sodium hypochlorite and 10% hydrogen peroxide. Sterile shoot cuttings were split into apical and basal shoot explants and incubated in an antioxidant solution containing 200 mg L-1 ascorbic acid (AA) and 50 mg L-1 polyvinylpyrrolidone (PVP). The solution was changed few times to leach out the latex and to prevent oxidative browning of the wounded explant tissues. Explants were then inoculated on full strength Murashige and Skoog (1962), (MS) media supplemented with different concentrations of BAP (0.0–8.8 µM). Rooting of *in vitro*-induced shoots was carried out on MS media containing different indole-3-butyric acid (IBA) concentrations (0.0–4.9 µM). *In vitro*-regenerated plantlets were acclimatised under controlled growth conditions at 24±2°C and 16 hour photoperiod of 160–200 µmol.m-2s-1.

Results and Discussion

Surface sterilisation of explants was effective in establishing aseptic tissue cultures. Pre-treatment of explants with antioxidant solution (AA and PVP) and frequent sub-culturing reduced oxidative browning in cultures, and increased the survival of explants. *In vitro* axillary bud/shoot induction on both types of explants was best achieved on two MS media each containing 2.2 µM and 4.4 µM BAP. Callus formation on both explants increased with increasing BAP concentration. *In vitro*-developed axillary shoots were predominantly rooted on MS medium without plant growth regulators (PGR) or on MS medium supplemented with 0.49 µM IBA.

Conclusions

Shoot multiplication can be induced *in vitro* on apical and basal shoot explants of *E. groenewaldii* cultured on MS media supplemented with 2.2 µM and 4.4 µM BAP. Regenerated multiple shoots were successfully rutted and *in vitro*-produced plantlets were acclimatised under controlled growth conditions.

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Keywords

antioxidant, axillary shoots, *in vitro* culture, acclimitisation

The effect of species and ripening stage on Total Soluble Solids (TSS), Titrable Acids (TA) and pH of three varieties of tomato (Lycopersicon esculentum)

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Introduction

Tomatoes are used in stews to complement the staple diet of maize meal (Department of agriculture forestry and fisheries, 2012). Total soluble solids and dry matter are known to increase fruit quality (Loboda and Chuprikova, 1999), which fits in well with consumers demand for high quality produce (ElSaeid et al., 1996).Therefore this study assessed the effect of ripening stage and variety on TSS, TA, and pH of three tomato varieties.

Materials and Methods

The study was conducted at University of Venda, Thohoyandou (23°35'.14.0" S & 30°15'50.3" E 595m asl) in Limpopo South Africa in summer 2015. The experiment consisted of a factorial combination of three varieties of tomato (Money maker, Oxheart and Floridade) and three ripening stages (green, pink and red) laid out in a complete randomised block design and replicated three times. Soluble solid content (°Brix) was determined using a hand refractometer (Reichert, Scientific Instruments), pH was measured with a pH-meter (pH-200L; Neo Met). For determination of total acidity, 10 g of tomato puree was titrated to 8.0 using 0.1 mol/L KOH. The titrated volume (mL) corresponds directly to total acidity expressed as g/L citric acid (Azodanlou et al., 2003).

Results and Discussion

Though the lack of statistical significance, the highest amount of TSS was observed in MM at green stage followed by OH and FL with lowest TSS at green stage. The significance $p<0,05$ difference was observed in TSS of different ripening stage with highest TSS in green stage followed by red and least in pink (Salunkhe et al., 1974). The highest amount of TA was observed in OH at pink stage followed by FL at green stage then MM at green stage. pH increased with advancement of ripening with highest pH in MM followed by OH and FL (Tilahum AT, 2013).

Conclusions

As tomatoes mature, there is generally a decrease in acidity while TSS and pH increases gradually with the advancement of ripening process.

References

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Keywords

tomato, varieties, ripening stage, TSS, TA, pH

DEGREE OF NEMATODE RESISTANCE IN BIOFORTIFICATED SWEET POTATO CULTIVAR ‘BOPHELO’ TO MELOIDOGYNE JAVANICA

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Introduction

Sweet potato (*Ipomoea batatas*) is one of six staple crops in the Biofortification Programme that addresses vitamin A, Fe, Ca, K and Zn deficiencies. South African orange– and cream–fleshed sweet potato cultivars are being targeted for use in biofortification for diversification of nutrition in SADC countries. The challenges of biofortification programmes include, inter alia, that most high potential agricultural soils are replete with the root-knot (*Meloidogyne* species) nematodes, which impose dire constraints on yield quality and quantity. The degree of nematode resistance in biofortified sweet potato cultivars is not documented. The objective of this study was to investigate the host-status and host-sensitivity of bioforticated cv. ‘Bophelo’ to *M. javanica* under greenhouse conditions.

Materials and Methods

Uniform sweet potato cuttings were propagated in 20cm–diameter plastic pots filled with steam–pasteurised loam soil and Hygromix–T at 3:1 (v/v) ratio. Cuttings were fertilised using 2g 2:3:2 (22) NPK and 2g 2:1:2 (43) Multifeed fertiliser a week after planting and plants were irrigated with 250ml water every other day. Treatments, namely, 0, 25, 50, 125, 250, 625, 1250 and 3125 eggs and second-stage juveniles (J2) of *M. javanica*, were arranged in a randomised complete block design, with five replicates. The nematode-susceptible cv. ‘Beauregard’ was used as a standard. Plant and nematode variables were collected at 56 days after the treatments, processed and subjected to analysis of variance.

Results and Discussion

The reproductive factor at all levels of inoculation was below unity, and nematode infection had no effect on any plant variables measured. Generally, when the reproductive factor is greater than one and nematode infection reduces plant growth, the plant is described as a susceptible host. When the reproductive factor is greater than one and nematode infection does not reduce plant growth, the plant is tolerant. In contrast when the reproductive factor is less than one and nematode infection does not reduce plant growth, the plant is resistant. The observed nematode-resistance in ‘Bophelo’ confirmed recent screening results where this cultivar was a non-host to various *Meloidogyne* species in South Africa (Pofu et al., 2016).

Conclusions

Because nematode resistance has been established in these cultivars, the next step would be to determine the form of nematode resistance to *M. javanica*.

References

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Keywords

Host-sensitivity, nematode resistance mechanism, resistant host, reproductive factor, susceptible host, tolerant host

Phenotypic characterization of mycotoxins/ear rot resistant maize (Zea mays L.) inbred families

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Introduction

Most South African households depend on maize as source of their staple food and daily calories intake, especially the rural communities which depend on the crop to maintain their livelihood. Despite the importance of maize, numerous factors either biotic or abiotic affect its production worldwide. Ear rot is one of the common diseases that affect maize production and productivity worldwide. Aspergillus flavus (Raper and Fennel) and Fusarium verticillioides (Sacc.) are two of the serious ear rot-causing maize fungi. These fungi secrete mycotoxins which are hazardous when consumed by humans or animals.

Materials and Methods

The study was executed to characterize mycotoxins resistant maize inbred families at the phenotypic level. Experimental trials were conducted at Ukulinga and Makhathini during the 2014/2015 growing seasons, using thirty-two S3:4 families derived from three way crosses among, A. flavus and F. verticillioides resistant maize lines. Grain yield and agronomic traits were measured in both experiments. Genstat 14th edition was used for ANOVA, and the NCSS was used for multivariate.

Results and Discussion

Phenotypic characterization study revealed a significant variability among the mycotoxins resistant maize inbred families for resistance to Aspergillus ear rot, Fusarium ear rot and other selected secondary traits except husk cover, insect damage and days to mid maturity. Generally, heritability (H2) estimates were large for most traits, indicating an opportunity for selection of the best inbred families for advancement in the breeding program. Plant height, ear height and primary tassel branches recorded higher heritability values (>80%) compared to the other traits. This was followed by Fusarium ear rot and Aspergillus ear rot resistance scores (≥77%) and grain yield (73%). The results revealed five principal components contributing more than 69% the total variation and the traits responsible to this variation are Fusarium ear rot, Aspergillus ear rot, plant height, ear height, days to mid maturity, husk cover, insect damage and primary tassel branches. The inbred families were grouped into five principal component groups based on their phenotypic characteristics.

Conclusions

Variation among resistant maize inbred families based on agro-morphology traits were observed, therefore selection would be effective for these traits. The results revealed five principal components contributed more than to 69% of the total variation. Heritability was large for most traits, indicating opportunity for selection of the best inbred families for advancement in the program. Lines to be derived from these grouped families would be exploited to make heterotic combinations by crossing lines from the different phenotypic clusters.

References

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Keywords

Aspergillus flavus, clusters, Fusarium verticillioides, mycotoxins, variability

ASSESSMENT OF DROUGHT TOLERANCE IN SELECTED BOTTLE GOURD [Lagenaria siceraria (Molina) Standl.] LANDRACE COLLECTION OF SOUTH AFRICA

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Introduction

Bottle gourd is an important crop in arid and semi-arid tropics where recurrent drought is the major constraint to crop production. Identification of drought tolerant bottle gourd genotypes is fundamental to enhance productivity and for effective breeding and conservation. The objective of this study was to determine drought tolerance of a diverse set of bottle gourd landraces and to identify promising genotypes for direct production or breeding.

Materials and Methods

A field study was conducted using a 12 x 2 factorial experiment involving 12 bottle gourd landraces under drought-stressed (DS) and non-stressed (NS) conditions and laid out using a randomized complete block design with three replications. Important agronomic data and indices of drought tolerance were collected and subjected to analysis of variance, correlation and principal component analyses.

Results and Discussion

Significant differences were observed among bottle gourd landraces with respect to fruit yield under DS and NS conditions. The mean fruit yield under DS and NS conditions were 8.75 t ha-1 and 22.4 t ha-1, respectively. Drought stress reduced fruit yield by 62%. Correlation and principal component analyses revealed the significance of yield-based indices of drought tolerance such as tolerance index, geometric mean productivity, stress tolerance, mean productivity, yield index and harmonic mean which allowed for the discrimination of drought tolerant bottle gourd landraces.

Conclusions

The study established the existence of considerable genetic variation for drought tolerance among South African bottle gourd landraces. Landraces such as BG-79, BG-31, BG-67, BG-52, BG-78 and GC were identified useful for drought tolerance breeding or rootstock development programs

References

Keywords

Breeding, drought tolerance, drought stress, conservation

EFFECT OF NITROGEN FERTILIZER RATES AND ETHEPHON APPLICATION ON SPAD VALUES, EAR TRAITS AND NUTRITIONAL COMPOSITION OF SUMMER MAIZE IN NORTH CHINA PLAIN

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Introduction

Improving maize production and quality in China is vital in order to feed the population. High application levels of nitrogen fertilizers are associated with improving yield, however, over fertilization could negatively affect yield by weakening root system and elongated weak maize stalks which are prone to lodging. Timely application of a growth retardant could improve lodging resistance and grain yield.

Materials and Methods

A 4 x 2 factorial arrangement fitted in RCBD with 4 replications was conducted at Wuqiao Experimental Station of China Agricultural University in 2015 growing season. Treatments consisted of four levels of nitrogen fertilizer (0, 75, 150 and 225 kg N/ha) broadcasted and incorporated into the soil, and two levels of ethylene (0 and 400mg/L) applied as foliar at V8 growth stage. The fertilizer source was Urea (46%). The cultivar used was Zhengdan 958. The inter and intra-row spacing of 0.6 m and 0.27 m respectively, was used on a 6 m x 6 m plot size. SPAD values of the 9th leaf were measured at 0, 3, 8, 13, 27 and 37 days after V9, ear length, ear bare tip length, ear diameter, lines per ear, kernels per line, protein, starch and oil contents of the harvested grains were measured and analysed using SAS 9.3.

Results and Discussion

It was observed that the SPAD values increased significantly with nitrogen rates in almost all the sampling occasions recording 51.2, 53.3, 54.6 and 55.0 respectively for 0, 3, 8 and 13 days after V9 at the fertilizer rate of 225 Kg N/ha as the highest, whereas 54.2 and 51.3 were recorded for 27 and 37 days after V9, respectively, at the fertilizer rate of 150 Kg N/ha. Similar trend was observed on ear length (15.4 cm), ear bare tip length (2.1 cm), ear diameter (49.8 mm), lines per ear (14.9) and kernels per line (31.2), recorded as the highest with the highest fertilizer rates. On the other hand, the significant increase in fertilizer rates increased the protein (7.89%) and oil (5.03%) contents of the grains. In contrast, the starch content (77.5%) decreased significantly with fertilizer rates. It was further observed that ethephon application significantly increased the SPAD values in all the sampling occasion, ear bare tip length, decreased ear diameter and kernels per line.

Conclusions

It is concluded that ear traits, SPAD values and grain quality parameters improved with increased nitrogen application rates.

References

Keywords

fertilizer, lodging, growth retardant, nitrogen, yield

THE EFFECTS OF DROUGHT STRESS ON THE PHYSIOLOGY OF DRY BEAN (Phaseolus vulgaris L.) PLANTS

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Introduction

The South African farming community is faced with a big challenge of irrigation water availability. Water is the major limiting factor affecting plant growth, development and yield in areas where plants are often exposed to drought stress. Water is essential to photosynthesis, plays an important role in transpiration and regulates the opening and closing of stomata. The objective of the study was to determine the effects of drought stress on leaf gaseous exchange and chlorophyll fluorescence parameters of dry bean under field conditions.

Materials and Methods

The variety DBS 360 was exposed to the following drought stress levels: the control: Irrigated to field capacity on a weekly bases throughout the growing season (S1), Irrigated to field capacity on a weekly bases and withholding irrigation from 36 days after planting (DAP) for 24 days, then irrigated to field capacity to the end of the growing season (S2), irrigated to field capacity on a weekly bases and withholding irrigation from 49 DAP for 24 days, then irrigated to field capacity to the end of the growing season(S3), irrigated to field capacity on a weekly bases and withholding irrigation from 73 DAP to the end of the growing season (S4) and irrigated to field capacity on a weekly bases and Irrigated to field capacity on a fortnightly bases from 36 DAP (S5). The following parameters were measured: Net photosynthesis, transpiration, stomatal conductance , intercellular carbon dioxide concentration minimal fluorescence (Fo), maximal fluorescence (Fm), maximal variable fluorescence (Fv=Fm-Fo) and the photochemical efficiency of PSII (Fv / Fm) . In light adapted leaves steady state fluorescence (Fs) yield, maximal fluorescence (F’m) after an 0.8s saturating light pulse and minimal fluorescence (F’o) was measured when actinic light was turned off. Photochemical (qP) and non-photochemical (qN) quenching parameters were also measured.

Results and Discussion

Drought stress resulted in a reduction of photosynthesis ranging between 30 and 46%. The results indicated that at 63 DAP drought stress reduced Ci with S2 resulting in the lowest of 259.31µmol mol-1. The results indicated that gs was reduced by drought stress with S2 resulting in 0.287 mmol m-2s-1. At 100 DAP drought stress reduced transpiration rates (P≤ 0.01) by 30% at S4. Drought stress resulted in a reduction in Fm and Fv/Fm. Drought stress increased Fo.

Conclusions

Drought stress can results in serious physiological challenges. Photosynthesis, intercellular carbon dioxide concentration, stomatal conductance, transpiration, Fm and Fv/Fm can be useful parameters to monitor drought stress in plants.

References

Keywords

Photosynthesis, transpiration, stomatal conductance, chlorophyll fluorescence

DOES GERMINATION PRE-TREATMENTS OF WILD OATS INFLUENCE THE SUSCEPTIBILITY TO GLYPHOSATE?

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Introduction

Successful weed management depends on a variety of methods, of which chemical weed control is paramount. Glyphosate plays an important role in controlling weeds that compete with crops. Numerous weeds have evolved resistance to glyphosate but to date no confirmed cases of glyphosate resistant wild oats (Avena fatua L.) has been documented in South Africa. Few wild oat populations are suspected to be glyphosate resistant and should be evaluated for resistance in greenhouse trials. Wild oat seeds are notorious for poor germination due to dormancy mechanisms. In order to obtain enough wild oat seedlings for testing, some germination pre-treatments need to be applied. The aim of this study was to determine a quick and effective pre-treatment to facilitate good germination and assess if the selected pre-treatment has any influence on the efficacy of glyphosate on the wild oat seedlings.

Materials and Methods

To assess survival rate of wild oat populations to four glyphosate dosage levels, an experiment was conducted at the Welgevallen experimental farm of the Stellenbosch University, in the Western Cape of South Africa to evaluate germination rate and germination percentage of three wild oat populations (Malmesbury, Prieska and Eendekuil) treated with ammonia gas, gibberellic acid and distilled water as the control. Second experiment consisted of seedlings of the three wild oat populations derived from two of the germination pre-treatments (gibberellic acid and water) treated with four different glyphosate dosage rates (0, 0.5, 1 and 2 L /ha-1). The survival of the seedlings was assessed six weeks after glyphosate application.

Results and Discussion

Interaction effects between seed treatment and population were noted ($P<0.05$) for both Prieska and Malmesbury populations the highest germination rate and percentage were obtained when the populations where treated with ammonia gas. Malmesbury population and gibberellic acid gave higher germination than water while in the Eendekuil population there was no differences between any of the pre-treatments. In the second experiment a three-way interaction between population, seed treatment and glyphosate dosage rate was noted but no clear trends were observed. None of the populations or the seed treatments had any effect on the efficacy of glyphosate.

Conclusions

Ammonia and to a lesser extent, gibberellic acid treatments, improved the germination of two of the three wild oat populations. Gibberellic acid treatment, which results in tall, lanky seedlings, did not influence the survival of wild oat seedlings treated with glyphosate. There was no sign of significant resistance to glyphosate in any of the three tested populations.

References

Keywords

germination percentage, glyphosate, seed treatment, survival rate, wild oats.

EFFECT OF PLANTING DEPTH AND ORIENTATION ON THE GROWTH AND YIELD PERFORMANCE OF SWEET POTATO (IPOMOEA BATATAS L.) CULTIVAR BOPHELO UNDER RAIN-FED CONDITIONS AT VERULAM.

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Introduction

Sweet potato is an important food crop for small scale producers in the Verulam area of KwaZulu-Natal. It benefits both the consumers and the producers. It is a source of Vitamin A and other nutrients. For farmers it is a cost effective cash crop to produce as it has low cost of production inputs and it grows with minimal inputs. Farmers in Verulam were observed to plant their sweet potato vines either vertically or horizontally although they did not have reasons for using either orientation. We therefore set out to study the effect of orientation on yield related parameters of sweet potato. Different sweet potato cultivars have been reported to respond differently to planting orientation and planting depth with regards to yield (Belehu, 2003).

Materials and Methods

There were two factors in the study viz. planting depth and planting orientation. The cultivar Bophelo was used for the experiment and was selected because of its popularity among the sweet potato producers in KZN due to its taste and attractive colour. Depth had five levels and orientation had two levels, namely, horizontal and vertical orientation. Thus the experiment was a 5x2 factorial in a randomised complete block design (RCBD) with four replications. Means were separated using Tukey’s test at 5% alpha level.

Results and Discussion

There was a significant interaction between planting orientation and depth for aboveground fresh mass (AFM). For horizontal orientation, the lowest AFM was obtained with planting depth 2 (20cm of the cutting buried under the soil and 10cm exposed). Although differences were observed in total tuber mass per hectare due to either planting orientation or depth, these were not significantly ($P>0.05$) different. As these are preliminary results, this study will be repeated with replications optimised so as to detect any true differences.

Conclusions

From the interim results, it was concluded that the orientation and depth main effects did not affect all the measured parameters for the cultivar used in this study.

References

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Keywords

sweet potato, planting orientation, depth

EFFECT OF SOIL AND FOLIAR APPLIED NITROGEN ON YIELDS AND YIELD PARAMETERS OF SPRING WHEAT (TRITICUM AESTIVUM L.) UNDER CONTROLLED GLASSHOUSE CONDITIONS

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Introduction

Foliar application is one of the nitrogen (N) application methods in cereal grain crops. Foliar urea applications have increased grain yield, especially when N availability is limiting and N losses through denitrification and leaching were reduced (Amanullah et al. 2015). The objective of this study was to evaluate the effect of soil and foliar applied N on yields and yield parameters of spring wheat (Triticum aestivum L.).

Materials and Methods

A glasshouse experiment was conducted in 2013 and 2014. Wheat cultivar SST 027 seeds were sown in pots filled with soil obtained from the Welgevallen Experimental Farm and irrigated with a nitrogen free balanced nutrient solution. At sowing, 30 kg N ha-1 was applied in all the pots while the control treatment received 0 kg N ha-1. Treatments included N applied as either solid (soil applied) or liquid (foliar applied) at rates of 30 kg N ha-1 and 60 kg N ha-1. The sources of N were Limestone Ammonium Nitrate (LAN 28%), Urea (46%), Urea (46%) solution and Urea ammonium nitrate (UAN 32%) solution applied at tillering. At physiological maturity, plants were harvested and oven dried at 65°C for 72 hours. Plant dry mass pot-1, number of heads pot-1, mass of heads pot-1 and grain yields pot-1 were measured.

Results and Discussion

Plant dry mass pot-1, number of heads pot-1, mass of heads pot-1, grain yields pot-1 and harvest index were significantly ($p<0.05$) influenced by the treatment in both 2013 and 2014. Wheat plants treated with 60 kg N ha-1 of UAN and 60 kg N ha-1 urea solution gave the best results in terms of plant dry mass pot-1, number of heads pot-1, grain yield pot-1 in 2013. In 2014, UAN solution at 60 kg N ha-1 produced the highest grain yield pot-1 but differences between treatments were much less significant than in 2013.

Conclusions

Foliar application of UAN at 60 kg N ha-1 gave the best yield results in both years. A combination of soil-applied N with sowing and foliar top-dressing can therefore be beneficial to wheat in terms of yields and yield parameters.

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Keywords

Foliar applied nitrogen, soil applied N, limestone ammonium nitrate, UAN solution, urea solution

EFFECTS OF LONG-TERM TREATMENT WITH SEWAGE SLUDGE ON CONCENTRATIONS OF HEAVY METALS IN SOIL AND TISSUE OF SELECTED PLANTS, POTENTIAL RISKS AND IMPLICATIONS FOR PHYTO-REMEDIATION

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Introduction

Long term application of sewage sludge has led to accumulation of heavy metals in soils, posing a threat to plant, human and animal health (Mapanda et al., 2004). The development of remediation strategies is thus important in the reclamation of heavy metal contaminated soils (Vamerali et al., 2010). The objective of this study was to determine the concentration of heavy metals in selected plants grown in contaminated soil and implications for phyto-remediation.

Materials and Methods

Heavy metals concentration in *Amaranthus dubius, Solanum lycopersicum, Solanum nigrum* and *Rumex pulcher*, and turf grass growing on sewage sludge disposal land were analysed. A pot trial was also conducted using soil with an over 50-year history of sewage sludge treatment to determine biomass yield and heavy metal uptake of *Brassica juncea*, *Medicago sativa, Vicia sativa, Brassica napus, Lolium perenne*, and *Spinacia oleracea*. Another pot experiment was conducted to determine the effects of adding EDTA at 0, 3, 6 and 10 mmol kg-1 on the tissue metal composition of Indian mustard. Plants and soils were digested with aqua regia using a microwave digester, and analysed for heavy metals using the 720 Varian ICP-OES.

Results and Discussion

Of plants sampled from polluted land, turf grass had the highest concentrations of all the metals, with Zn (419 mg kg-1), Pb (23 mg kg-1), Cu (81 mg kg-1), Ni (223 mg kg-1) and Cr (429 mg kg-1) being far above their toxicity thresholds. Metal concentrations in the other plants also exceeded the thresholds. In the pot trial, vetch had the highest concentration of Zn, Cu, Ni and Pb , which were about 3, 8, 4 and 7 times higher than their toxicity thresholds. Mustard had the highest uptake of Cd, Cr, Cu and Zn. Dry matter yield of mustard decreased with increase in EDTA rate. Higher EDTA rate increased tissue Cd, Pb and Zn, and not As, Cr, Cu and Ni.

Conclusions

Indigenous vegetables, especially amaranthus, growing at the polluted sites pose a health risk to humans who consume them. Turf grass, mustard, lucerne, vetch and rape have shown potential for removal of large amounts of heavy metals, especially when EDTA had been added to the soil for mustard.

References

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Keywords

Contaminated, heavy metals, phytoremediation, plants and soil

Alterations in Oil Content, Dry Matter and Fruit Size During Development of Late Hang (‘Hass’) Avocado Fruit

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Introduction

Avocado (Persea americana Mill.) fruit growth is known to follow a single-sigmoid pattern. The fruit is, however, uniquely different from other climacteric fruit due to the unrestricted cell division that occurs continuously in the fruit while attached to the tree (Bower and Cutting, 1988). Avocado is also unique with respect to the ability to "store fruit on the tree", as preharvest fruit abscission does not occur like in other subtropical fruit. As an oil-accumulating fruit with a large seed, it could be possible that avocado, like other nut crops as well as stone fruit, follows a double sigmoidal growth. Therefore, a study was carried out to investigate, if an additional fruit enlargement could be visible in late-hung 'Hass' avocado fruit.

Materials and Methods

In this study, growth and development of late-hung 'Hass' avocado fruit was followed over a three months period in a rain-fed orchard in cool subtropical KwaZulu-Natal. Five trees in a twenty-year-old orchard were selected in March 2016 and fruit growth measured (25 fruit) on a monthly basis. Additionally, the mesocarp oil content (Meyer and Terry, 2008) and dry matter (Olaoluwa et al., 2016) were determined using 10 fruit per sampling. Differences between picking dates were determined by ANOVA using the GenStat statistical package.

Results and Discussion

GenStat statistical analysis showed significant differences between fruit of the monthly pickings in oil content, dry matter and fruit size. Mesocarp dry matter accumulation at the first sampling averaged 54.4%DM and for the last sampling 57.6%DM. Concomitantly, the mesocarp oil content increased from 25 to 32% DM. An increase in fruit diameter was determined throughout the three-month observation period. Fruit continued to increase in size, up to the second month of sampling. No further evaluation was possible due to fruit drop. It is not clear, whether this fruit drop was aligned with the prevailing weather conditions (dry autumn and winter) or to a naturally occurring abscission.

Conclusions

The oil content, percentage dry matter and fruit diameter increased significantly throughout the late hanging period, indicating a possibility of avocado fruit to follow a double sigmoid growth curve. the observed fruit drop of late-hung fruit, however, could either be a natural phenomenon or environmentally induced.

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Keywords

single-, double-sigmoid growth curve

Effects of tillage, crop rotation, and residue management on earthworm diversity and abundance in the Alice Jozini Ecotope in the Eastern Cape, South Africa

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Introduction

Earthworms can contribute up to 80% of the soil animal biomass and influence soil health through their impact on soil physico-chemical and biological properties. Their abundance and activity is, however, affected by agricultural management practices such as tillage and the use of pesticides. Conservation agriculture (CA) is increasingly being promoted as a climate smart approach for improving soil health, productivity and mitigation of greenhouse gas emissions. This study sought to quantify the effects of CA components on earthworm numbers, diversity and abundance in comparison with conventional tillage practices in the Alice Jozini ecotope, Eastern Cape.

Materials and Methods

Data for this study was collected from an ongoing CA trial which was established in the summer of 2012 on an Alice Jozini ecotope at the University of Fort Hare farm. The trial was designed to study the interactive effects of tillage (no tillage NT and conventional tillage CT), crop rotation (maize-fallow-maize (MFM), maize-fallow-soybean (MFS), maize-wheat-maize (MWM) and maize-wheat-soybean (MWS), and residue management (retention or removal). The experiment was laid out as a split-split plot arrangement in a randomized complete block design with three replicates. Tillage treatments were applied on the main plots while crop rotation treatments were applied as subplots. Crop residue retention treatments were allocated to the sub-sub plots. Earthworms were sampled and quantified during summer, winter and spring 2016 cropping seasons. A 35cm x 35cm quadrant was randomly placed in each plot and earthworms sampled by the addition of 4L mustard seed solution followed by hand-picking the earthworms that emerged as a result of the solution application.

Results and Discussion

Three earthworm species were identified during the summer and spring seasons. These were *Dendrobaena octaedra*, an anecic sp (81%), *Lumbricus terrestris*, an epigeic sp (12%) and *Amynthus* sp.(7%). Over 70% of the earthworms were juvenile during the summer and followed the order *D. octaedra* > *L. terrestris* > *Amynthus* sp. While in the spring it followed the order *D. octaedra* > *Amynthus* sp. >*L. terrestris*. Earthworm abundance was significantly greater under NT than under CT. Residue retention increased earthworm abundance under both NT and CT, but more so under NT. Earthworm biomass was positively correlated to soil organic carbon (SOC). Microbial biomass carbon (MBC) was correlated to earthworm abundance suggesting a positive impact of earthworms on soil microorganisms.

Conclusions

Earthworm abundance was negatively affected by tillage, but greatly enhanced by residue retention. The maize-wheat-maize and maize-wheat-soybean rotations under residue retention had the most positive impact on earthworm abundance.

References

CHAN K.Y. 2001. An overview of some tillage impacts on earthworm population abundance and density-implications for functioning of soils. Soil. Hil. Res. Vol 57 p179-191.

Keywords

Earthworm abundance, tillage, residue management, crop rotations

CHARACTERISATION OF DROUGHT TOLERANCE IN SELECTED BREAD WHEAT GENOTYPES USING STOMATAL CONDUCTANCE, CANOPY TEMPERATURE AND SHOOT-ROOT RATIO

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Introduction

Wheat (Triticum aestivum L.) is a cereal crop used globally notably for bread-making. Adaptability of agriculture to drought is a critical requirement in the changing climate. Canopy temperature, stomatal conductance and root structure are involved in crop drought stress adaptation. Therefore these morpho-physiological traits may be used in drought stress phenotyping.

Materials and Methods

Randomly selected 15 CIMMYT bread wheat genotypes were cultivated at the University of KwaZulu-Natal, Pietermaritzburg greenhouse using randomized complete block design [RCBD] with three replications. Treatment 1 [T1] and Treatment 2 [T2] were drought stress imposed a week before and after 50% heading, respectively and Treatment 3 [T3] was the control. The canopy temperature was read from 09:00 am to 11:00 am using the Major Tech High Temperature Infrared Thermometer and the stomatal conductance was read from 11:00 am to 13:00 pm using the Decagon Devices Leaf Porometer, both readings were taken on sunny, cloudless and windless days. The shoot and root biomasses were measured using a weighing scale. The stomatal conductance was analysed using the Two-Sample T-Test, the canopy temperature was analysed by One-Way Analysis of Variance, the shoot-root ratio was analysed by General ANOVA all were analysed using GenStat 17th Edition software.

Results and Discussion

The stomatal conductance displayed no significance. The average stomatal conductance was 261.2 millimoles per meter squared seconds (mmol.m-2s-1) The lowest stomatal conductance was for SYM2016-005 with 71.96 mmol.m-2s-1 For canopy temperature, the water levels were significant at the $P<0.001$ level of significance. The mean canopy temperature was 16.69oC throughout treatments and water levels. The lowest temperatures were 16.77oC for SYM2016-009 and SYM2016-004 in T1 and SYM2016-006, in T2. The trends observed was an increase and decrease in canopy temperature and shoot-root ratio from non-stress to water stress, respectively. The water levels were observed to have significant effect at the $P< 0.05$ level of significance for shoot –root ratio. T1 displayed the lowest mean shoot-root ratio [2.05] followed by T2 [2.37]. The genotypes with the lowest average shoot-root ratio were SYM2016-005 [1.51] and SYM2016-015 [1.03] for T1 and T2, respectively.

Conclusions

Canopy temperature can be utilized for germplasm drought tolerance characterization whilst stomatal conductance and root biomass parameters are more tedious. Drought tolerant genotypes showed a higher root biomass compared to shoot biomass. The climatic heat and rat infestation was a source of error in this experiment and evaluation over more seasons and sites is required.

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Keywords

Bread wheat, canopy temperature, drought stress, shoot-root ratio , stomatal conductance

A SOIL ALTERATION INDEX RESPONSIVE TO DIFFERENT APPLE ORCHARD FLOOR MANAGEMENT PRACTICES

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Introduction

Alteration index three (AI3) is an enzyme-based soil alteration index which quantifies the balance between β-glucosidase, urease and phosphatase. Abroad, Al3 has been shown to be sensitive to alterations in soil characteristics caused by management practices (Puglisi et al., 2006). Locally, and of greater relevance to the South African apple industry, Al3 has been able to distinguish between organic and conventional apple orchard floor management practices (Meyer et al., 2014). This has inspired confidence to further test AI3 as an index of soil health in local apple orchards. The aim was to assess the AI3 in relation to (1) compost/mulch treatments, (2) ARD/fumigation treatments, and (3) different cover crop treatments, and to soil nutrient and apple tree data.

Materials and Methods

Compost/mulch treatments were applied at Oak Valley (Grabouw), ARD/fumigation treatments at Vergelegen (Elgin), and cover crop treatments at Vyeboom Boerdery (Vyeboom). Tree and work row soil samples were taken from the top- (0-15cm) and subsoil (15-30cm) layers at different sampling times during the year. AI3 indices were generated using the formula by Puglisi et al. (2006). Trials followed a statistical design.

Results and Discussion

In general, top soil had better AI3 scores, and by implication, better soil health, than subsoil layers, indicating the ability of AI3 to reflect gradients in mineralizable substrates across soil layers. Indices were better under mulching than bare soil, confirming the known positive effects of mulching on soil. Better AI3 indices were associated with nitrogen fixing cover crop species and species with bio-fumigant properties than a permanent weed cover, indicating the ability of AI3 to differentiate between cover crop practices. Indices distinguished between rootstock genotype response. Lack of distinction between ARD and fumigation treatments was presumably due to re-colonization of fumigated sites by microorganisms at the time of sampling. Lack of relationship between AI3 and soil chemical and tree parameters is probably due to slower chemical and tree reactions to treatments.

Conclusions

These findings confirm that the AI3 could be useful for testing soil health in local apple orchards.

References

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Keywords

AI3, compost, cover crop, enzyme activity, organic, straw mulch

Developing a rating chart for Pelargonium sidoides root damage by Meloidogyne spp.

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Introduction

Pelargonium sidoides DC. is a medicinal plant used in traditional medicine in South Africa and in treatment of upper respiratory tract infections, in many parts of the world. It's wild harvest has raised concern for its conservation. Cultivation will reduce the pressure on natural populations of *P. sidoides*. Root-knot nematodes penetrate plant roots in search of food and reproduction locations, resulting in root galls. These galls or knots can be used to assess levels of root damage or nematode infestation by determining the extent of galling on the roots. The study aimed at developing a chart for rating *P. sidoides* root damage by root-knot nematodes.

Materials and Methods

Ten plants were harvested per plot from a fertilizer trial with 15 plots and subsequently rinsed in clean tap water to remove the soil. A representative sample of twenty grams was sent to the nematology unit of the Agricultural Research Council, for identification of the nematode species. A previously published rating chart for tomatoes was adapted to assess and rank each root system on a class of 0 to 10. The classes were described as follows: 0 = no galling, 1 = few small knots that are difficult to find, 2 = clearly visible small knots, 3 = some large knots visible, 4 = large knots predominant, 5 = 50% of the roots infested with knotting on parts of the main roots, 6 = visible knotting on the main roots, 7 = majority of main roots are knotted, 8 = all the main roots are knotted, 9 = severe knotting on the main roots and 10 = all roots severely knotted, plants usually dead.

Results and Discussion

High population numbers of the endoparasitic root-knot nematodes *Meloidogyne incognita* and *Meloidogyne javanica* were observed in the sampled roots of the *P. sidoides* plants. The severity of the rating increased from 1 up to 10, where the plants were usually dead. Only 20% of the roots showed a less than 50% infestation rate (rated 4).

Conclusions

The study successfully developed a simple root-knot nematode rating chart for the estimation of root damage by *Meloidogyne* spp. on *P. sidoides*, which has not been reported before. The developed rating method will help growers to quickly identify the levels of infestation on *P. sidoides* roots, and estimate yield loss by comparing the damage with the rating chart. Root-knot nematodes can affect yield significantly in *P. sidoides* production, thus making nematode control a critical part of production.

References

Keywords

Root-knot nematodes, *Meloidogyne incognita, Meloidogyne* javanica, galling

Physiological response of Moringa oleifera to nitrogen application: Preliminary results

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Introduction

The leaves of *Moringa oleifera* are a rich source of macro (e.g.) and micronutrients (e.g.) and as a result the tree has been identified as a healthy food source (Fahey, 2005). Whether the nutritional composition of Moringa leaves could further be improved by application of fertilizers is not known. Nitrogen (N) is one of the most important nutrients for plant growth and development (Dordas and Sioulas, 2009). N can influence leaf area development and plant photosynthetic efficiency (Arduini et al., 2006, Dordas and Sioulas, 2008) which may ultimately affect the nutritional composition.. The aim of this study was to determine the effect of N on nutritional composition of Moringa leaves.

Materials and Methods

The experiment was conducted at Juno on one year old moringa trees. Lime ammonium nitrate (LAN) fertilizer was applied at the following levels: 0, 50, 100,150, 200, 250 and 300 N kg/ha) with four trees allocated per N treatment. Treatments were divided into two applications, whereby 50% of each treatment was applied. The results are based on the first application of each treatment.

Results and Discussion

All the trees that received 200, 250 and 300 N kg/ha were severely defoliated within seven days of application. Further, the trees were severely yellowish and white spots, indicative of possible N toxicity and a possible reduction of nutritional composition.

Conclusions

Although the results were preliminary, this has in validation indicated that moringa tree may not necessarily require N fertilizer application in large amounts as this can be detrimental to the nutritional composition of leaves A follow-up study is underway to determine the effect of N application on the nutritional composition of the leaves.

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Keywords

Moringa, nitrogen, nutrition, physiology,

Exploring DNA methylation in the cactus pear (Opuntia ficus-indica) genome

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Introduction

Cactus pear is popular in arid and semi-arid regions of the world. It can be consumed as a fruit, vegetable or animal fodder, in addition to being useful in the pharmaceutical and cosmetic industries. Climate change and insufficiency of arable land has made crop production to serve increasing human populations more challenging. Improving cactus pear as a crop, especially since it is able to use water efficiently due to CAM metabolism, can therefore aid sustainable food production in arid or semi-arid regions. Cactus pear can reproduce sexually or asexually and has potentially important adaptive traits considering its natural environment. Continued asexual propagation without periodic sexual cycles can effect the so-called ‘Muller’s ratchet’, a phenomenon whereby asexual populations accumulate deleterious mutations (Muller, 1963; Muller, 1964). Ultimately, this may lead to significant clonal decline, affecting traits including fertility and growth (Anderson & Ascher, 1994). Moreover, clonal variation has been linked to DNA methylation (Miguel & Marum, 2011). The aim of the current study was to identify and characterize genetic factors related to DNA methylation in various South African cactus pear cultivars.

Materials and Methods

Five cactus pear cultivars (Burkbank type) were selected for determining the levels of DNA methylation in their respective genomes. Cultivars ‘Algerian’ and ‘Direkteur’ were selected to denote high yield cultivars, while low yield cultivars were represented by ‘Malta’ and ‘R1251’. ‘Berg x Mexican’ yields average amounts of fruit and cladodes (Fouche and Coetzer, 2015). Genomic DNA was extracted from cladode samples of the five cultivars using the NucleoSpin® Plant II kit (Macherey-Nagel GmbH & Co, Düren, Germany). DNA quality and quantity were correspondingly assessed by electrophoresis in 1% (w/v) agarose gels and spectrophotometry (NanoDrop Products, Delaware, USA). About 200 ng of each DNA sample was then subjected to bisulphite treatment via the EZ DNA Methylation-Gold kit (Zymo Research Corp., California, USA), followed by large-scale sequencing of each converted library on the Illumina HiSeq2500 platform based on the paired-end method.

Results and Discussion

DNA extraction from the five cultivars showed DNA of high molecular weight, with average A260/280 and A260/230 ratios of 1.61 and 0.84, respectively. Even so, DNA samples were treated to bisulfite conversion and sequencing is currently in progress.

Conclusions

Selecting mature cladodes for analysis affected DNA recovery from specimens. Unraveling methylation mechanisms in cactus pear will facilitate the development of molecular assays for screening breeding material to detect key alleles associated with genetic traits of interest.

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Keywords

Opuntia ficus-indica, clonal decline, next-generation sequencing, bioinformatics, DNA methylation

IMPACT OF GRAFTING ON SELECTED GROWTH AND QUALITY PARAMETERS OF TOMATO (Lycopersicon esculentum Mill)

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Introduction

Tomato (Lycopersicon esculentum Mill) is widely cultivated in South Africa for home consumption. It is an important source of vitamins and income for growers in South Africa. However, the production of tomato is influenced by season as well as soil-borne diseases. Production of grafted tomato in the tunnel could be a solution for the influence of season and diseases. Therefore, this study evaluated various scion x rootstock grafting combinations in the tunnel during the winter season (2016).

Materials and Methods

The study was carried out in a standard plastic tunnel (30.0 m X 10.0 m), at the Thohoyandou (22° 35’ S and 30° 15’ E). The experiment was laid in a randomized complete block design with four replications. Four tomato rootstocks (‘Powapak’, ‘Everest’, ‘Matterhorn’ and ‘Golf’) and two scion cultivars (‘Money maker’ and ‘Rodade’) were evaluated during the winter season (April/July, 2016). Several growth parameters including plant height and the number of branches as well as total soluble solids TSS were measured.

Results and Discussion

The results showed that there were significant ($P<0.05$) differences in terms of PHT among the treatments. ‘Money’ ‘Maker’ x ‘Everest’ produced the tallest (85.34 cm) plants. ‘Rodade’ x ‘Matterhorn’ produced the shortest (56.22 cm) plants. The NB in the grafting combination involving ‘Rodade’ (scion) was generally depressed. The results suggested that grafting influenced PHT in tomato. In terms of fruit quality, the TSS was similar in all the grafting combinations which was in agreement with the other previous finding (Flores et al., 2010).

Conclusions

The results showed that there was genotypic variation in terms of response to grafting as measured by the growth parameters. Tomato production during the off-season was feasible under the tunnel condition which is useful for commercial tomato grower in the area.

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Keywords

Grafting, Fruit quality, Tomato and Tunnel.

Synthesis and characterization of Cu(II) based metal-organic frameworks (MOFs) using the ligand 1,2,4-benzentricarboxylic acid (H3BAC).

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Introduction

Metal-organic frameworks (MOFs) are a network of metal ion clusters coordinated to organic units (ligands), and their molecular structures form crystalline porous materials with various applications in separation, gas storage and catalysis (Fujita, 2010). MOFs capture guest molecules in their porous network without compromising structural integrity (Fugita, 2010). An example of an application of a MOF is MIL-101 which was used to pre-concentrate trace levels of pesticide compounds such as organochlorides in aqueous solution before instrumental analysis (Huang and Lee, 2015). The objective of this paper is to synthesize and characterize a potential MOF for application in agriculture.

Materials and Methods

Two methods of synthesis were used; an and hydrothermal method. In ambient synthesis, 1.72g (7.14mmol) Cu(NO3)2.2.5H2O placed into a beaker with 20mL H2O, and 1.0g (4.76mmol) H3BAC was placed into a beaker with 20mL ethanol. The solutions were mixed with stirring and left overnight. The resultant precipitate was filtered by suction and washed with 60mL ethanol and air dried for 1 hour. In hydrothermal synthesis, 1.72g (7.14mmol) Cu(NO3)2.2.5H2O and 1.0g (4.76mmol) H3BAC were placed into 15mL H2O, the suspension was stirred and placed into an autoclave at 200°C for 36 hours. It was allowed to cool at room temperature, filtered by suction, washed with 50mL H2O and air dried for 1 hour. The resultant compounds were characterized by C, H, N microanalysis, mid-IR spectroscopy, SEM and EDX spectroscopy and TG and DTG thermal analysis.

Results and Discussion

The ambient compound, baby blue in colour, has the molecular formula [Cu(H2BAC)2].4H2O, and is produced independent of the nature of the anion associated with the copper salt. The hydrothermal product, dark green in colour has the following empirical formulae; Cu(HBAC).CuO4, Cu3(BAC)2.(CuO)7.H2O, and Cu2(BAC).(CuO)3.OH, indicating the presence of a metal oxide cluster as a secondary building unit (SBU) in the MOF. With the absence of single crystals for XRD, MALDI-TOF mass spectroscopy may confirm which of the proposed molecular formulae is correct for the hydrothermal products.

Conclusions

Both compounds were different from one another chemically and structurally. Future work still needs to be done, to determine the capacity for guest inclusion and possible application of the MOF in agriculture by conducting gas evolved studies, desolvation-resolvation, computer modelling, and XRD studies.

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Keywords

metal-organic frameworks (MOFs), ambient, hydrothermal

NITROGEN AND PHOSPHORUS FERTILISER VALUE OF COMPOST FROM THULAMELA

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Introduction

Some gardeners in Thulamela apply compost. The objective was to determine the capacity of compost to supply plant-available nitrogen (N) and phosphorus (P) to crops planted immediately after application.

Materials and Methods

Seven compost samples were analysed for total N and P and their ability to supply N and P to crops was assessed. Greenhouse pot experiments involved determining first-season apparent relative N fertiliser value (FSARNFV) and irst-season apparent relative P fertiliser value (FSARPFV) of compost . FSARNFV and FSARPFV values were the ratio of the test crop biomass in the compost treatment and the test crop biomass in a chemical fertiliser treatment in which the nutrient of interest was applied at the same rate as the compost . Both compost and chemical fertiliser biomass values were adjusted by deducting the biomass obtained in the control treatment to account for the nutrient content of the soil used. Maize and Chinese cabbage grown over a period of 42 days were the test crops. In the incubation experiments the concentration of mineral N and the Olson soil P test value of compost-amended soils were compared with those of soil amended with chemical fertiliser applied at the same rate as in compost-amended treatments. The N fertiliser value NFV) and P fertiliser value (PFV) of compost was the ratio of net mineral N and net soil P test value in compost-amended soils to net mineral N and net soil P test value in chemically amended soil after 42 days.

Results and Discussion

N content of compost ranged from 0.26% to 1.88% (mean 0.77%), and P from 0.07% to 2.05% (mean 0.51%). FSARNFVs ranged from 11.7 to 31.6% (mean 20.9%), and FSARPFVs from 50.7% to 126.3% (mean 75.3%). NFVs ranged from 2.2% to 17.9% (mean 10.4%), and PFVs from 32.2% to 105.8% (mean 51.9%). FSARNFVs were not well correlated with NFVs (r=0.56) but FSARPFVs strongly with PFVs (r=0.88)**.

Conclusions

Whilst the N and P contents of the compost samples from Thulamela were generally lower than those of local kraal manure, their N and P fertiliser values were comparable, if not higher. Accordingly, households can expect modest but immediate productivity gains from generating compost and using it as a home garden fertiliser. This is of particular importance for gardeners who do not have access to animal manure.

References

The authors acknowledge the Flemish Interuniversity Council (VLIR-UOS) for financial support.

Keywords

soil fertility, compost, nitrogen, phosphorus

EVALUATION OF AGRONOMIC PERFORMANCE OF WATER EFFICIENT MAIZE IN LIBODE SUB-DISTRICT, EASTERN CAPE PROVINCE

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Introduction

Maize represents life to more than 300 million of Africa's most vulnerable people and is Africa's most important cereal crop (La Rovere et al, 2014). Incidentally, maize is a crop that is highly susceptible to droughts. According to Fisher et al. (2015), around 40 % of Africa's maize-growing area faces occasional drought stress, resulting in yield losses of 10–25 %. Breeding of drought tolerant maize cultivars and made them available to small holder farmers can play an important role in improving food security.

Materials and Methods

A maize trial composed of three different cultivars (PAN 6671, WE3127 and ZM 523) was established in Libode sub-district at Nkanga location. The trial was arranged in randomized complete block design (RCBD) with three replicates. Planting was carried on the 29th of January 2016 due to prolonged drought period. Weeds were controlled manually. Preventative spraying for maize stalk borer and aphids was done using Cypermetrin. The following traits were recorded: cob number, cob weight, germination percentage, plant height and leaf area. Data was analyzed using JMP version 12. Analysis of variance (ANOVA) was done to determine differences among hybrids considering all agronomic traits.

Results and Discussion

Average rainfall (314 mm) during growing season was below the water requirement for maize growth . According to du Plessis (2003), maize plants needs 450 to 600 mm of water per season. There was no significance difference ($p>0.05$) observed between cultivars on germination percentage but WE3127 cultivar had high mean germination percentage (76.7 %) compared to PAN 6671 (56.7 %) and ZM 523 (55.0 %). WE3127 also recorded an increase in leaf area and plant height compared to other cultivars . Maximum grain yield (3.7 tons ha-1) was obtained from WE3127 which differed significantly ($p<0.05$) from all other cultivars under study . ZM 523 had the least number of cobs and recorded the lowest grain yield.

Conclusions

Results showed that postponing the planting date coupled with drought had a negative effect on yield components, leaf area and plant height. Drought is an unavoidable part of the farming systems and farmers should focus on adapting to coping mechanisms for erratic scenarios. WE3127 cultivar that has been bred genetically to be drought tolerant has proved to be more adaptable at Nkanga location in Libode. Future research focuses on water harvesting techniques such as basin planting and planting dates should be explored in order to mitigate the effect of drought on maize productivity.

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Keywords

Cultivar, germination percentage, leaf area , plant height , grain yield

EFFECT OF CLIMATE CHANGE ON CHICKPEA (CICER ARIETINUM) PLANTING DATE IN NORTH EASTERN PART OF SOUTH AFRICA.

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Introduction

Climate change in form of a significant increase in carbon dioxide, temperature and a decrease in rainfall may alter the current planting date for chickpea crop (Cicer arietinum) in Southern Africa. This study aimed at determining the likely effect of climate change on winter planting date for chickpea crop in North Eastern Region of South Africa.

Materials and Methods

Daily temperature data for chickpea winter growing season (May –October) was simulated using 15 Global circulation models (GCMs) from the coupled Model Intercomparison Project phase 5 (CMIP 5). Output from GCMs was downscaled to local level of Thohoyandou using self-organised maps (SOM) approach (Hewitson and crane, 2006) by University of Cape Town-Climate Systems Analysis Group (UCT-CSAG). Simulated dataset had baseline data ranging from 1950-2015 and projections of future climate ranging from 2020-2100. Dataset was generated in accordance with CMIP 5 agreement of medium mitigation representative pathway scenario (RCP 4.5) and high representative pathway emissions scenario (RCP 8.5). Possible optimal planting dates for each year (1950-2100) were generated using a calibrated and validated AquaCrop model for chickpea in the Region. Assessment of climate change amongst temperature, and planting date, in the years 2030, 2060, 2090, 2100 based on the year 2000 was done using Mann-Kandell test. The Cumulative sum test was used to test presents of change point in simulated data (Tabari, et al., 2014). Level of variability in simulated temperature and planting date was evaluated by the variability test.

Results and Discussion

Different GCMs gave contrasting chickpea planting date results, with seven models showing a significant shift in planting date of between 20-30 days from the base planting date of 14th of May as a result of changes in temperature increase, whilst other five models did not show any variation in planting dates. Several GCMs gave a mean temperature increase of the magnitude between 1.5-2.6 oC by the year 2100. 2030 temperature did not vary significantly and so were the planting dates during that same period. However highest variation in planting dates was observed between 2060 and 2090 and was associated with a marked temperature increase of magnitude between 1.8-2.0 oC.

Conclusions

The study results clearly show that climate change is taking place in the study area and will affect winter planting dates for chickpea crop. We recommend further studies to evaluate the effect of climate change (in the form of temperature and planting dates variations) on chickpea yield using a crop simulation model in the study area.

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Keywords

Climate change, Chickpea, planting date and temperature

EVALUATION OF AGROFORESTRY SYSTEMS FOR MAIZE (ZEA MAYS L.) PRODUCTIVITY IN SOUTH AFRICA

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Introduction

Maize (Zea mays L) is the dominant staple food crop grown by most smallholder farmers in South Africa. Low inherent soil fertility is one of the identified limitations in maize production in the smallholder farming systems. A field experiment was conducted to determine the influence of agroforestry tree species in enhancing the soil fertility and hence the yield of the component crops in the intercrop system.

Materials and Methods

The trial was established in the 2015/16 season at Wartburg in KwaZulu-Natal to determine maize yields in cropping systems containing maize, Cajanus cajan L; (pigeonpea) and Sesbania bispinosa (Jacq) A. Wright var. bispinosa (S. bispinosa). The experiment had 5 treatments which were as follows: sole maize; sole pigeonpea; sole S. bispinosa; maize + S. bispinosa; and maize + pigeonpea. The experiment was laid out in a randomised complete block design replicated three times giving a resultant fifteen treatments

Results and Discussion

Sole maize had a significantly ($P<0.05$) higher grain yields of 1867 kg/ha as compared to the intercropped treatments. The yield of maize in maize + pigeonpea was 604 kg/ha and the lowest maize yield was 538 kg/ha from maize + S. bispinosa intercrop. Sole Pigeonpea had significantly ($P<0.05$) higher seed yield of 1073 kg/ha and 1029 kg/ha for intercrop as compared to 207 kg/ha for sole S. bispinosa and 58.3 kg/ha in the intercrop. No significant difference ($P>0.05$) in the tree seed yield was noted between the sole treatment and intercrops in both species. Land equivalent ratios (LERs) were higher in maize-pigeonpea (1.23), as compared to maize-S. bispinosa (0.6).

Conclusions

Although sole maize outperformed intercrops in grain yield, Pigeonpea is recommended in agroforestry with maize due to its higher LERs and production for grain for human consumption and livestock fodder, soil fertility replenishment and firewood.

References

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Keywords

cropping systems,land equivalent ratio,pigeonpea,soil fertility

EFFECT OF VARYING PHOSPHORUS FERTILIZER RATES IN NODULATION ON THREE DESI CHICKPEA GENOTYPES (Cifer arientinum)

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Introduction

Phosphorus (P) is an important element in chickpea production as it enhances roots development and plays a role in energy transformation, it also promotes legume nodulation which will then lead to biological nitrogen fixation (BNF). Inorganic nitrogen (N2) fertilizers are relatively expensive to poor resourced farmers. Introducing chickpea legume in cropping system to establish BNF through nodulation could be beneficial. Optimum rate of P is required to achieve maximum nodulation rate that suits each genotype. The objective of the study was to evaluate the effect of phosphorus fertilizer rates in nodulation potential on three desi chickpea genotypes.

Materials and Methods

The study was conducted at the School of Agriculture Experimental Farm (22°58’32”S, 30°26’45”E; 596 m above sea level) at the shade house. It was conducted in winter season. The pot experiment was 3 x 3 factorial combination. Two treatments were three rates of phosphorus fertilizer (0g/cm2, 18g/cm2 and 30g/cm2) and three different chickpea genotypes (ACC#4, ACC#6 and ACC#8). Chickpea seeds were all inoculated with bradyrhizobium strain. The experiment was laid out in complete randomized design and it was replicated 3 times. Inoculated seeds were sown in 25 cm pot filled with 5 dm3 compost at the depth of 4cm. Pots were irrigated when necessary. The data was analyzed using GENSTAT 17th edition and significant difference between the treatments was determined at 5% level using LSD of the mean.

Results and Discussion

Phosphorus fertilizer at a rate of 18g/cm2 had an effect on plant growth, nodulation and yield biomass. The number of nodules were enhanced and maximized at moderate rate of phosphorus fertilizer. Genotypes had no effect in yield biomass and in inducing nodulation, although there were significant at 50% flowering stage and in pods number at physiological maturity. Chickpea genotypes with phosphorus fertilizer had no significant difference when interacting. Different genotypes had no effect on nodulation, however ACC#4 had the maximum number of nodules.

Conclusions

Therefore it can be concluded that maximum development of nodules can be achieved at moderate rate of P (18 g/cm^2), and the genotype that is recommended at that rate is ACC #4. Future studies must be done in the field to evaluate the difference between pots experiment with field experiment so that the information can be useful to small scale farmers.

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Keywords

Chickpea (Cicer arietinum L); Phosphorus; genotypes; nodulation.

The effects of residue management strategies on the population dynamics of Nitrogen and Phosphorous related microbes in a maize-based Conservation Agriculture system in the Eastern Cape region.

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Introduction

Conventional Agriculture has contributed a lot to land degradation in the Eastern Cape and this has affected the biological status of the soil. Alternative systems such as Conservation Agriculture (CA) has been introduced as a sustainable system that addresses not only biological properties of the soil but also chemical and physical properties. The management of residues under CA is one way that also affects soil biological properties and the conversion of limited residues to biochar has been introduced as a system that can also address soil biological properties.The inclusion of biochar under CA needs further assessment on how it affects microbes involved in the Nitrogen and Phosphorous cycle as these microbes are responsible for the nutrient status of the soil.

Materials and Methods

The experiment was carried out at the University of Fort Hare farm and Zanyokwe irrigation farm. The experimental design was a split-split plot with tillage as the main plot, rotation as the sub-plot and residue management strategies as sub-sub plots with the following three levels ; residue removed, residue retained and biochar added.Soil samples were collected and analyzed for the number of phosphate producing and nitrogen assimilating bacteria. Pikovskayas Agar was used to grow phosphorous solubilizing soil microorganisms and Norris Glucose Nitrogen Free medium for bacteria that fixing nitrogen from serially diluted soil samples.

Results and Discussion

Results indicated that residue retained had a significant effect on the quantity of both N and P microbes in the soil ($P<0.05$). The counts recorded in summer season of 2015 for N related microbes increased by an average of 20% compared to winter season 2015 under residue retained treatments. Results for P related microbes indicated 12% increase from the winter season, which was lower as compared to N related microbes for residue retained treatments. Results also showed that the addition of biochar as a residue management strategy had a significant effect on the population of microbes in the soil ($P< 0.01$). The findings indicated that the addition of biochar improved the number of N microbes by an average of 30% and P microbes by an average of 20% . Residue removed treatments had no significant effect on the population of both N and P related microbes.

Conclusions

The findings of this study suggests that retaining residues improves microbial population in the soil, but the conversion of these residues to biochar is more preferable as it increases the populations of N and P related microbes more.

References

Keywords

Residue management; Nitrogen, Phosphorous; Microbes; Population dynamics.

ADOPTION OF BIODIGESTER AND BIOSLURRY SYSTEMS BY RESOURCE POOR FARMERS TO ENHANCE SOIL FERTILITY

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Introduction

Poor soil management over the past 30 years in Africa has resulted in an average annual depletion rate of about 22kg Nitrogen (N) per hectare of cultivated land and a reduction of organic carbon content to an all time low of of about 1%. Biodigesters are a source of biogas and production of bioslurry, whose application to soil can replenish the N lost and Carbon(C) with time (Pedro S, 2002). This paper advocates the holistic use of biodigesters with emphasis on bioslurry utilization in soil fertility management.

Materials and Methods

A literature review was conducted on biodigester technology use in households to investigate bioslurry potential in improving food production. Data from experiments were evaluated to provide a basis for quantification of the nutrient value of bioslurry when added to soil and its associated agronomic benefits.

Results and Discussion

Biodigesters are mainly used for the provision of energy, purification and recycling of household waste water and production of a nutrient ready organic fertilizer (bioslurry). Through anaerobic decomposition, organic material is converted into a high pH bioslurry which is rich in ammonium N (50-75% of total N), has a C: N ratio of 24:1 for rapid digestion by microbes and provides a more efficient option to retain nutrients in the farm by minimizing losses during decomposition as well as making nutrients into readily available form for plants (Orskov E R et al, 2014). There is a scarcity of basic analytical data of manures in literature and bioslurry usage is limited by the lack of quantification of its potential (Kirchman H and Witter E., 1992). Research on soil restoration and soil health is left behind as most interest is on agronomic value of organic and inorganic fertilizers. The introduction of biodigesters to resource poor farmers has been focused on production of fuel and less on exploiting the potential of bioslurry as a source of soil nutrients. Use of bioslurry has been reported to increase crop yields in some African countries, but no similar wark is reported from South Africa.

Conclusions

Successful incorporation of biodigesters for resource poor farmers requires focus on its multiple potential benefits, as this allows for recycling resources, improvement in food production levels and an associated increase in quality of life.

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Keywords

Anaerobic digestion, Biodigesters, Bioslurry, Resource poor

Phosphorus fertilizer source and its effect on potato production.

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Introduction

Successful potato cultivation depends on a variety of factors, of which fertilization forms an important component. Phosphorus (P) plays a major role in the growth and development processes of potatoes. Phosphorus fertilizers differ not only in formulation (solid or liquid), but also in chemical form (orthophosphate or polyphosphate). Limited studies have reported on the most suitable phosphorus source for potatoes. The aim of this study was to assess the response of potatoes to P sources and P application levels.

Materials and Methods

A series of experiments were conducted at Welgevallen experimental farm of the Stellenbosch University, South Africa. In the first summer trial potato seedlings of cultivars Mondial, Sifra, Larnorma and Innovator were grown using orthophosphates and polyphosphate and four P application levels (100%_ortho-P, 25%, 50% and 100%_poly-P). This trial was repeated in winter 2016 but cultivars Destiny and Eos instead of Sifra and Innovator, were used. Total tuber yield and total number of tubers were determined. Each treatment combination was repeated six times (4X4X6) and treatments were laid out as a completely randomized design with one plant per repetition. Data was analysed using ANOVA, and means compared ($P<0.05$) using the general linear model of Statistica 12 software (Statistica 2012).

Results and Discussion

In both seasons (2015 and 2016) best yield was realized when plants were treated with 100%_ortho-P. Yields were lower in 2016 due to climatic factors. P applied as either 100% ortho-P or 100% poly-P resulted in an increase in tuber number compared to when 25% and 50% of the P was applied as poly-P.In both trials interaction between P treatments and cultivars did not influence plant morphological development, tuber quality (defects) or yield. Phosphorus-utilization efficiency was not influenced by the different P treatments and cultivars. In the first trial (2015 growing season) 100%_ortho-P was higher than 100%_poly-P, however there were not significantly different from each other. However in the second trial (2016 growing season) it was clear that 100%_ortho-P performed far better than the 100%_poly-P not only was the 100%_ortho-P higher it was also significantly different /higher than all the polyphosphate treatments (25% 50% and 100%) in most of the measured growth and yield parameters.

Conclusions

Overall results of the three experiments show that orthophosphates are a better source of P in comparison to its counter polyphosphate source. Mondial generally showed higher yield and morphological parameters in comparison to all other cultivars.

References

Keywords

cultivars, orthophosphate, polyphosphate and yield.

INFLUENCE OF NITROGEN FERTILISER APPLICATION RATE ON FLAG LEAF CHLOROPHYLL AND -NITROGEN CONTENT OF WHEAT DURING ANTHESIS

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Introduction

The adoption of conservation agriculture (CA) practices will influence the physical, chemical and biological properties of soils. It is expected that these changes will influence the amount of plant available nitrogen (N) to crops during the growing season. Flag leaf chlorophyll- and N content can be instrumental in evaluating the N status of the wheat crop. The aim of this study was to evaluate the effect of fertiliser N rate on flag leaf chlorophyll- and N content at anthesis.

Materials and Methods

Wheat (SST 056) was planted at a rate of 80 kg ha-1 at Riversdale, Riviersonderend, Caledon, Moorreesburg, Porterville and Darling. Cropping systems tested included wheat after canola (C/W), wheat after medics (M/W) and wheat after lucerne (L/W). Nine sites were laid out in a randomised block design with eight treatments and four replications. The treatments comprised planting with 25 kg ha-1 N and different N rates (0, 25, 50, 75, 105, 135 and 165 kg N ha-1), applied as top-dressing. The control (C) treatment was planted without any N and received no further N. Chlorophyll content index (CCI) and N % of the flag leaf were determined. The N % was determined by a Leco N-analyser and CCI was measured using a CCM-200 device.

Results and Discussion

Preliminary results showed that N % and CCI of flag leaves responded to N fertilisation at most localities. As N fertilisation increased, N % in flag leaves increased from 1.78 to 4.71, and CCI from 8 to 31.8. Although this varied between localities and cropping systems, a regression analyses between N % and CCI showed that they were highly correlated ($R2 = 0.82$; $P<0.001$). Any one of these measurements can therefore be regarded as a good indicator of flag leave nitrogen content.

Conclusions

The measurement of CCI is less labour intensive, non-destructive and less expensive than N %, it is therefore anticipated that CCI could be a reliable alternative to predict flag leaf N %. Further studies to relate N % and CCI of the flag leaf to grain kernel protein content are in process. If these are good predictors, then one could use the information gathered at flag leaf stage to manage grain kernel protein content by foliar N application.

References

Keywords

conservation agriculture, fertiliser, nitrogen, wheat

Growth and yield response of kenaf (Hibiscuss cannabinus L) cultivars to Nitrogen regimes under irrigated conditins

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Introduction

Kenaf (Hibiscus cannabinus L), responds well to added fertilizers depending on the soil nutrient status, cropping history and other environmental and management factors. Sufficient nitrogen fertilization will enhance growth and bast fibre production. High levels of nitrogen may promote the uptake of other essential nutrients, but can also have a negative effect on fibre content. The economic balance between these factors needs to be determined. . Therefore, the objective for this study is to determine minimum N fertilization rate that produce optimum Kenaf yield under irrigation.

Materials and Methods

The study was conducted under varied climate and rainfall condition at Winterton (KZN) and Rustenburg (NW) during 2013/2014 growing season. The trials were laid in split-plot design with main plot being cultivar: Elal 1 and Raz 2 and sub plot being nitrogen level (0, 40, 80, 120, 160 kgN ha). The application of nitrogen fertilizer was split into two, 60% of required nitrogen was applied four weeks after planting and 40% 8 weeks after planting. Plants were harvested manually at flowering stage (Duke and Ducellier, 1993). samples dry stem yield (kg.ha-1) of one meter stalk was put into an oven to dry for 5 days at 60 0C. Then fibre yield(%)The weight of bast in the above ground dried stalk divided by dry stalk mass x100 fibre quality was measure in terms of reed length, bundle breaking etc.

Results and Discussion

There were significant differences (P≤0.05) observed in fresh biomass, green stem, dry stem yield and fibre yield of cultivars as influenced by nitrogen, cultivars and cultivar x nitrogen interactions. Kenaf yield tends to increase with increase in nitrogen regimes for both cultivars and localities. At Rustenburg, Elal 1 (371 t ha-1) and Raz 2 (397 t ha-1) obtained the highest fresh biomass yield with 160 kg Nha-1. These yields were respectively 58% and 76% higher than when 0 kgN ha-1 was applied. Similarly, dry stem yield was higher when 120 and 160 kgN ha-1 was applied compare to lower N-regimes. Fibre yield varied significantly under nitrogen regimes (P≤0.05) at both localities. At Winterton, Raz 2 obtained the highest fibre yield of 9 t ha-1 with 160 kgN ha-1 and also, Elal 1 yielded high at Rustenburg with 8.6 t ha-1 at the same N-regime. Fibre quality responded.

Conclusions

The minimum nitrogen application rates to produce optimum Kenaf fibre yield were observed to be 80 kgN ha-1 to 160 kgN ha-1 at both Winterton and Rustenburg localities.

References

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Keywords

Kenaf, Nitrogen regimes. Elal 1, Raz 2

Literature review: Evaluating suitability, effectiveness and application method of bio-slurry as an organic fertilizer in communal areas of the Eastern Cape, South Africa

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Introduction

Crop production among smallholder farmers in the Eastern Cape Province of South Africa is often constrained by low and variable rainfall, as well as poor soil fertility. Furthermore, the majority of communal farmers are often constrained by lack of financial resources to purchase sufficient or any inorganic fertilizers. Hence, the use of organic manures and their recycling has been considered as an alternative in ensuring sustainable land use and agricultural production. Therefore, in an attempt to improve food security amongst rural households the research team has embarked on a project to recycle animal manure through the implementation of biogas digesters in rural areas of the Eastern Cape.

Materials and Methods

A literature review was conducted using standard procedures as well as unconventional methods to collect unpublished data regarding the subject.

Results and Discussion

It has been reported that use of nutrient rich organic effluent produced from anaerobic digestion (AD) of manure and water from biogas digesters enhances soil fertility and increases crop yields. As such, it is a nutrient rich substrate when compared to other organic sources such as cattle manure. However, its efficiency as a fertilizer is highly influenced by method of application and nature of the slurry (dry matter or pH), weather conditions, soil conditions, volume of water added or lost from the feed, crop type and soil physio-chemical properties. As such, application method is an important component in bio-slurry management that ensures that the desired results are obtained from using it as a soil amendment. In addition, when organic fertilizers are applied at optimum application rates they have great potential to provide plant essential nutrients, maintain soil fertility and sustain crop yields. However, little knowledge exists on nutrient release patterns of bio-slurry and factors that affect them.

Conclusions

Therefore, this paper seeks to evaluate the most effective method of applying bio-slurry and to compare its fertilizer value with organic manure and inorganic fertilizers in a selected village in the Eastern Cape.

References

Keywords

Bio-slurry, bio-gas, organic manure, application, efficiency

NITROGEN FERTILISER VALUE OF ANIMAL MANURE IN THULAMELA

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Introduction

Home gardeners in Thulamela who apply fertilisers mainly use animal manure, cattle kraal manure in particular. The objective of this study was to determine the capacity of manure samples collected in Thulamela to supply plant-available nitrogen (N) to crops planted immediately after manure application.

Materials and Methods

Manure samples collected in the village of Manamani were analysed for total N. Their ability to supply N to crops was assessed using greenhouse pot experiments, in which the first-season apparent relative N fertiliser value (FSARNFV) was determined. FSARNFV was the ratio of the test crop biomass in the manure treatment and the test crop biomass in a urea treatment applied at the same rate of N as the manure sample. Both manure and urea biomass values were adjusted by deducting the the control treatment biomass (no N) to account for the N content of the soil used. Maize and Chinese cabbage grown for 42 days were the test crops. Incubation experiments were done to determine net mineral N (NH_4^+-N and NO_3^--N) in manure-amended soils and compare these with that of soil amended with urea at the same rate of N (29.22 mg N kg soil-1). The N fertiliser values (NFVs) of manure in the incubation experiment was the ratio of net mineral N in manure-amended soils to net mineral N value in the chemically amended soil after 42 days of incubation.

Results and Discussion

The N content ranged from 1.43% to 1.66% (mean 1.57%) in cattle kraal manure; 1.00% to 2.35% (mean 1.96%) in goat manure; and 2.21% to 2.90% (mean 2.54%) in chicken manure . Average FSARNFVs ranged from -0.8% to 4.5% (mean 0.80%) for cattle manure; 9.05% to 32.08% (mean 23.76%) for goat manure; and 47.94% to 75.38% (mean 60.75%) for chicken manure. The N-fertiliser values (NFVs) obtained in the incubation experiment ranged from -6.63% to 0.37% (mean -2.82%) for cattle kraal manure; -2.65% to 14.30% (mean 5.53%) for goat manure and 11.92% to 34.47% (mean 26.79%) for chicken manure. FSARNFVs and NFVs were closely correlated (r=0.95)**.

Conclusions

Cattle kraal manure, the most commonly available and used manure in Thulamela home gardens was a poor first-season source of N. Goat manure was better and chicken manure the superior organic source of first-season N.

References

The authors acknowledge the Flemish Interuniversity Council (VLIR-UOS) for financial support.

Keywords

soil fertility, animal manure, plant-available nitrogen

PRELIMINARY EVALUATION OF DIVERSE COWPEA (Vigna unguiculata) GERMPLASM FOR AGRONOMIC PERFORMANCE

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Introduction

Cowpea (Vigna unguiculata) is an important food and nutrition security crop attributed by its most edible plant parts and adaptation to arid and semi-arid regions. In South Africa, however, production is low due unavailability of improved varieties (Asiwe, 2009). Evaluation of more cowpea germplasm is imperative in determining the superior genotypes that can be used as parents in breeding programs aimed at developing well adapted high yielding cowpea genotypes. Therefore, the objective of this study was to evaluate the growth and yield performance of cowpea.

Materials and Methods

A field experiment arranged in 7×4 rectangular lattice design replicated three times was conducted at ARC-VOP experimental farm. Twenty-eight genotypes were used in the experiment. Each unit plot consisted of three rows spaced at 70 cm and spacing of 30 cm between plants. Data was collected on five randomly selected plant to measure phenotypic traits which include duration to 50% flowering, chlorophyll index, duration to 50% maturity, pod number per plant, pod length, seed number per plant, harvest index, 100 seed weight, yield per pant and yield per plot from the whole plot. Data was subjected to analysis of variance and principal component analysis using SAS program version 9.3 (SAS Institute Inc., 2000).

Results and Discussion

The quantitative morphological traits were recorded. Analysis of variance for the traits revealed that differences among cowpea genotypes were highly significant for most of the traits. This indicated that there was a high level of genetic variability among the genotypes studied. The principal component analysis also showed the total variability among the genotypes. Cluster analysis of the phenotypic traits resulted in different distinct groups of genotypes.

Conclusions

The quantitative traits provided a useful measure of genetic differences among the genotypes and will enable the identification of potential parental lines for future cowpea breeding programme in the ARC for the traits of interest.

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Keywords

Cowpea; Agronomic performance; genetic variability; Yield.

YIELD RESPONSES TO RAINWATER HARVESTING AND CONSERVATION

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Introduction

Rainwater harvesting and conservation (RWH&C) brings hope to the subsistence of farmers of Msinga, in KwaZulu Natal. These farmers are farming in very marginal soils and harsh climatic conditions where they face very high temperatures and very erratic rainfalls. Rainwater harvesting and conservation is a technique to collect, capture and store runoff water using on farm methods such as contour ridge and runoff strips. Extensive research at different parts of South Africa has indicated that this technique conserves soil moisture and improve maize grain yields, biomass and harvest index. However this technique has not been introduced and demonstrated to the subsistence farmers of Msinga. The objective of this study was to evaluate the yield responses, soil moisture content and water productivity of maize planted under rainwater harvesting and the current cultivation practices.

Materials and Methods

Mxheleni woman’s group was identified and the RWH&C concept was introduced them in the 2013/2014 growing season. The project was conducted over three consecutive growing seasons (2013/2014; 2014/2015 and 2015/2016). The experiment followed a quasi-experimental layout comparing 1 treatment plot and 1 control plot. The treatment consisted of a RWHC&C demonstration where contours/ridges were built and maize was planted along the contours. The control was a conventional tillage method with seeds broadcasted randomly in the field. Gravimetric soil water content was measured at different growth stages and random destructive plant samples replicated three times were taken at harvest to determine yield responses to RWH&

Results and Discussion

The RWH&C greatly improved maize grain yield in 2013/2014, the average grain yields recorded for the treatment was 1.26 ton/ha compared to 0.96 ton/ha of the control. In 2014/2015, there was a complete crop failure in both the treatment and control and hence yield parameters were not recorded. Crop failure resulted from water stress due to very limited rainfalls and high daily temperatures. In 2015/2016 the grain yield responses to RWH&C were better compared to the control. Findings from this season showed that grain yield of 2.55 ton/ha were obtained from the RWH&C compared to 2.13 ton/ha of the control. The grain yield improvements observed in the RWH&C were associated with high moisture content stored on the contours.

Conclusions

Rainwater harvesting and conservation retains soil moisture along the contours which become available to the plant for prolonged periods. This RWH&C technique has a potential to improve yields obtained by subsistence farmers of Mxheleni, KwaZulu Natal.

References

Keywords

Rainwater harvesting and conservation, climate resilience, communal farming systems

Effect of biochar and poultry manure on maize productivity of different soil types

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Introduction

South African soils contain less organic carbon percentage compared to many parts of the world (Du Preez *et al*., 2011). The organic carbon percentage degrades annually and reduces soil fertility. This drives an increasing demand and usage of soil amendments such as biochar and poultry manure as soil fertility enhancers. Hence, the objective of this study was to assess the effects of biochar and poultry manure application on maize productivity under different soil types.

Materials and Methods

A greenhouse study was conducted using four different soil types with variable clay content (Mutshenzheni= 18 % clay, Rambuda= 32 % clay, Tshiombo Irrigation= 26 % clay, and Tshiombo Madzivhandila= 57% clay). Treatments consisted of the four soil types and biochar + poultry manure amendments combined in different proportions as follows: 0% BC: 0% PM, 100% BC: 0% PM, 75% BC: 25% PM, 50% BC: 50% PM, 25% BC: 75% PM, and 0% BC: 100% PM. The 100% biochar is equivalent to 40t ha^{-1}, while 100% poultry manure is equivalent to 5 t ha^{-1}. Maize seeds were sown and left to grow up to 8 weeks. Plant height and stem diameter were measured weekly. Selected soil chemical properties (pH, N, Ca, Mg, P, Cu, Mn, Na, Zn, CEC, EA and OM %) and crop biomass were determined after harvest. Analysis of variance was conducted using general linear model (GLM) procedure of SAS software version 9.4 package. Treatments means were compared using LSD at $p<0.05$.

Results and Discussion

The results of the study revealed that soil chemical properties had variable responses to Biochar and poultry manure application based on application rates and soil types. Biochar and poultry manure application on soil showed insignificant interaction on selected soil chemical properties. While other soil types (Tshiombo Madzivhandila, Mutshenzheni, Rambuda and, Tshiombo Irrigation) showed significant differences of certain selected chemical properties after biochar and poultry manure application. Increased pH, N, Ca, and Na, was a result of biochar application (Liang et al., 2006) through its liming ability effect. Effect of biochar and poultry manure application had no significant interaction on plant height and stem diameter. Contrary, in soil Tshiombo Madzivhandila, biochar and poultry manure application significantly affected the plant height; owing to the increased N. However, in soil, Tshiombo, Irrigation and Madzivhandila, biochar and poultry manure application significantly increased the stem diameter.

Conclusions

Biochar and poultry manure have the potential to improve soil characteristics and crop growth, maize in particular, by ameliorating degraded land. When enough time is given, soil chemical properties will improve and become available for plant use.

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Keywords

Biochar, organic carbon, soil fertility, crop biomass

Effects of deficit irrigation on the agronimic traits of chinese cabbage

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Introduction

Non-heading Chinese cabbage (Brassica rapa L. subsp. chinensis) is an important indigenised leafy vegetable in rural areas of South Africa, where it is primarily grown during the dry winter months, making it reliant on irrigation for its water requirements. Since water is becoming a very scarce resource in South Africa, there is a need to optimize crop water productivity through the application of limited amounts of irrigation water, while stabilizing the crop yield. Thus, the objective of this study was to determine the effect of different irrigation water application regimes on yield and growth of non-heading Chinese cabbage in order to identify the best irrigation scheduling practice for maximum irrigation water use efficiency.

Materials and Methods

A trial was carried out under a rain-out shelter during the 2015 winter season at Agricultural Research Council-Vegetable and Ornamental Plant (ARC-VOP) in Roodeplaat (25°35' S; 28°21' E; 1164 m.a.s.l), Pretoria, South Africa. The trial was laid out in a completely randomized block design, with four management allowable depletion levels (MAD): 20, 40, 60 and 80% applied through drip irrigation. Irrigation water management within the root zone was monitored using a neutron probe and tensiometers. Crop performance was analysed in terms of variability in yield, canopy growth and physiological responses using Gen Stat statistical software, version 14. Treatment means were compared using Duncan’s multiple range test at the 5% level of significance.

Results and Discussion

Experimental results demonstrated that non-heading Chinese cabbage needed to be irrigated at least twice per week to maintain the water of the rooting zone close to field capacity (20% allowable depletion level) in order to achieve maximum fresh marketable yield (39 t ha-1). Increased soil water stress significantly reduced yield, growth and physiological response of the crop. Consequently, considerable reductions in irrigation water use efficiency were observed (from 0.08 t ha-1 mm-1 at 20% MAD to 0.03 t ha-1 mm-1 at 80% MAD).

Conclusions

Based on experimental results from this study, non-heading Chinese cabbage is not an efficient user of water, which suggests that the implementation of deficit irrigation may not be an adequate strategy to maximize water use efficiency, since it significantly compromises crop yield, which may have negative impacts on crop quality as well.

References

Keywords

deficit irrigation, indigenised leafy vegetable.

IMPROVING FIELD TRIAL LAYOUTS USING PRECISION AGRICULTURE TECHNIQUES

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Introduction

Researchers understand that the locality of a trial can significantly affect the ability to detect experimental treatment differences (Nielsen, 2010). Highly variable soil conditions between trial blocks may adversely affect the analysis of an experiment (van Es & van Es, 1993). This could lead to results showing no significant differences between treatment effects and is often unexplainable or seemed to show little biological meaning (Palé et al., 2016). Thus, it is imperative to assure some level of confidence prior to establishing long-term agricultural trials.

Materials and Methods

The site for the trial is located on Langgewens Research farm in the Western Cape, South Africa. The 10 ha trial area is divided into four camps, all of which were planted to wheat as a uniformity trial in 2015. After harvest, soil pits were excavated and classified. The trial consists of 3 cropping systems with 10 crop sequences each and replicated 4 times. Remote sensing (RS) data was obtained by drone flights. A NDVI was extracted from the RS data and correlated with a yield harvest map to determine within field variation of wheat yield and soil properties for optimizing the trial layout.

Results and Discussion

A bimodal distribution in wheat yield over the four camps was found, and a decision was made to exclude one of the four camps. The exclusion of one camp resulted in a setup allowing the whole trial with four replications to move into three camps. The 4th replicate was added to the camp that produced a lower yield in the 2015 season, which will provide the opportunity to remove this replicate if need be.

Conclusions

The spatial distribution of the NDVI corresponded well with the yield pattern. A one-way ANOVA showed that the treatments with four replications had no significant effect on yield (p-value = 0.3053) and thus no bias in initial conditions. Camp position however, had a significant effect on yield (p-value = < 0.05), suggesting that soil variability could significantly affect the outcome of the trial.

References

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Keywords

Block design, randomization, remote sensing, spatial variability

OVERVIEW OF RAPID MULTIPLICATION OF CASSAVA

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Introduction

Cassava (Manihot esculenta Crantz) is one of the most important food crop in the Tropical areas of Africa. It serves as a food security and cash crop. In South Africa its agricultural potential has not been fully exploited since it is not a well-known crop. Its starchy roots are a major source of dietary energy and industrial starch. The leaves are relatively rich in protein and can be consumed as a vegetable. Its flour can be used in proportion with wheat flour to make bread and other flour products. The objective of the study was multiplying cassava plant material which are disease free such as Bacterial Blight and Cassava Mosaic (CMD) for distribution to farmers in semi arid areas of south Africa.

Materials and Methods

Techniques have been developed using shoots produced from stem cuttings grown under conditions of high humidity. Stem cuttings, 15-30 cm in length, are used as planting material to establish its plantation. Single node, woody cuttings have been successfully used for its rapid propagation. Where inter nodes are short, preventing the preparation of single node cuttings, eye cuttings may be used. The tray compartments are filled with loamy soil, moistened and then the cuttings are placed in each compartment with the bud pointing upwards. The trays are kept in the shade until the plants have sprouted and are ready for transplanting. The trays can be put in a simple dome-shaped, polyethylene covered structure to enhance sprouting. Other method for seed multiplication include nursery seedbed. The cuttings should be 7−10 cm long and planted vertically at a spacing of 10 × 10 cm in the nursery bed with two-thirds of each cutting buried in soil then watered regularly to ensure that the cuttings do not dry out.

Results and Discussion

Farmers require supply of healthy stem as planting materials. Cassava is propagated by stem cuttings and the main sources of the planting materials are the farmers' fields, farmers’ neighbours and sometimes rural markets. The development of cassava and amount of yields depends on the quality of stem cuttings. There are several cassava pests and diseases, which are stem-borne. Selecting healthy stem cuttings reduces the spread and damage caused by pests and diseases.

Conclusions

The method was developed to increase the availability of clean planting material to address the shortcomings in the cassava production system. It was anticipated that yield of roots would improve thereby providing employment and income to several community members.

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Keywords

cassava, rapid multiplication, virus, termites

Litter quality influence on soil splash rates and organic carbon dynamics in different soil horizons.

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Introduction

Rainsplash is an important component of soil erosion. Soil organic carbon (SOC) content of at least 2% (Kay and Angers 2000) is known to enhance aggregate stability against raindrop splash effects. Addition of SOC can be very effective in preventing soil erosion (Center for Watershed Protection, 2001) as by improving aggregation hence resisting raindrop splash effects (Fan and Li, 1993). Again Fan and Li (1993), concluded that soil particle distribution has strong relation with splash erosion. However, the relationship between rain splash and soil properties are still unclear. To date, few studies have critically examined the linkages between the quality of SOC and soil particle detachment by raindrop splash impact and associated SOC lost.

Materials and Methods

The study was conducted in Ntabelanga area, Eastern Cape Province of South Africa. It is characterized by highly erodible soils. Soil samples were randomly collected from seven soil horizons which represented dominant soil forms of the area. Initial soil characterization for erodibility showed low (< 2%) SOC content to highly enhanced soil erodibility. We then amended the soils with different litter sources Vachellia karoo leaf (C/N = 23.8) and/or Zea mays stover litter (C/N = 37.4) raising the SOC to critical levels (2%) and incubated for 30 weeks. At 1, 3, 8, 14, 21 and 30 weeks of incubation, subsamples were taken and amount of splashed sediments were determined at 360mm-h simulated rainfall intensity applied as either 6-min single rainstorm (SR) or 3 × 2-min intermittent rainstorms (IR) separated by a 72 h drying period. SOC content from the splashed sediments was determined

Results and Discussion

The results showed that single application of litter had significant ($P < 0.05$) effects on reducing splash erosion until certain time after incorporation thereafter its effectiveness declined. Fresh litter had to be re-incorporated after this time to maintain litter effects on splash detachment. Litter quality did not influence splash erosion per soil horizon, though soils with more clay than sand particles enhanced litter effects on soil resistance against detachment. There were more splashed sediments under IR than SR and SOC loss was influenced by the primary particle size distribution of the soil and SOC content of original soil.

Conclusions

Rainfall pattern and original SOC content were main factors by which different soils influenced SOC loss. Soil properties had a greater impact on the role of litter against soil and SOC loss than rainfall characteristics. However, more rainfall patterns should be investigated on these soils.

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Keywords

Litter, sediments, resistance, particle, erosion

INFLUENCE OF GREEN MANURE COVER CROPS ON WEED DYNAMICS AND THE GROWTH OF ZEA MAYS UNDER CONSERVATION AGRICULTURE

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Introduction

Modern weed management technologies are focusing more on the use of environmentally friendly strategies of weed control. One such method is the use of green manure cover crops either as smoother crops and / or allelopathic crops to reduce weed interference in crop production. The aim of the study was to evaluate the allelopathic effect of 10 Green manure cover crop residues on weed dynamics in maize grown under conservation agriculture.

Materials and Methods

A field experiment was conducted at the University of Zimbabwe. Mucuna pruriens, Crotalaria grahamiana, Crotalaria ochroleuca, Canavalia ensiformis, Tephrosia vogelii, Crotalaria juncea, Crotalaria spectabilis, Lablab purpureus, Cajanus cajan were grown at appropriate densities for each GMCC in winter and the residues were retained for use as mulch in the summer season under dry land conditions to mimic farmer conditions. Maize residues were used as the control. The plot size will be 5.4 m x 6 m and all the crops will be grown in furrows under no tillage. Weed density and species composition indices were recorded during the maize phase of the rotation. Soil samples were taken at three depths namely 0-5 cm, 5-10 cm and 10-15 cm and were used to carryout a seed bank study using the seedling emergence method. as described by Mandumbu et al. (2010).

Results and Discussion

Weed density and biomass were significantly affected ($P < 0.05$) at 3 WAE. Z. mays was more effective in reducing weeds while M. pruriens was effective in reducing both weed density and weed biomass. The interaction between GMCC type and soil sampling depth was not significant ($P > 0.05$) on the weed density species composition. Depth of sampling had a significant reduction ($P < 0.05$) on weed density, diversity, richness and evenness. Significant effects ($P < 0.05$) of GMCCs mulch were seen to increase weed density, diversity, richness than maize. However, there was no significant effect of the GMCCs on species evenness. The study showed relatively higher annual weed densities and species composition in GMCCs plots than the maize plot in the first year of adoption of (CA).

Conclusions

It was concluded that mulching with residues of GMCCs does not have immediate benefits in terms of weed control. Hence, there is need to repeat the experiment over a long period of time and see the changes in weed dynamics that are caused by the allelopathic cover crops.

References

Mandumbu, R., 2008. Weed seed bank dynamics under different tillage practices and mulch retention levels in semi-arid south western Zimbabwe (Masters dissertation, University of Zimbabwe.

Keywords

Allelopathy, Cover crops, Weeds, seed bank

EFFICACY OF GLYPHOSATE AND GLUFOSINATE-AMMONIUM ON LOLIUM MULTIFLORUM AS AFFECTED BY TEMPERATURE

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Introduction

Contrasting evidence from literature **exist** regarding optim**al** temperatures for efficient action of glyphosate and glufosinate-ammonium ~~exist~~. It appears as if the optim**al** temperature for maximum efficacy of both herbicides may be species dependent. The objective of this study was to determine the optimal temperature for maximum efficacy of both these herbicides on ***Lolium multiflorum***, a major problem weed in the Mediterranean **climatic** area of South Africa.

Materials and Methods

Lolium multiflorum seedlings were grown in four greenhouses with night/day temperatures of 10/15, 15/20, 20/25 and 25/30 ºC respectively. Six dosage levels of glyphosate (0, 400, 800, 1200, 1600 and 2000 ml ha-1 of 360 g ai L-1 formulation) and six dosage levels of glufosinate-ammonium (0, 1500, 3000, 4500, 6000 and 7500 ml ha-1) ~~was~~ **were** applied to the seedlings in two separate experiments at the 6-10 leave stage by means of a pot sprayer. Evaluations were carried out ~~6~~ **six** ~~-~~weeks after application and the percentage control was calculated. Analysis of variance (two-way) was carried out by means of the Statistica 12 statistical package.

Results and Discussion

The ***Lolium multiflorum*** seedlings ~~behaved~~ **reacted** quite similar**ly** in response to the two herbicides at the different temperatures. In both cases a significant ($P < 0.01$) interaction between dosage rate and temperature occurred with regard to percentage survival. ~~.~~At the lowest glyphosate and glufosinate-ammonium dosage rates the 20/25 ºC temperature resulted in significantly lower survival percentages than at **the** 10/15 or 25/30 ºC temperature **ranges**. However at the second lowest dos**age** the 25/30 ºC temperature resulted in significantly higher survival percentages than all other temperatures which did not differ significantly from each other. With regard to dry matter production, there were no significant differences between any of the three lower temperatures at any dosage rate. However**,** with glyphosate the survivors of the seedlings treated with the three lowest dosage rates produced significantly more dry matter than those treated with the other dosage rates. The same trend was shown with glufosinate ammonium but the difference between the 25/30 ºC temperature and the other temperatures was only significant at the lowest glufosinate-ammonium dosage rate.

Conclusions

Both herbicides performs optimally on ***L. multiflorum*** at temperatures ranging from 15 to 25 ºC whilst they performed poorer at the lowest and the highest temperatures. These results are in **both** accordance ~~with some published results but~~ and in contrast to other results published. This indicates that optimal temperature for efficacy of glyphosate and glufosinate-ammonium is species specific.

References

Keywords

efficacy, gufosinate-ammonium, glyphosate, Lolium multiflorum, optimal temperature

Can alternative vegetables break the monopoly of contemporary ones to enhance food and nutrition security?

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Introduction

This paper examines alternative food sources that provide superior energy and nutritional properties than their contemporary counterparts, such as lettuce, spinach, carrots, and varieties of cabbages that have global dominance. Indigenous knowledge and ethno-botanical studies have establish the potential of indigenous leafy vegetables and pulses as sources of energy, proteins, vitamins and minerals. Many of these vegetables have been used over decades in Africa, Asia and South America. Many still are not exploited to enhance the food and nutrition security of the communities that use them. Inadequate health care provisioning, poor nutrition, low income levels, use of trees and their by- products for provision of food, medicine and cosmetics are common among the rural people. The paper further examines the possibility of replacing contemporary vegetables with these alternative sources in diets of rural and other communities.

Materials and Methods

A literature survey of studies on the nutritional properties of a range of indigenous vegetables and the contemporary ones were conducted to establish a basis for substitution of these commonly dominant vegetables with alternatives that show superior nutritive value.

Results and Discussion

Research have shown that the perennial leaf vegetable, Moringa oleifera, used in different traditional and indigenous systems, contains 25 times more iron than spinach, 0,75 times vitamin C than oranges, 15 times more potassium than bananas and 10 times more vitamin A than carrots. Other food sources that contain significantly higher nutritive values include Amaranthus sp., Cleome gynandra, cassava, cowpeas and okra. Apart from being nutritious Moringa tree has been regarded as a wonder plant that is useful in human and animal nutrition, health, cosmetics, bio-gas and water purification among other uses.

Conclusions

The cultivation and use of M. oleifera, and some of the above named indigenous vegetables and their by-products should be promoted in resource-poor households, as they serve as vehicles for poverty alleviation, food and nutrition security. It’s recommended that concerted effort should be made by multiple stakeholders to spearhead the promotion and adoption of these alternative food sources in rural, urban and peri-urban households and diets. They can also replace the cultivation of contemporary vegetables, as some are drought and heat tolerant, as well as adapted to mineral deficient environments, common under resource-poor farmer’s conditions.

References

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Keywords

Poverty alleviation, resource-poor households, rural development, nutrition security

DIAGNOSTIC SERVICES – A TOOL TO IDENTIFY PROBLEM AREAS AND IMPROVE PRODUCTION IN QUEEN PINEAPPLE CULTIVATION.

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Introduction

The diagnostic service offered by the Hluhluwe research station is an initiative to improve Queen pineapple production by identifying problem areas and by involving the farmers in exploring new concepts thereby stimulating innovation. Results of the service are used to understand the population dynamics of the pests subjected to the cultivation practices applied by the grower

Materials and Methods

The aim is to sample a field on a 3 monthly basis throughout the production cycle, starting 3 months after planting and continuing until harvesting of suckers approximately 8 months after fruit harvest. Fields planted in a particular month will represent a production block. The production block will be mapped into subdivisions. Any observable variation in previous crop growth, soil texture, moisture and draining patterns, or cropping history will constitute a subdivision. Samples will then be collected from each subdivision for a particular month. Insect and nematode pests will be identified and counted on the plant, while soil and leaf samples will be sent away for analysis.

Results and Discussion

Population dynamics and threshold levels for control of lesion nematode (*Pratylenchus brachyurus*), pineapple red mite (*Dolichotetranychus floridanus*) and pineapple mealybug (*Dysmicoccus brevipes* (Cockerell)) have been established over the years. The effect of certain climatic and cultivation practices on population dynamics have also been determined and a possible application could facilitate the determination of the effect of climate change on insect and nematode pests of pineapples.

Conclusions

Each year more farmers are making use of the diagnostic service on a more regular basis and more samples are analysed than the previous year, indicating the value of the service to the farmers.

References

Keywords

Queen pineapple, population dynamics, lesion nematode, pineapple red mite, pineapple mealybug

Improving growth of the slow-growing indigenous Mimusops zeyheri seedlings using auxins

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Introduction

The evergreen Transvaal Red Milkwood (*Mimusops zeyheri*) is being targeted as an urban- and rural-greening tree in Limpopo Province, due to its excellent nutritional, medicinal and aesthetic attributes. However, the slow growth of this plant species is the greatest concern to nursery owners. The objective of this study was to determine whether indole-3-acetic acid (IAA), gibberellic acid (GA3) and 6-benzylaminopurine (6-BAP) could improve growth of *M. zeyheri* seedlings.

Materials and Methods

Six-month old seedlings were transplanted into 30-cm diameter plastic pots containing steam-pasteurised loam soil and river sand growing mixture at 3:1 (v/v) ratio. Treatments, 0.0, 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8, 25.6 and 51.2 mg.mL-1 for each plant growth regulator (PGR), were arranged in a randomised complete block design, with five replications. Stock solutions of IAA, GA and 6-BAP were prepared in 100 mL plastic containers, with 102.2 mg of each PGR first dissolved in 2 mL methanol and then diluted in 98 mL distilled water. A pipette was used to draw different concentrations from the container into the spray bottles, which were topped up with 100 mL distilled water which was mixed with a sticker and wetter. Treatments were applied weekly. At 84 days after initiation, collected plant variables (plant height, stem diameter, leaf number, leaf length, petiole length, chlorophyll content, dry root and shoot mass) were subjected to analysis of variance, and then subjected to lines of the best fit.

Results and Discussion

The PGR concentrations had significant effects on various plant variables. Plant variables over increasing concentration of PGRs exhibited positive curvilinear quadratic relations in the context of density-dependent growth (DDG) patterns. Generally, the DDG patterns are characterised by three phases, namely, stimulation, neutral and inhibition phases. In context of the DDG patterns, the PGRs used in this study had similar effects to those observed in phytonematicides (Mashela et al., 2015), suggesting that above the observed optimum values the products might be phytotoxic.

Conclusions

The use of IAA, GA3 and 6-BAP as foliar sprays on *M. zeyheri* demonstrated for the first time the existence of DDG patterns of various organs of this plant species, thereby allowing for the computation of growth stimulating concentrations of PGR.

References

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Keywords

Allelochemicals, inhibition, saturation, stimulation

BIOACTIVITIES OF MELOIDOGYNE INCOGNITA AND MELOIDOGYNE JAVANICA IN CUCUMIS MYRIOCARPUS AND CUCUMIS AFRICANUS SEEDLINGS

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Introduction

In plant-parasitic nematodes, two forms of nematode resistance, namely, pre- and post-infectional nematode resistance had been identified (Moon et al., 2010). Only post-infectional nematode resistance can be introgressed in nematode-susceptible cultivars for nematode resistance through molecular plant breeding technologies. Wild watermelon (Cucumis africanus) and wild cucumber (Cucumis myriocarpus), both indigenous to Limpopo Province, South Africa, are highly resistant to all root-knot (Meloidogyne species) nematodes in South Africa. However, the form of nematode resistance in the two wild Cucumis species is not documented. The objective of this study was to determine the form of nematode resistance in the two Cucumis species to M. incognita and M. javanica under greenhouse conditions.

Materials and Methods

Uniform four-week old C. africanus and C. myriocarpus seedlings were transplanted into 250 mL polystyrene cups containing 200 mL pasteurised fine sand. A week after transplanting, Cucumis seedlings were each infested by dispensing 100 M. incognita or M. javanica second-stage juveniles (J2). Similar experiments were conducted for C. africanus and M. incognita, C. africanus and M. javanica, C. myriocarpus and M. incognita and C. myriocarpus and M. javanica combinations. Starting from two days after inoculation, five seedlings were removed every second day for a 30 days and their roots severed, cleaned and then stained, whereas nematodes in soil were extracted.

Results and Discussion

At each sampling time, seedling roots were assessed for necrotic spot, rootlet interference, giant cell formation and root gall number. The presence of necrotic spots suggested that the J2 penetrated the root system. Rootlet interference showed that the plant resisted nematode infection and the establishment of the feeding site (Moon et al., 2010). The failure of the development of giant cells and the root gall in C. africanus and C. myriocarpus was an indicator that the seedlings were resistant to infection by both nematode species.

Conclusions

The preliminary results suggested that the two Cucumis species had post-infectional nematode resistance to M. incognita and M. javanica since J2 were allowed to penetrate but restricted to develop inside the root system.

References

Moon, H.S., Khan, Z., Kim, S.G., Son, S.H. and Y.H. Kim 2010. Biological and structural mechanisms of disease development and resistance in chili pepper infected with the root-knot nematode. Journal of Plant Pathology 26:149-153

Keywords

Cucumis species, Meloidogyne species, necrotic spots, rootlet interference, giant cells, root gall number

SOIL MICROBIAL ACTIVITY IN MAIZE AS AFFECTED BY CONSERVATION AGRICULTURE

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Introduction

The disturbance of soil structure, composition and natural biodiversity due to continuous conventional cultivation practices can be abated through Conservation Agriculture (CA). CA practices consist of minimum disturbance of the soil, multiple cropping systems and maintaining soil cover of crop residues (Montgomery, 2007). These practices may prompt major shifts in the population and composition of soil microbial life, which may impact on soil structure, organic matter decomposition and nutrient cycling. CA has been widely studied, but research on the impact that local CA maize based systems have on soil microbiology remains limited. The study aimed to evaluate the effect of CA systems on soil microbial activity in local maize production systems.

Materials and Methods

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

Results and Discussion

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

Conclusions

Changing from conventional agricultural to CA cropping systems encourages higher soil microbial activity and fungal diversity.

References

Montgomery, D.R. 2007. Soil erosion and agricultural sustainability. P. Natl. Acad. Sci. USA 104:13268-13272.

Keywords

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

The effect of white shade net on physiology, phenology and production of mandarin (Citrus reticulate Blanco, cv. Nadorcott)

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Introduction

Shade nets are increasingly used by citrus growers, including mandarin growers, to protect their crop against hail and sunburn damage. However, shade nets also alter the micro-climate of the orchards and, therefore, have an effect on the physiology, performance and production of tree crops. The effect of shade nets on the physiology, growth and production of mandarins has not been investigated in much detail. Erecting shade nets over mandarin orchards without a proper understanding of their effect will impose potential risks possibly associated with financial losses. This study therefore aimed at gaining a better understanding of the effect of a low density white shade net on the physiology, phenology and production of a late-season mandarin cultivar, ‘Nadorcott’.

Materials and Methods

The current study was carried out in the Nelspruit area of Mpumalanga during the 2015 and 2016 seasons. Bearing ‘Nadorcott’ mandarins trees, grafted on ‘Carrizzo’ rootstocks were used. In a randomized pseudo-block design, the trial consisted of two treatments (covered and uncovered) with six replicates per treatment. Trees for the covered treatment was covered with a 20% white shade net. Physiology (transpiration, photosynthesis and stomatal conductance), phenology (vegetative vigour, leaf area index, flowering, fruit set and retention) and yield data were collected.

Results and Discussion

Night temperatures and humidity were higher in the covered orchard, when compared with the uncovered orchard. During the day, the net reduced photosynthetic active radiation significantly and created slightly cooler conditions. This change in micro-climate brought about by the shade net affected tree physiology viz. increased stomatal conductance, which resulted in a significant increase in gas exchange. The shaded environment created by the net further resulted in some morphological adaptations, which included larger and thinner leaves with a higher leaf chlorophyll content, as well as increased vegetative vigour. Flowering and fruit set was not affected by the shade net. During the two seasons in which the study was carried out, ‘Nadorcott’ showed distinct alternate bearing behaviour. During the 'off' season there were no yield differences between the treatments, while the uncovered orchard had significantly higher yields during the 'on' season. Fruit size was significantly increased by the net.

Conclusions

Covering ‘Nadorcott’ mandarins with shade net showed some beneficial effects. These included environmental protection against adverse temperatures, improved plant performance and improved fruit size. The effect of the net on long-term yield, tree water use and pest and disease incidences are subjects for further investigation.

References

Keywords

Micro-climate, photosynthesis, transpiration, flowering, fruit set

PHYSIOLOGICAL RESPONSES OF WINTER WHEAT CULTIVARS UNDER TWO ECOTOPES

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Introduction

Rising mean temperatures causing heat stress has drawn the attention of researchers in the field of agriculture. In Zambia, despite growing wheat in the winter season known for cool temperatures, yields below 5 t ha-1 are common in the warm ecotope. Growing cultivars with capacity to adapt to high mean temperatures might enhance production. Obtaining knowledge and understanding on the physiological responses of wheat cultivars could enable growers to choose the correct cultivar or manipulate the physiological processes, leading to normal growth and yield. The objective of this study was to evaluate the physiological responses of four winter wheat cultivars under warm and cool ecotope.

Materials and Methods

Four cultivars, UNZA II, Nduna, Pungwa and Loerie II were grown in warm and cool ecotope using . A randomised complete block design was used with five replicates. Canopy temperature (CT) during vegetative and reproduction stages using an IRT; stay green duration (SGD) scored according to Pask and Pietragalla (2012) , fresh biomass (FM) and dry matter accumulation (DM) were measured.

Results and Discussion

The warm ecotope exposed cultivars to short, gradual and/or continuous high temperatures throughout the growing season compared to the cool ecotope. No definite pattern was observed on CT responses of cultivars in the warm ecotope though the SGD was shortened. Pungwa had a longer SGD, and tended to maintain normal plant functions in the warm ecotope compared to UNZA II. FM and DM accumulation was enhanced throughout the growth period in season I, while in season II FM increased to the beginning of kernel and milk phase and then dropped, and DM decreased after the seedling phase. Loerie II and Nduna attained the peak of DM at physiological maturity and after physiological maturity, respectively while Pungwa and UNZA II were not consistent. Pungwa reached peak either before or at physiological maturity, while UNZA II was at physiological maturity or after. The early, gradual and continuous exposure to high temperatures in warm ecotope, conditioned plants and had potential to trigger adaptation. This could explain the normal functioning in Pungwa which resulted in more FM and DM accumulation in warm ecotope.

Conclusions

Based on these results, there is urgent need to investigate the country’s winter wheat cultivars to provide information on their adaptation if growers were to make informed decision before planting in the warm ecotope. Adaptive nature of Pungwa could offer growers an option for wheat production in the warm ecotope.

References

PASK, A. & PIETRAGALLA, J., 2012. Leaf area, green crop area and senescence. In: A. Pask, J. Pietragalia, D. Mullan & M. Reynolds (eds.). Physiological breeding II: A field guide to wheat phenotyping. Mexico. D.F.: CIMMYT.p.58-62.

Keywords

Canopy temperature, stay green duration, temperature stress, wheat cultivar, dry matter

SEED QUALITY OF SELECTED NEGLECTED UNDERUTILISED CROPS

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Introduction

There are many traditional vegetables that have a potential to contribute to food insecurity. Studies on their production processes are necessary. The aim of this study was determine the potential value of selected underutilised cultivated and wild vegetable crops on the basis of seed quality. The hypothesis was that seed quality can be used to predict crop establishment.

Materials and Methods

The International Seed Testing Association (ISTA) rules for testing seed were used to test germination of red amaranthus (Amaranthus hybridus), white amaranthus (A. albus), cleome (Cleome gynandra), chorchorus (Chorchorus olitrius), nightshade (Solanum nigrum), wild mustard (Sinapsis avernsis) and cowpea (Vigna unguiculata). The experiment was replicated four times using the petri dishes method of ISTA. Seed germination was recorded daily. Seedling size was determined on the last day of the germination test. Data were analysed using Genstat version 17 to determine significant differences at $P \leq 0.05$ and least significant (LSD) values were used to separate different means for each variable.

Results and Discussion

There were highly significant differences among crop species with respect to all variables tested. Nightshade showed 100% germination from the first day after incubation, whereas chorchorus showed 80% germination on the first day and reached 100% by day eight. The next best performing crop was cowpea, which showed 10% germination on day one and reached 100% by day six. Cleome only reached 10% maximum germination. The significant differences in seedling size were associated with genetic differences among species. In this respect, cowpea produced seedlings that were 152 mm in size compared to white amaranthus with 17 mm, for example. However, all species produced normal seedlings as indicated by shoot length, root length and root: shoot ratio.

Conclusions

Seed germination is an important determinant of seed quality. As a future study, a seed germination model is needed as a tool to distinguish seed quality of neglected underutilised crops within species and to compare different species for the purposes on intercropping.

References

Keywords

Germination, seed, wild vegetable

MODELLING CROP GROWTH AND THE WATER BALANCE OF SOYBEANS AND SUGAR BEANS IN A DRYLAND CROP ROTATION SYSTEM WITH POTATOES

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Introduction

The stagnancy of real product prices in the past decade in contrast with increasing input costs and declining profits, has caused potato growers to be under immense pressure to reduce input costs to ensure financial sustainability. Crop rotation can help minimize production risk while improving productivity, especially for dryland production. This study forms part of a long-term trial being conducted in the Eastern Free State to develop region-specific crop rotation programmes, where potato is grown in rotation systems with maize, wheat, soybeans, sugar beans and sunflower. The aim is to forecast the effects of different crop rotation systems on the soil water balance and yields, in the long run.

Materials and Methods

A trial with 3.8 m by 4.5 m plots was set up in a randomized complete block design at the University of Pretoria's Hatfield Experimental Farm, with soybeans and sugar beans, which are part of the five year crop rotation systems in the EFS trial. Three levels of water treatment were used – fully irrigated, supplemental irrigation and dryland, with three replications. Soil water content was monitored using a calibrated neutron probe and daily weather conditions were recorded throughout the growing season using an automatic weather station. Sampling for growth analyses was done destructively at two-weekly intervals. After final harvest, harvest index and total yield were measured. The growth analysis data will be used to develop crop-specific model parameters for calibration of the SWB model, which will be used to run long-term simulations to determine the best crop rotation systems for the Eastern Free State.

Results and Discussion

Preliminary data analysis indicated that the fully irrigated treatment performed better than both the supplementary irrigated and the dryland treatments; while the supplementary irrigated treatment performed better than the dryland treatment in both plant species. The average yields for sugar beans were 2.1, 2.7 and 2.9 tonnes per hectare for the dryland, supplementary irrigated and the fully irrigated treatments respectively. Soybean yields ranged from about 3.9 to as high as 6.4 tonnes per hectare. The total water added through irrigation and rainwater was 552 mm (dryland), 843 mm (supplementary irrigated) and 888 mm (fully irrigated) for soybeans; while the sugar beans got 442 mm (dryland), 604 mm (supplementary irrigated) and 625 mm (fully irrigated).

Conclusions

Both sugar beans and soybeans are prolific under conditions of adequate moisture. SWB calibration is still underway, whereafter simulations will be run to determine the best crop rotation systems and cropping sequences.

References

Keywords

Designing and analysing KASP markers linked to a Russian wheat aphid (Diuraphis noxia) resistance gene in wheat (Triticum aestivum L.)

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Introduction

Wheat (Triticum aestivum L.) is a top import commodity in South Africa due to the inability of the country to meet its own demands (FAOSTAT 2016). This can be attributed to the many biotic and abiotic factors that greatly affect healthy and sufficient production of this cereal. One biotic stress that has greatly affected the production of wheat in South Africa is the Russian wheat aphid (RWA, Diuraphis noxia). This insect pest causes irreversible damage to susceptible plants which often lead to death, thereby reducing plant and economic yields. Means to control the pest are available, the most widely used being breeding for host plant resistance. Conventional pre-breeding and breeding methods, coupled with molecular methods and tools is the current strategy of choice in the fight against aphids. This study will exploit this strategy in a South African wheat pre-breeding programme at the Agricultural Research Council-Small Grain Institute (ARC-SGI) aimed at identifying SNP markers linked to the resistance gene (Dn2401) present in the wheat accession CItr 2401. These SNP markers will be converted to cost-effective and flexible throughput Competitive Allele Specific PCR (KASPar) assays.

Materials and Methods

Twenty-two near isogenic lines (NIL) created from a cross between CItr 2401 (resistance donor) and Kavkaz (a susceptible line) were sent for the 9K SNP genotyping array. The genotypic data was analysed with the Plink 1.9 and TASSEL 4.3.15 software's. The linkage map was constructed using the QTL IciMapping Version 4.0 software.

Results and Discussion

A total of 8 632 SNPs were generated from the SNP array with only eight SNPs linking to the resistance phenotype. The eight SNPs were used in KASP marker designing. The designed KASPar assays were validated on the 22 NILs and also tested on RWA resistance genotypes that have been developed at ARC-SGI.

Conclusions

The designed cost-effective KASP markers for SNP genotyping will be useful in genetic research and breeding of wheat as well as other related cereals. The identification of molecular markers such as SNPs has enabled genetic mapping of pest resistance genes and quantitative trait loci (QTL). Markers linked to pest resistance genes have been used successfully in marker-assisted selection of pest resistant genotypes.

References

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Keywords

Backcrossing, Genotyping, Linkage map, Molecular markers, Sequencing

Establishment and placement of wheat and canola seed using a tine and disc planter

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Introduction

Most Western Cape farmers following conservation agriculture rely on tine planters to establish wheat and canola. However, due to the success with disc openers elsewhere in the world, the interest in planters using disc openers is increasing. The aim of this study is to evaluate the effectiveness of a tine or disc planter to establish canola and wheat at different depths.

Materials and Methods

The trial was conducted in Langgewens Research Farm in the Swartland. The trial was laid out as a randomised block design. An Equalizer planter with exchangeable disc and tine openers was used to sow wheat and canola at three different sowing depths in May 2016. After four weeks, 15 plants were collected per plot to determine the depth of seed placement. For wheat, this was determined by measuring the distance between the point on the hypocotyl with white discolouration to remnant of the seed. For canola, the seed was not visible anymore and the distance between the discolouration on the hypocotyl and the branch of the first secondary root was noted. Plant density was determined after 90 days to evaluate success of establishment.

Results and Discussion

Wheat seed depth was effectively controlled using tines, i.e. 22.3, 36.8 to 46.1 mm for the shallow, medium and deep settings on the planter ($P<0.05$). A similar pattern was observed for canola, but generally shallower at 10.7, 11.4 and 13.5 mm, respectively ($P<0.05$). Conversely, the disc opener placed wheat seed at an average depth of 35.5 mm and canola seed at 8.9 mm, regardless of the depth setting ($P>0.05$). Plant density was affected by the seeding depth and opener for wheat ($P<0.05$), but not for canola ($P>0.05$). The most wheat plants (230 m-2) established when seeds were placed at 46.1 mm and it did not differ ($P>0.05$) from when being placed at 36.8 mm (197 m-2). For canola plant density, there was no difference ($P>0.05$) between tine and disc opener or seeding depth (98.5 m-2). Soil moisture is a critical factor to consider during establishment. These crops were established in dry soil, when the soil water content was 4%.

Conclusions

Control of planting depth is more effective with a tine than a disc. The best wheat establishment was obtained when planting deeper with a tine, while for canola, planting depth was not controlled effectively, regardless of using a tine or disc.

References

Keywords

Keywords: canola, disc, Equalizer, planter, tine, wheat

EFFECT OF COMMENCEMENT OF TIPPING ON BIOMASS AND ECONOMIC YIELD OF AMARANTHUS CRUENTUS L.

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Introduction

Commercialisation of a crop creates the need to optimise its production, harvest and post-harvest practices. Pigweed (*Amaranthus cruentus* L.) is one of several traditional leafy vegetables which are in the process of being commercialised. The objective of the present study was to identify the optimum growth stage at which tipping of *A. cruentus* should be started. Tipping is one of several methods that can be used to harvest the crop. It involves removal of the tips of the shoots of the plants to which the youngest leaves are attached.

Materials and Methods

The study was done by means of a greenhouse pot experiment with 20 treatments arranged in a completely randomised design with four replications. Treatments consisted of successive, two-day delays in the on-set of tipping, with tipping starting 14 days after planting in the earliest treatment and 52 days after planting in the latest. Main stem and branches were considered ready for tipping when they had three fully unfolded leaves. Tipping consisted of cutting the top 2 cm of the shoot with a pair of secateurs. The experiment was planted on 20 September 2015 and was terminated on 2 December 2015 when 50% of the plants in the experiment had started to flower. At termination, the leaves that remained on the stem were considered part of the above-ground biomass and not economic yield as they were too fibrous for consumption. Economic yield consisted of the tips. Both above-ground biomass and economic yield were determined on a fresh-weight and oven-dry weight basis. The biomass and economic yield data were analysed using ANOVA and treatment means were separated using the Least Significant Difference (LSD) test.

Results and Discussion

Treatment effects on above-ground biomass and economic yield were highly significant ($p<0.001$). Highest biomass was obtained when tipping was started from 26 to 38 days after planting (DAP), at which stage the plants were 15-20 cm tall. Highest economic yield was recorded when tipping was started from 26 to 32 DAP. Starting tipping at an earlier growth stage restricted plant growth. Delaying tipping to a stage later than the optimum resulted in decrease in both biomass and economic yield (18.11 and 49.6 %) respectively.

Conclusions

Both biomass and economic yield of *A. cruentus* were affected by the growth stage at which harvesting of the plants by tipping was started. In this greenhouse pot study, optimum economic yield was achieved when tipping started between 26 and 32 DAP.

References

Keywords

leaf yield, amaranth, harvest, tipping, commencement, optimisation.

VARIATIONS IN COMPOSITION OF COVER CROP MIXTURES

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Introduction

Cover crops can enhance conservation agriculture systems by increasing diversity and soil cover and increase overall soil health. Different plant species have different functional roles within mixtures, thus enabling farmers to combine and utilise these different functional roles. Two mixture combinations were included in a new long term production trial within the Swartland. Variations in eventual mixture composition (differing from the expected composition) was noted during sampling within the current season.

Materials and Methods

The main trial was conducted on Langgewens Research Farm in the Swartland, Western Cape, with a Mediterranean-type climate. Two treatments were laid out in a completely randomised design, replicated 12 times in 15 x 30 m plots. The treatments consisted of two different cover crop mixtures, i.e. 1) 70% legumes and 30% cereals or 2) 70% cereals and 30% legumes. Biomass samples were cut from 0.25m2 quadrants 90 days after planting and the proportion legumes to cereals determined on a dry matter basis. Extensive soil data taken from each of the plots at the start of the season was used to explain the mixture variations.

Results and Discussion

A statistical analysis showed significant correlations of nitrogen (N), phosphorous (P), sodium (Na) and electrical resistance (ER) with the varying compositions As total dry matter yield increased the proportion of legumes to cereals decreased ($p<0.01$). Legumes require more P, but less N than cereals. In mix 2, with fewer legumes competing for limited P, an increase in P lead to a significant increase ($p<0.05$) in the proportion of legumes. In mix 1 N caused a significant increase ($p<0.05$) in the proportion of cereals of the first mixture, which had fewer cereals competing for the limited N. As Na increased ($p<0.05$) and salinity (ER) ($p<0.05$) increased in the plots planted to mix 1, the proportion of cereals increased in the eventual composition. However, no significant ($P>0.05$) effect from Na and ER were noted in mix 2 plots. Legumes are more sensitive to saline conditions which might explain why the mixture with fewer legumes do not show a significant effect.

Conclusions

Results from the first year of the trial indicated that cover crop mixture composition and biomass production might be influenced by P, N, Na and electrical resistance. More data from coming seasons will shed more light on the results obtained in this study thus far. This will contribute to improve future mixture selections.

References

Keywords

Cereals, Conservation agriculture, Legumes, Mediterranean, Nitrogen

DEVELOPMENTAL DYNAMICS IN CITRUS LAND REFORM PROJECTS: CASE STUDIES IN THE SARAH BAARTMAN DISTRICT, EASTERN CAPE

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Introduction

A comparison was made between two land reform citrus farm operations in the Sarah Baartman District of the Eastern Cape to, firstly; evaluate and identify factors that influence long-term sustainability and prosperity of farms owned and run by beneficiaries, and farms jointly owned by beneficiaries and a former farmer / mentor in an equity share scheme, and secondly; to identify forms of government support in each of the two models.

Materials and Methods

A mixed methodology, characterized by a mixture of qualitative and quantitative instruments, comprising structured and semi-structured questionnaires, was used to conduct the study. It involved the administration of structured interviews with beneficiaries and semi-structured interviews with the mentors and government officials.

Results and Discussion

The study found that the equity share scheme improved the livelihood of the beneficiaries in terms of annual dividends, resulting in home improvements and means to send children to institutions of higher learning; empowered beneficiaries in decision-making in terms of financial expenditure on farm operations and dividend pay-outs and the project showed great potential of long-term sustainability and prosperity. The mentor provided business and financial management services to the equity share scheme beneficiaries. Conversely, the beneficiary-owned and run projects did not improve the lives of beneficiaries, was prone to infighting and fraught with organizational and management problems, with no prospects of long-term sustainability and economic viability (HSRC 2003: iv). Of the original ten members in the project, seven had abandoned the project, making it very difficult for the remaining beneficiaries to access credit without the other signatories. The beneficiary owned and run operation received government support in the form of vegetable seedlings for vegetable production; possibly crop diversification to spread risk factors, whereas the share equity scheme was provided with a tractor, harvesting bins, irrigation infrastructure, and ladders.

Conclusions

Land reform projects have a great potential of long-term sustainability and economic prosperity when former farmers get into mentorship / equity share programs with smallholder farmers, where such an institutional arrangement benefits the partnership positively.

References

HSRC (HUMAN SCIENCES RESEARCH COUNCIL), 2003. Land Redistribution for Agricultural Development: Case Studies in Three Provinces. Pretoria: Integrated Rural and Regional Development.

Keywords

Land reform, qualitative, quantitative, beneficiaries, equity, sustainability, mentor

LIME REQUIREMENT IN RELATION TO SOIL PROPERTIES FOR VARIOUS LIME REQUIREMENT METHODS

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Introduction

The problem of determining the lime requirement (LR) for acid soils is one that has been studied extensively, resulting in numerous methods which are variously used. A study was conducted to investigate the relationship between soil properties and LR predicted by the Eksteen, Cedara, ARC- Small Grain Institute, SMP-, and Adams and Evans single buffer methods.

Materials and Methods

Samples from the A and B horizons of 20 acid soils from the Eastern Free State, KwaZulu Natal, Western Cape, and North West Province were used in this study. Soil pH (water and KCl); exchangeable acidity (KCl), titratable acidity (KCl and K2SO4), organic carbon (Walkley Black), total C (dry combustion), CECpH7 and CBD (Citrate-Bicarbonate-Dithionite) Al were determined. LR were calculated as specified by procedures related to each LR method.

Results and Discussion

The Eksteen method correlated significantly with pHKCl ($r^2 = 0.56$), pHW ($r^2 = 0.62$), organic C ($r^2 = 0.63$), total C ($r^2 = 0.63$), CECpH7 ($r^2 = 0.62$), and CBD Al ($r^2 = 0.56$). The Cedara method did not correlate significantly with pHKCl ($r^2 = 0.11$) and pHW ($r^2 = 0.14$). However, significant correlations were found for organic C ($r^2 = 0.76$), total C ($r^2 = 0.76$), CECpH7 ($r^2 = 0.80$), and CBD Al ($r^2 = 0.55$). The ARC – Small Grain Institute method correlated significantly with pHKCl ($r^2 = 0.96$) and pHW ($r^2 = 0.86$). The SMP single buffer method showed no correlation with pHKCl ($r^2 = 0.11$), pHW ($r^2 = 0.08$). However, significant correlations were found for organic C ($r^2 = 0.92$), total C ($r^2 = 0.93$), CECpH7 ($r^2 = 0.67$), and CBD Al ($r^2 = 0.79$). The Adams and Evans single buffer method showed no significant correlation with pHKCl ($r^2 = 0.26$) and pHW ($r^2 = 0.30$), but strong correlations were found with organic C ($r^2 = 0.90$), total C ($r^2 = 0.88$), CECpH7 ($r^2 = 0.67$), and CBD Al ($r^2 = 0.75$).

Conclusions

Methods based on a given soil pH, such as the Eksteen and ARC – Small Grain Institute methods, related strongly with pH. This warrants caution however, as soil pH does not serve as an accurate parameter for quantitative LR. LR recommendations generally increase with an increase in each respective soil component, aside from soil pH, evaluated in the study. It should be noted that over liming may occur when methods are used that incorporate pH-dependent acidity components, such as the Eksteen, SMP and Adams and Evans methods.

References

Keywords

carbon, CEC, lime requirement, oxides, pH

SOIL ACIDITY IN RELATION TO SOIL PROPERTIES FOR SELECTED SOUTH AFRICAN SOILS

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Introduction

The nature and contributing components of acidity were investigated for a group of 20 acid South African soils (pH 3.6 – 5.6). Exchangeable acidity, titratable acidity, and total acidity were related to pHKCl and pHW, organic and total combustible carbon, CEC at pH 7.0, and CBD-extractable Al oxides. The aim of this study was to quantify various forms of extractable acidity, and concomitantly examine the inter-relationship between these forms and selected soil properties.

Materials and Methods

Samples from the A and B horizons of 20 acid soils from the Eastern Free State, KwaZulu Natal, Western Cape, and North West Province were used in this study. Soil pH (water and KCl); exchangeable acidity (KCl), titratable acidity (KCl and K2SO4), total acidity (BaCl2), organic C (Walkley Black), total C (dry combustion), CECpH7 and CBD Al were determined.

Results and Discussion

Exchangeable acidity correlated significantly with pHKCl ($r^2 = 0.70$) and less so with pHW ($r^2 = 0.55$). Results showed that little or no exchangeable acidity was found at pHW > 5.5. Exchangeable, titratable, and total acidity correlated significantly with organic carbon ($r^2 = 0.69$; $r^2 = 0.88$; and $r^2 = 0.84$ respectively). Exchangeable, titratable and total acidity was also strongly correlated with total combustible carbon ($r^2 = 0.70$; $r^2 = 0.86$; and $r^2 = 0.83$ respectively). Titratable and total acidity showed moderately significant correlation with CEC ($r^2 = 0.58$; $r^2 = 0.67$), however, no significant correlation existed between exchangeable acidity and CEC ($r^2 = 0.40$). Significant correlations were found between CBD Al and exchangeable, titratable, and total acidity ($r^2 = 0.55$; $r^2 = 0.68$; and $r^2 = 0.75$, respectively).

Conclusions

A clear relationship can be found primarily between extractable acidity and soil carbon. This may be attributed to a greater sorption capacity for acidic cations with increasing soil carbon contents. The pH value of the extracting solution used to determine soil acidity plays a significant role in the relationship between acidity and soil components that can serve as sources for pH-dependent acidity. These components include, but are not limited to, soil carbon and metal oxides.

References

Keywords

acidity, carbon, CEC, soil pH, oxides

HOW DIFFERENT WHEAT SEED ZINC CONCENTRATIONS INFLUENCE THEIR VIGOUR

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Introduction

Increased vigour of seeds of crop species can increase their ability to compete for important resources such as water, light and nutrients. Competition by weeds in croplands in South Africa is a real threat and leads to decreased yields, seed quality and increases in production costs due to the costs of chemical herbicides and spraying equipment. Previous studies have found that higher zinc concentrations in wheat (*Triticum aestivum*) seeds improve their vigour and therefore ability to outcompete weeds for resources. The germination rate and success of wheat seeds with different zinc concentrations where investigated during this study.

Materials and Methods

Two similar trials where performed. During the first trial spring wheat (*T. aestivum cv* SST027) seeds (20 seeds per petri dish) with different zinc concentrations were placed into a 9 mm radius Petri dish on a moist filter paper. These petri dishes where placed into a germination cabinet at a constant temperature of 22oC with no light exposure. The number of seeds that germinated every day thereafter was recorded to calculate germination rate and percentage. The trial was discontinued when no seeds germinated for three consecutive days. The same procedure was performed during the second trial with one difference. The seeds were first exposed to an accelerated ageing test. The seeds were placed into a germination cabinet at 100% humidity and at a constant temperature of 420C for 72 hours. After this they were exposed to the same germination test as explained above.

Results and Discussion

The results indicate that the different zinc concentrations had no significant effect on the germination rate and germination percentage. This is in contrast to previous studies where higher zinc content improved the vigour of seeds. No clear trend line was seen in the data suggesting that there might be other nutrients or factors that play a larger role in the germination success of wheat. What was clear was that germination rates and germination percentages were much lower in the second trial after the accelerated ageing treatment than in the first trial. This is to be expected because the accelerated test reduce the vigour of the seeds.

Conclusions

The results of this pilot trial indicate that higher zinc concentrations does not increase the viability of vigour of spring wheat seeds significantly. The study can be improved by increasing the variation in wheat zinc differences. More research is needed before a scientifically strong conclusion can be made.

References

Keywords

Competition, vigour, wheat, zinc

ENZYMATIC ACTIVITIES AND SOIL MICROBIAL COMMUNITIES ASSOCIATED WITH BT MAIZE UNDER FIELD CONDITIONS

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Introduction

Bt maize is maize (Zea mays L.) that has been genetically engineered to express the Cry1Ab gene from Bacillus thuringiensis (Bt) and produce an insecticidal toxin. The study aimed to investigate any potential impact of the genetic modification of Bt maize on the enzymatic activities and structure of soil associated microbial communities under field conditions.

Materials and Methods

A total of 14 Bt and 14 non-Bt maize soil samples at 0-15 cm depths were collected from two localities in the North West Province. These localities comprised of fields under dryland (DL) and irrigated (IL) conventional cultivation where Bt maize had been planted for at least 3 consecutive years. Transgenic Bt maize expressing the Cry1Ab protein (event MON 810) and a near-isogenic non-Bt line were used for study. Sampling was done in a W-shape pattern to obtain representative samples per field. Soil samples were subjected to chemical and biochemical analyses. Next generation sequencing (NGS) were also used to study the soil community diversity. This was followed by analyses that involved diversity estimators such as ACE, Chao1, Shannon-Weaver diversity calculations as well as multivariate analysis.

Results and Discussion

Results showed that nitrate and phosphorus concentrations were significantly ($p>0.05$) higher in non-Bt maize soil samples under DL conditions, while organic carbon was significantly higher in non-Bt maize soil samples under IL conditions. Acid phosphatase and β-glucosidase activities were significantly higher in both non-Bt maize fields, while urease showed no significant differences. Bacterial alpha diversity showed that Bt maize fields under DL and IL conditions had the highest number of sequences present, compared to non-Bt maize fields. However, soil bacterial richness in non-Bt maize field samples under DL conditions were greater. Furthermore, results showed that Actinobacteria, Proteobacteria and Acidobacteria were the dominant phyla commonly found in maize fields. Redundancy analyses (RDA) indicated that organic carbon, nitrate, phosphorus and pH could be used to explain differences in bacterial community structures. These trends were also observed in RDA analyses, which displayed a t positive correlation to these fields.

Conclusions

The results indicated that Bt toxin was not the direct factor causing variances in soil microbial community differences in chemical and biochemical analyses. Rather, other factors such as agricultural practises and environmental parameters may be responsible.

References

Keywords

agricultural practices, Bt maize, enzyme activities, NGS, soil microbial community

THE RELATIONSHIP BETWEEN CONSERVATION TILLAGE PRACTICES FOR POTATO PRODUCTION AND COVER CROPS IN THE SANDVELD REGION OF SOUTH AFRICA

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Introduction

Conservation tillage embraces crop production systems involving the management of surface residues. These practices and cover crop management have the potential to limit the degradation of soil and to maintain crop yields as well as ecosystem stability. The frequent cultivation of fields removes plant residues and organic matter, causing increased rates of soil mineralisation, resulting in losses of soil organic carbon. Tillage plays a major role in modification of soil structure as it influences the distribution of energy rich organic matter within the soil profile and thus impacts on the energy flow and the dynamics of soil geo-chemical functions.

Materials and Methods

Three tillage treatments were investigated and consisted of a conventional tillage treatment with a mouldboard plough to a depth of 350 mm combined with a rip treatment 600 mm deep between planting rows, a conservation rip treatment to a depth of 600 mm between planting rows and a conservation paraplough treatment over two planting rows to a depth of 600 mm. Three different cover crop combinations were tested which were as follows: C1 - Black oats after harvesting of potatoes and leave volunteer crop. C2 - Rye after harvesting of potatoes and leave volunteer crop. C3 - Rye after harvesting of potatoes and leave volunteer crop, after three years establish triticale.

Results and Discussion

Black oats used as cover crop resulted in the lowest dry crop residue mass production of 42.0 - 54.5 gm-2. The other cover crops resulted in no statistical difference in dry mass and ranged from 105 - 150 gm-2. The percentage cover of the cover crop treatments was determined by utilising the line-transect method. The C2 and C3 cover crop treatments resulted in the highest percentage cover ranging from 37 - 43%. The black oats treatments gave the lowest cover of 13 - 17% which is statistically lower than the other cover crop treatments. The number of cover crop plants per square meter ranged from 210.5 - 279.25 plants m-2 for the black oats and rye respectively.

Conclusions

Tillage did not influence the cover crop performance but the choice of cover crop is of utmost importance to achieve satisfactory results from the cover crops. A mixture of cover crops is recommended to be planted in place of black oats to achieve higher cover crop outputs under conditions found in the Aurora area of the Sandveld.

References

Keywords

tillage, cover crop, potato, percentage cover

Integrating indigenous knowledge systems (IKS) into climate variability mitigation and adaptation in semi-arid farming communities

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Introduction

Climate variability has a negative socio-economic activities to human being, however agriculture is more affected especially communal farmers. Local traditional farmers in Africa rely in agriculture for food and income. Most part of Southern Africa are semi- arid experiencing higher temperatures and little rainfall with extreme events in other times. In spite those conditions communal farmers developed strategies to mitigate, adapt and cope in order to sustain production. Traditional farmers for several years have been using indigenous indicators to predict weather and plan in advance the type of crop, time of planting and method of cultivation. Integration of indigenous knowledge system (IKS) with scientific knowledge would highly benefit communal farmers in semi-arid regions to increase production.

Materials and Methods

In a study conducted in Bergville and uMsinga, KwaZulu Natal, indigenous data was gathered using baseline survey and it was supplemented with scientific laboratory work. In KwaZulu Natal, South Africa, local communal Zulu farmers have been coping with climate extremes for centuries, using knowledge transferred from forefathers. The experimental design included eighty villages where communal farming was practiced with convectional traditional tillage techniques utilized, with one village practicing conservation tillage technique being control. The sampling for aggregates stability and bulky density was only done by point, depth was not considered. Core were sampled for bulky density.Bases, pH, EC, total P, exchangeable acidity, particle size and organic carbon were all analyzed in laboratory. Total N and C were analyzed using LECO.

Results and Discussion

In both Bergville and uMsinga local farmers have been observing the trends in climate patterns over the years turning for worse. In each district farmers have their own distinct observation about the climate pattern, same applies to each village within the district. Indigenous coping strategies to extreme events such as droughts, floods, thunderstorms and pests/disease outbreaks, were adopted with time. Indigenous indicators have made significant contributions towards more sustainable development, due to the resource management involved.

Conclusions

Socio-economic status of an area play a pivotal role in agriculture. Most crucial constraints that limit communal farmers to get access to scientific strategies are lack of education, poor infrastructure and lack of finances. However communal farmers have been surviving extreme events such as drought, floods, thunderstorms and diseases and pests using IKS.

References

Keywords

IKS- Indigenous Knowledge System

EVALUATION OF ICRISAT GROUNDNUT VARIETIES UNDER IRRIGATION IN MPUMALANGA MIDDLEVELD

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Introduction

Groundnut (Arachis hypogaea L.) originated in South America (Zhao et al., 2012), and is a major food as well as cash crop for smallholder farmers in Mpumalanga Province of South Africa, where it is grown mainly under rain-fed conditions. It is also grown under irrigation in the province by a few farmers as practised by commercial groundnut producers in other parts of South Africa. Groundnut is a major source of edible oil and vegetable protein in South Africa. Groundnut seeds contain 47-53% oil, 25-36% protein and 10-15% carbohydrate (Holbrook et al., 2003). The best soil for groundnut production is well-drained, light textured sandy or sandy loam which facilitates easy penetration of pegs and pod development.

Materials and Methods

Twenty-two groundnut genotypes developed at the International Crops Research Institute for the Semi – Arid Tropics (ICRISAT), Hyderabad, India and selected from the previous field evaluations carried out in Mpumalanga were tested under irrigation during 2015-2016 cropping season. The field experiment was conducted at Steynsdorp (26o 8’ 9”S, 30o 59’ 2” E) east of Elukwatini, Mpumalanga province, in a Randomized Complete Block Design (RCBD) with three replications. The plot size was four rows of 3 m long, with inter and intra-row spacing of 70 cm and 10 cm respectively. The seed placement was at 6-7 cm deep.

Results and Discussion

The study showed greater seed yield in thirteen genotypes than the control (Inkanyezi). The highest seed yields were recorded in the genotypes ICGV 07406 (3503 kg ha-1), ICGV 06051 (3242 kg ha-1), ICGV 06144 (3196 kg ha-1) and ICGV 07395 (3029 kg ha-1) .The trend was also similar with the pod yield obtained by these varieties. Although twenty varieties had lower shelling percentages than Inkanyezi, the decrease was not large enough to be significant. In general, the shelling percent was satisfactory and it ranged from 61% in ICGV 07395 and to 71% in ICGV 06041.

Conclusions

The most outstanding varieties selected based on their seed yield, and other yield parameters such as shelling percentage, number of seed per pod, 100 seed mass and days to maturity would be further evaluated in farmer-managed trials in the coming seasons across Mpumalanga Province.

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Keywords

Groundnut, Irrigation, Seed yield, Smallholder farmers

Maize Production in Southern Africa Semi-arid Areas under Climate Scenarios

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Introduction

As maize forms the staple diet across SADC region, it is important to be able to plan for the impact of future changes in climate on maize production. Increased occurrences and severity of drought was projected for countries of Southern Africa (SADC) under climate change scenarios. AgMIP uses a robust modelling framework to understand the impact of climate on main staple crops, such as maize. This study compared simulated maize yields (Zea mays L.) with the historical (1980-2010) climate and future mid-century (2040-2070) climate yields using APSIM in four selected semi-arid areas in different countries of Southern Africa (Beletse et al., 2015).

Materials and Methods

Tools and protocols developed for climate-crop modelling by the AgMIP group (Rosenzweig, et al., 2013) were adopted to address improved projections of climate impacts on smallholder maize production with and without adaptation strategies. Projected climate data for 30 years in the mid-century period (2040-2070) were obtained from five GCMs. The projected maize yields were generated using APSIM model (McCown et al., 1995).

Results and Discussion

Countries in SADC Sites No. of Farmers Performance Historic (t ha-1) Mean Future Scenarios (t ha-1) with Adaptation R2 RMSE CCSM GFDL HADG MICR MPI Mean South Africa 3 2254 0.53 624 1.44 1.63 1.54 1.75 1.63 1.35 1.58 Botswana 1 30 0.59 355 0.49 0.75 0.74 0.80 0.92 0.35 0.71 Namibia 6 467 0.46 639 0.27 0.39 0.42 0.49 0.52 0.62 0.49 Lesotho 2 30 0.65 548 0.66 1.04 0.84 0.70 0.69 0.80 0.81 Summary results of yield simulations for historical and future scenarios with adaptation Countries in SADC Countries in SADC Sites No. of Farmers Performance Historic (t ha-1) Mean Future Scenarios (t ha-1) with Adaptation R2 RMSE CCSM GFDL HADG MICR MPI Mean South Africa 3 2254 0.51 536 2.31 2.31 2.31 2.31 2.31 2.31 2.31 Botswana 1 30 0.65 483 1.6 1.6 1.6 1.6 1.6 1.6 1.6 Namibia 6 467 0.47 351 2.31 2.31 2.31 2.31 2.31 2.31 2.31 Lesotho 2 30 0.42 401 1.6 1.6 1.6 1.6 1.6 1.6 1.6 Reasonable values were obtained for model performance, when only district yields were used for testing, in spite of climate-related year-to-year variations being present. Projected future climate change gave variability in yields that appears to make maize production risky without adaptations. Therefore, agronomic management interventions should be used as adaptations to projected climate change. From the economic analysis, it was shown that rural livelihoods could improve with adaptation interventions from a range of diversified potential management practices in response to climate change.

Conclusions

The current maize production systems in SADC was found to be sensitive to climate variability and change. A negative impact is predicted for future maize production in the semi-arid of SADC region under future climate scenarios as projected from five Global Climate Models.

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Keywords

SADC, Semi-arid, Maize,APSIM, Climate Change, Adaptation Strategy

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