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Abstracts Oral

EFFECT OF TEMPERATURE STRESSED Amaranthus cruentus L. RESIDUES AND EXTRACTS ON PEPPER GERMINATION AND SEEDLING GROWTH

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Introduction

Climate change is a big concern for the agricultural sector. The protection of food security has become vital due to the ever increasing human population. Allelopathic plants can disrupt the germination and growth of agricultural crops, therefore leading to a lower yield in production. The aim of this trial was to examine the effect of different temperatures on the allelopathic properties of A. cruentus on pepper germination and growth.

Materials and Methods

A. cruentus plants were exposed to temperature stress to determine if there will be an effect on the allelopathic compounds produced and how this could impact other vegetables when used in rotation systems. Plants were stressed at 40/33 °C, 28/21 °C and 14/7 °C, 12 hours daylight. The allelopathic potential of plant residues and extracts from stressed plants were evaluated. Dried leaves were finely ground and extracted with dichloromethane (DCM) and a methanol water mixture (7:3). A double layered agar (5 % w/v) technique was used to evaluate the effect of the dried plant residues (1 and 5 mg ml-1) and the extracts (0.5 and 2 mg ml-1) on the germination and growth of pepper seeds. The extracts were dissolved in the respective solvents (1 ml) and transferred to filter paper which was dried then placed between agar layers in six-well plastic dishes. Filter paper with only the solvents was used as controls. Five seeds were placed on the top surface of the agar. A completely randomised bock design was used with three replicates. After three days the lengths of the radicle and hypocotyl, as well as germination percentage were determined. All results were compared to the controls and subjected to statistical analysis.

Results and Discussion

Seed germination was most markedly inhibited by residues of heat treated plants on peppers by 78% at the highest concentration. Organ length was inhibited by 76% and 91% for the hypocotyl and radicle respectively when exposed to leaf litter. Polar extracts showed germination was inhibited by 91% and organ growth was also impacted negatively.

Conclusions

Residues of all three temperature stresses caused a significant reduction in organ elongation with the greatest effect being found at 5 mg ml-1. The organ length of pepper seeds were most severally affected of all the vegetables exposed in both the residue and extract trials. Pepper seeds should never be grown in soil that was exposed to amaranth and should not be used when intercropping.

References

Keywords

Temperature stress, Residues, Extracts. Pepper seeds

Evaluation of mesotrione as a pre-emergence herbicide to control volunteer potatoes

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Introduction

Approximately 25% of the number of tubers required to establish a land of potatoes remain behind on the land after mechanical harvesting is complete. These are the source of the volunteer plants that emerge as weeds in the following crop. Not only do they compete with the crop for resources, so reducing the expected yield, they also serve as a source of pests and diseases for nearby potato planting. Control of these plants is both difficult and costly. The aim of this experiment was to determine if pre-emergence applications of mesotrione would be effective in controlling volunteer potato plants.

Materials and Methods

A glasshouse trial (28/18°C day/night) was conducted using 37 x 37 x 27.5 cm poyethylene pots filled with a sandy soil (11% Cl). Four potato cultivars (Mondial, Sifra, Lanorma and Innovator) and five application rates of mesotrione (0, 50.4, 76.8, 100.8 and 124.8 g ha-1) were used. The trial was laid out in a randomised complete block experimental design with four replications. Herbicide was applied using a laboratory sprayer calibrated to deliver 200 L ha-1 seven days after four potato tubers were planted in each pot. Products were all leached into the soil using 10 mm water following application. Pots were monitored daily and watered as needed. Harvesting took place 65 DAP and stem numbers, plant height, and tuber number, as well as plant and tuber mass determined. Data were converted to a percentage of the control treatment in order to negate inherent cultivar differences prior to statistical analysis.

Results and Discussion

Cultivars reacted differently to this herbicide regarding the formation of tubers, while aerial plant mass was affected by the cultivar and herbicide application rate. Innovator was less sensitive to the herbicide regarding the production of top growth, and all cultivars showed significant reductions in tuber numbers and masses when mesotrione was applied. Removal of inherent cultivar growth differences by analysing data as a percentage of the control treatments showed that all rates of the herbicide were effective in reducing tuber production. However, Innovator plants proved more resilient to applications of this herbicide, while Lanorma was the most sensitive. Similar results regarding the efficacy of mesotrione to control potato plants of Pentland Dell have been obtained in the United States.

Conclusions

All rates of mesotrione provided good control of tuber formation, but only inhibited plant growth of potato plants. Differences in cultivar sensitivity were apparent.

References

Keywords

Application rate, cultivars, plant mass, tubers, tuber mass

NUTRITIONAL EVALUATION OF HYDROPONICALLY GROWN TOMATO CULTIVARS UNDER DIFFERENT PRODUCTION SYSTEMS

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Introduction

The choice of cultivar is critical in different production systems in order to maximize yield, profitability and produce quality. The objective of the study was to evaluate the nutritional quality of tomato cultivars grown under a shadenet structure *versus* a non-temperature controlled tunnel.

Materials and Methods

Seventeen indeterminate tomato cultivars were hydroponically grown in a non-temperature controlled tunnel (NTC) and a 40% black & white shadenet structure. The standard open bag hydroponic system was used in this study with sawdust as a growing medium. The harvested ripe tomato fruit were thereafter analyzed for their nutritional value, including lycopene and β-carotene concentration.

Results and Discussion

Nine of the cultivars grown hydroponically under a shadenet structure had a significantly higher lycopene concentration compared with the respective lycopene concentration when grown in NTC. On the other hand, eight cultivars had a significantly higher lycopene concentration when cultivated in NTC compared with cultivation under the shadenet structure. The difference in lycopene concentration in some cultivars grown under the different production systems was up to 65 %. Similarly, in terms of β-carotene content, cultivating three of the cultivars in NTC significantly increased their β-carotene by 27% to 68% compared with cultivation under the shadenet structure. Significant differences in total phenolic and flavonoid concentration as well as antioxidant activity between the different cultivars in the two production systems were also observed.

Conclusions

Our findings indicate that cultivar performance can be influenced by the production systems or conditions employed. It becomes important that prior cultivar evaluation be carried out for any specific production system in order to select the most suitable cultivar for maximizing production yield and quality.

References

Keywords

antioxidant, beta-carotene, flavonoid, lycopene, phenolic, shadenet, tunnel production

BROADENING THE FOOD BASE: NUTRITIONAL EVALUATION OF SWEET PEPPER LEAVES FOR FOOD AND NUTRITIONAL SECURITY

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Introduction

Sweet pepper plants are often pruned during production in order to optimize the use of space and sunlight, enhance air ventilation and circulation, enhance fruit production, improve growth and limit disease incidence, amongst other reasons. The pruned side-shoots comprise of leaves which are consumed as vegetables in some South African rural communities. As part of the effort in promoting the consumption of these leaves as vegetables for broadening the food base, the nutritional value of different cultivars of sweet pepper leaves were evaluated.

Materials and Methods

The study was conducted in a temperature control plastic tunnel (TC) at the Agricultural Research Council-Vegetable and Ornamental Plants (ARC-VOP), Roodeplaat. The TC was equipped with a pad and fan cooling system. Eleven sweet pepper cultivars (Clair, Double-up, King Arthur, Maranello, Marletta, Nemalite, Rhemus, Selene, Star6657, Tamarin and Telmo) were laid-out in a randomized complete block design with three replicates. The vitamin C, beta-carotene, total phenolic and flavonoid content as well as antioxidant activity of the pruned leaves obtained from these hydroponically grown sweet pepper cultivars were evaluated using HPLC and colorimetric techniques.

Results and Discussion

Varied but non-significant high vitamin C and beta-carotene contents were recorded in all the eleven cultivars. Their beta–carotene content was so high that the consumption of approximately 4 grams leaf dry weight can provide 100% of the vitamin A recommended dietary allowance for adults. There were variations in total phenolic and flavonoid contents as well as antioxidant activity between the different cultivars.

Conclusions

The consumption of sweet pepper leaves is thus recommended as a component of diversified healthy diet and can be included in the food fortification programme. The promotion of this inexpensive food can be an effective measure to counteract malnutrition and vitamin A deficiency, and thus reduce disease burden and mortality rate especially among the susceptible South African population.

References

Keywords

antioxidant, beta-carotene, cultivars, flavonoid, phenolic

Effects of Litsea glutinosa plant bio-waste enrichment media on plant growth of Thyme and Rocket

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Introduction

Enhancing and sustaining agricultural productivity is increasingly challenging, particularly as soil quality in many parts of the world is either already, or rapidly becoming, unsuitable for agriculture. The biomes in KwaZulu-Natal, South Africa, are particularly diverse, but threatened by a number of alien invasive plants (Castro-Diez *et al*., 2011). In order to achieve environmental stability it is imperative to create measures to re-use plant material, arising from removal of these plants, that would commonly be discarded . Such alien plant bio-waste could be turned into soil amendments that may improve soil fertility. These alien species have dramatic impacts on the natural environment and carry implications for human welfare and quality of life. Biological invasion is a natural process, however human intervention has accelerated the rate of spread and naturalization of many species across a multitude of foreign landscapes (Ewel *et al*., 1999). Composted alien invasive bio-waste has been found to be a viable source of nutrients, usable as livestock-feed and to fertilize crops (Honeyman and Kent, 2001).

Materials and Methods

Composting of *Litsea glutinosa* (Indian Laurel) was conducted at a vacant site in Lotusville, Verulam, SA. Once composted, the material was moved to the experimental site at the Durban University of Technology, Horticultural Practical Centre. Three media (Gromor potting soil (Co= control), enriched composted *Litsea glutinosa* (LG), and compost at a 1:1 ratio (Co-LG) were used. Five replicates of rocket and thyme were planted per treatment medium. Leaf diameter and plant height were measured weekly. Total plant fresh and dry mass were recorded on termination of the experiment after two months. Simultaneously, leaf chlorophyll and carotenoid concentrations were determined.

Results and Discussion

Fresh and dry mass of thyme plants grown in the three media was similar, while rocket plants responded differently to the three treatments. Leaf diameter differed significantly between control rocket plants (4.92 cm) and rocket grown in the LG medium (3.10 cm leaf diameter). Thyme plants, however, responded differently, with those grown in LG averaging 15.60 cm leaf diameter, compared with less vigorous growth in Co (10.20 cm). The height of control rocket plants averaged 17.00 cm, compared with 13.20 cm height in the LG treatment. Thyme plants, however, had a similar height in the Co and the LG treatment. Leaf chlorophyll and carotenoid concentrations were very variable, with no significant differences determined between treatments.

Conclusions

Rocket and thyme plants responded differently to the media used. A percentage of composted *Litsea glutinosa* higher than 50 could be used to grow thyme plants, while Gromor potting soil is a better medium for producing rocket plants. While only growth was considered in this study and the best LG:Co ratio needs further investigation, other quality parameters also need to be evaluated to determine possible differences in volatiles and, therefore, taste of herbs from the different treatments.

References

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Keywords

invasive alien plants, compost, nutrient recycling, soil amendment

VEGETABLE SOYBEAN CULTIVAR RESPONSE TO SEEDING RATE AND SEASON

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Introduction

Vegetable soybean (*Glycine max* (L.) Merrill), also known as edamame, is poorly known in South Africa, but this high-protein crop could be suitable for both small-scale and commercial production. The seeds are larger, milder-tasting and more tender than grain soybeans. The pods are picked green when the beans have filled 80 to 90% of the pod. The beans are usually eaten like green peas.

Materials and Methods

Four vegetable soybean cultivars, AGS 292 (109 days after planting to harvest maturity (DAP)), AGS 353 and AGS 354 (135 DAP), and Lightning (148 DAP), were grown at six seeding rates from 50 000 to 250 000 seeds ha^{-1} on a Hutton soil at the Cedara Research Station, KwaZulu-Natal, South Africa in the 2013/14 and 2015/16 seasons. The trials were planted on 12 November 2013 and 18 November 2015. Each plot consisted of four rows of 5 m length and spaced 0.75 m apart.

Results and Discussion

The higher rainfall received during the 2013/14 growing-season compared to the 2015/16 growing-season resulted in significantly taller plants, higher bottom pod heights, more branches and pods $plant^{-1}$, a higher percentage of marketable pods (≥ 2 beans pod^{-1}), a higher 100-seed mass and a larger seed yield (3.09 t ha^{-1} versus 2.35 t ha^{-1}). As cultivar growing-season length increased, plant height, bottom pod height, number of branches $plant^{-1}$ and number of pods $plant^{-1}$ increased significantly, whilst 100-seed mass decreased significantly. AGS 353 (3.32 t ha^{-1}) and AGS 354 (3.21 t ha^{-1}) produced significantly higher mean grain yields than Lightning (2.76 t ha^{-1}) and AGS 292 (1.58 t ha^{-1}). Plant height and bottom pod height increased significantly from 50 000 seeds ha^{-1} to 150 000 and 250 000 seeds ha^{-1}, respectively, whilst the number of branches $plant^{-1}$ and pods $plant^{-1}$ decreased significantly with increasing seeding rate. 100-seed mass decreased significantly from 50 000 seeds ha^{-1} to 200 000 seeds ha^{-1}. In the 2013/14 season no significant differences in yield were measured between the seeding rates. However, in the 2015/16 season and overall, seed yield increased significantly from 50 000 seeds ha^{-1} to 150 000 seeds ha^{-1}. When comparing both seasons, a significant interaction was measured for yield between the cultivars and seeding rates. The yields produced by AGS 292 increased significantly from 50 000 to 150 000 seeds ha^{-1}. The yield of AGS 292 at 250 000 seeds ha^{-1} was not significantly different to the yields of Lightning at 50 000 and 75 000 seeds ha^{-1}. The yields of AGS 354 and Lightning at 150 000 seeds ha^{-1} were significantly higher than the yields at 50 000 and 75 000 seeds ha^{-1}. Seeding rate had no significant effect on the yields of AGS 353.

Conclusions

Vegetable soybean compensates for low populations by producing more pods $plant^{-1}$. In seasons when sufficient rainfall occurs from flowering to maturity, a seeding rate of 50 000 seeds ha^{-1} can be used for AGS 353, AGS 354 and Lightning, and 150 000 seeds ha^{-1} for AGS 292. When drier conditions occur, a seeding rate of 150 000 seeds ha^{-1} is suggested for all the cultivars except AGS 292, which should be planted at 200 000 seeds ha^{-1}.

References

Keywords

Edamame, season, seeding rate, cultivars

Evaluating the effects of DEM resolution and generalisation approaches on the extraction of terrain indices in KZN

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Introduction

Digital Elevation Models provide a convenient and representative interpretation of the Earth's surface and generally considered to be the de-facto dataset(s) for a variety of terrain and spatial analyses. Using scale-specific DEMs to derive key topographic indices specifically related to soil formation is therefore essential for spatially representing the statistical associations with soil properties across varying topographic phenomena. DSM therefore requires a solid understanding of the correct application of spatial scale and grid resolution for feature selection and information generalization. The ability of sensors such as LiDAR to readily provide very high resolution bare surface models has allowed researchers to investigate whether terrain attributes derived at finer resolutions are more correlated to pedo-geomorphic properties. This regional study therefore builds on the scientific incentive to further assess the utility of applying DEMs from varying sources, at different spatial resolutions and using various generalisation and neighbourhood algorithms for DSM. The aim would be to highlight the operational pitfalls of selecting DEMs not "fit-for-purpose" for DSM and offer a simple yet effective solution to pre-treating elevation data prior to terrain analyses and topographic feature characterization.

Materials and Methods

The 5200 ha study site was situated south of the town of Durban in the Kwazulu- Natal Province of South Africa. The utility of Airborne-based Lidar in extracting certain topographic matrices for describing soil-landscape relationships were compared to other freely available broader-scale satellite platforms, namely: global 30m SRTM, 90m SRTM DEM, 5m SUDEM and the EarthEnv 90m. A combination of descriptive and inferential statistical approaches as well as visual outputs were used to evaluate the performance between the various scale-dependent DEM generalization and terrain extraction outputs.

Results and Discussion

The results of the study show that there is a clear relationship and dependency between DEM platform selection and terrain variable extraction. Most notably is that certain sensor platforms are better suited than others for predicting selected soil-terrain parameters, particularly at a landscape and regional level. The extent-neighborhood DEM combination products from this study have provided further insight into grid resolution effects using conventional interpolation approaches where both the grid resolution and neighbourhood extent influence terrain data extraction.

Conclusions

The application of DSM to a variety of agricultural and environmental related disciplines relies on the accurate modelling of terrain parameters within the soil-landscape continuum. The findings from this study have shown that consideration needs to be given to sensor selection, spatial resolution and generalization approaches in deriving various geomorphic parameters within the landscape.

References

Keywords

DEM, LiDAR, DSM, SRTM

SENSITIVITY OF APPLE FRUIT PEEL PHOTOSYSTEMS TO HIGH LIGHT AND TEMPERATURE AS INFLUENCED BY A RANGE OF DWARFING AND SEMI-VIGOROUS ROOTSTOCKS

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Introduction

A low Class 1 packout caused by sunburn remains one of the biggest reasons for lowered profitability of South African apple orchards. Producers are keen to adopt the new generation of dwarfing rootstocks suitable for more intensive orchard systems, compared to the industry standards such as M793. It is not yet clear how they will perform locally in poor shallow soils and in hot summers with high incident solar irradiation (Costa, 2011). The aim of this study was to determine the effect of different rootstocks on the innate peel sensitivity to photothermal stress and visible peel damage (sunburn symptoms).

Materials and Methods

‘Rosy Glow’ apples were collected from nine dwarfing and semi-vigorous rootstocks (Cepiland, MM109/M9, G3007, RN29, G222, M793, MM109, G778, and ‘Rosy Glow’ on own roots) at a rootstock trial site at Paardekloof, Witzenberg, during 2014-2015 and 2015-2016. ‘Golden Delicious’ apples were collected from seven rootstocks (Cepiland, G007, G222, M7, M793, G228 and G778) at a trial site at Bo-Radyn, Villiersdorp, during 2015-2016. In 2015-2016 fruit were picked separately from shaded and exposed canopy positions. Apples were subjected to five durations (1-5 hours) of exposure to ambient high irradiance and high temperature. Damage to peel photosystems and recovery over four days was assessed by measuring the maximum light use efficiency of photosystem II (Fv/Fm). Visible peel damage development was assessed on a second set of apples exposed to the same conditions. Data was analysed using repeated measures ANOVA.

Results and Discussion

In 2014-2015, no significant rootstock effects were found, with only isolated effects in 2015-2016. Duration of stress exposure, the recovery period, and canopy position were the dominant influences on photostress and visible peel damage in both cultivars. Apples exposed to one hour of strong light and high temperature showed a higher photosystem recovery and less visible peel damage at the end of day five than those exposed for longer periods. We identified a slightly lower sensitivity in CG3007 and a higher sensitivity in M793. CG228 also showed sensitivity to visible peel damage, more so in fruit from shaded canopy positions.

Conclusions

There was little indication that rootstocks influence the innate susceptibility of the peel to photostress and visible peel damage in the apple cultivars used in this trial. Results will be further interpreted against whole-tree growth and production data.

References

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Keywords

Apple, climate stress, photostress, rootstock, sunburn ACKNOWLEDGEMENTS We thank HORTGRO Science and the South African Apple and Pear Producers’ Association for funding this study.

Verifying Land Assessment Techniques Using High Resolution Yield Data

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Introduction

One of the biggest threats facing food security in South Africa is the loss of agricultural land to non-productive land uses. To combat this threat National Government have drafted the new Preservation and Development of Agricultural Land Bill (PDALB) to replace the Subdivision of Agricultural Land Act (Act 70 of 1970). As with its predecessor, the new PDALB will still rely on an agro-ecosystems report to substantiate the release or subdivision of agricultural land. The objective of this research is to determine if the land assessment techniques currently being practised in industry adequately reflect the land use potential and production levels.

Materials and Methods

The study area is adjacent to Woodstock Dam in North Western KwaZulu-Natal and covers approximately 2 000 ha of commercial farm land. A total of 153 representative soil observation pits were dug to a depth of between 1.5 and 2 m. The soils were classified to form and family level, mapped and converted into various land assessment classes based on Land Capability, Land Potential and Ecotope criteria. High resolution (2.5 m x 6 m) yield data was and extracted using the Apex software suite. Finally, spatial relationships and trends between yield and the three land assessment techniques were completed within a GIS interface.

Results and Discussion

The results from the spatial analyses indicate that the Ecotope derived polygons had the highest correlation to dryland maize and soybean yield at a farm and landscape level, compared to that of Land Capability and Potential methods. This is attributed to the Ecotopes classification method, which is more reliant on actual soil classification information and which places more emphasis on soil groups to delineate homogenous areas. The preliminary results also show a positive relationship between soils that exhibit signs of wetness in the mid to lower profile and dryland production. While the three selected techniques adequately determined broad land use suitability none could account for inter-field yield variability where fertility management, soil water relations and micro-relief play a significant role in overall production.

Conclusions

The correlation between land assessment classification and actual production is poorly understood and often results in a lower rating than what the land can, and is, actually producing. This undervaluation could lead to valuable agricultural land being released to non-agricultural developments. The preliminary results have shown that a more integrated approach to land assessment should be investigated further and incorporated into the PDALB and subsequent Act.

References

N/A

Keywords

Land assessment, soil mapping, ecotope, capability, precision yield

THE POTENTIAL RELATIONSHIP BETWEEN PREHARVEST SPROUTING TOLERANCE AND ALUMINIUM SENSITIVITY IN WHEAT

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Introduction

Acid soils are widespread in the major wheat producing regions of South Africa and the major limiting factor to crop productivity in these soils is aluminium (Al) toxicity. It has been reported in various publications that lines or cultivars with good resistance to preharvest sprouting (PHS), more often than not, have poor tolerance to aluminium in the soil and vice versa (Tolmay et al., 2006), while lines or cultivars with moderate aluminium tolerance, usually have moderate resistance/susceptibility to preharvest sprouting (Riede et al., 2015). This study was undertaken to investigate the possible association between the PHS susceptibility of wheat cultivars and their tolerance or resistance to aluminium toxicity.

Materials and Methods

A total of 57 wheat cultivars were evaluated for their PHS resistance over a period of at least 10 years and scored on a scale from 1 to 8 (Barnard et al., 1997). These cultivars were also screened in the laboratory for aluminium tolerance using the hematoxylin staining method of Polle et al., 1978. In addition, ALMT1 type markers were used to determine the presence of different forms of the ALMT1 gene, which confer varying levels of aluminium tolerance, in each cultivar. Data were analysed using the statistical program GenStat®.

Results and Discussion

The PHS resistance of the cultivars in the study varied from excellent (35% of the cultivars) to susceptible (21% of the cultivars), while the laboratory screening of aluminium tolerance indicated that 31% of the cultivars were tolerant and 56% of the cultivars were susceptible. The ALMT1 marker data showed a good correlation between the laboratory screening of aluminium and the marker validation ($r2 = 0.81$). The results further indicated that there is a significant negative correlation ($r2 = 0.68$) between the PHS of the cultivars and their aluminium tolerance or susceptibility. In 85% of the time cultivars with ‘n good PHS tolerance (<2.9), will have poor aluminium tolerance and in 75% of cultivars tested, those cultivars with poor PHS tolerance (>5.4), will have a good aluminium tolerance.

Conclusions

There is a significant negative correlation between PHS and aluminium sensitivity in South African wheat cultivars. The ALMT1 data marker appears more sensitive than the laboratory aluminium testing, as a clearer distinction between moderate tolerance genotypes could be made. The data from this study can be used in future to specifically target and select for germplasm that contain both good PHS and aluminium tolerance.

References

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Keywords

aluminium, ALMT1, preharvest sprouting, wheat

A FINANCIAL ANALYSIS OF CROP-LIVESTOCK INTEGRATION IN CONSERVATION AGRICULTURE

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Introduction

The Swartland has a typical Mediterranean climate with hot, dry summers and cold, wet winters. Grain production is predominantly based on dry-land production systems, while wheat has traditionally been produced in monoculture systems. As a result of various driving forces, the attractiveness of crop rotation as a part of a holistic Conservation Agriculture (CA) approach as an alternative to monoculture, has increased significantly since the late 1990's. The addition of annual legume pastures into crop rotation systems with wheat has provided Swartland farmers the opportunity to diversify in terms of farming enterprise with benefits such as increased financial and income stability and increased profits. However, despite the fact that livestock fit perfectly in crop rotation systems, there is concern about the impacts of livestock on soil compaction and cover, posing various threats to the successful implementation of CA. To achieve successful integration of a livestock component into a mixed farming system without mitigating CA outcomes, therefore, requires livestock approaches based on lower stocking rates or alternative feeding systems. This study aims to assess the financial implications of different approaches that could be followed to achieve successful crop-livestock integration.

Materials and Methods

Technical data from the Langgewens experimental farm served as basis for developing livestock approaches and strategies. To capture the interrelatedness of variables and complexity of the farming system, this study is based on a systems approach. To assess the financial performance of the different livestock management approaches on whole-farm level, a typical farm model was developed. A multi-disciplinary expert group discussion was used to obtain valuable information necessary for developing the typical farm model. The financial performance of the different strategies on whole-farm level was measured in terms of the Internal Rate of Return on Capital (IRR) and the Net Present Value (NPV).

Results and Discussion

Wheat-medic rotation systems with additional saltbush pastures proved to be the most profitable. Of the three livestock management approaches modelled, a grazing approach is least profitable. While an intensive speculation approach is the most profitable for integrating livestock on a particular farm, treating medics as a cash crop by selling medic hay to neighbouring farmers is a valuable alternative.

Conclusions

The financial gains of CA may only be realised in the medium to long run, while the addition of livestock to CA farming systems provides the opportunity to gain financial returns in the short to medium term. Livestock may contribute positively to the financial sustainability of farms in the Swartland.

References

Keywords

conservation agriculture, crop-livestock integration, sustainability

Seed quality of Chicorium intybus differing in seed colour

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Introduction

Chicory (*Cichorium intybus* L. var. sativum) is a perennial, tap-rooted herb cultivated in South Africa for the production of a caffeine-free coffee substitute. The chicory seed available in South Africa is imported from Europe and has been reported by SA growers to be of low quality. As chicory seed differs in colour and differences in seed colour have been associated with seed performance in other crops (Odindo, 2008), typical seed quality parameters of different seed colour groups were investigated.

Materials and Methods

Chicory seeds (cv. 'Orchies') were visually separated into eight seed colour categories and could further be assigned to two colour categories, a light- and a dark-coloured seed. Seed quality of these two main categories was determined using standard germination (SG), accelerated aging (AA), imbibition and electrolyte leakage (EC) tests.

Results and Discussion

There was a significant interaction between seed colour and seed germination percentage and mean germination time. Seed colour and seed quality (germination velocity and imbibition time) were also related. Electrolyte leakage from the seeds was not significantly different between seeds of the different colour groups.

Conclusions

As there seems to be an association between chicory seed colour and seed performance, the nature of the different seed colour as well as means to enhance the accumulation of the substances associated with the darker seed coat should be investigated.

References

Odindo, OA, Cowpea Seed Quality in Response to Production Site and Water Stress, PhD thesis UKZN, 2008

Keywords

root chicory seed performance, imbibition

Honeybush Breeding: Important role of complimentary research

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Introduction

Honeybush (Cyclopia spp.) is a traditional South African herbal tea and unique to the Western and Eastern Cape regions. Its popularity world-wide is due to its caffeine-free and low tannin status, combined with health-promoting properties. However, the demand for this herbal tea puts pressure on wild populations as a source of fresh biomass and seeds. More than 70% of the tea is still harvested from the wild, with only ±150 hectares under commercial production. The growing market requires a stable and sustainable supply, and it is therefore essential to have a dependable and viable source of plant material. A plant improvement programme was initiated for honeybush in 1999 by the ARC.

Materials and Methods

The aim of the breeding programme is to improve the commercial traits (growth, yield and chemical properties) of the different species through intra-species crosses, selecting promising individuals from the crosses and evaluating the selections in different climatic regions for adaptability. Continuous improvement of the different species will ensure that new and improved material becomes available on a regular basis for commercial purposes. Promising individual plants in commercial plantations of C. genistoides and C. subternata were selected at different farms. However, with very little basic genetic information (chromosome number, ploidy level) as well as without any fecundity data, breeding soon became a challenge. Propagation was another difficulty to overcome, but several complementary research projects helped to solve some of the mysteries.

Results and Discussion

Chromosome numbers and ploidy level of six important commercial species have been confirmed with cytogenetic studies and three with flow cytometry analysis as well. Flow cytometry can now be used for quick determination of ploidy levels of new selections. The use of SSR markers proved valuable for fingerprinting of selections and population studies. Progeny trial results indicate that breeding and selection can increase the yield significantly. Early indications of broad sense heritability are about 0.4 for yield and, simply through better selection and using an open pollinated polycross strategy, yield was increased by at least 3 tonnes (35%) per hectare. Propagation protocols, for seeds and cuttings, have been developed and are used for commercial deployment of honeybush.

Conclusions

The breeding programme is still in its initial phase, but in recent years valuable information and results have been obtained for this formerly unknown agricultural crop. This information will form the basis for the breeders to continue the improvement of this new crop and to ensure that the emerging industry becomes sustainable.

References

Keywords

Cyclopia, plant breeding, chromosomes, ploidy level

Acknowledgements

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THE ABILITY OF CITRUS ROOTSTOCKS TO IMPART GOOD QUALITY AND PRODUCTION TO CITRUS SCIONS

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Introduction

The ability of a citrus tree to adapt to the impact of various biotic and abiotic stresses is dependent on the genetic composition of the scion and its rootstock. To be useful, a rootstock must meet certain criteria such as compatibility with a chosen scion and adaptability to soil and climatic environments, but most importantly the rootstock must be able to impart productivity and quality to the scion. It has been proven that the influence of citrus rootstocks on tree vigour, flower initiation, fruit set and internal fruit quality are pronounced. The objective of this study was to investigate the genetic variability in and amongst families used for rootstock development as well as the influence that the male parent in these cross combinations has to impart good quality and production to a scion.

Materials and Methods

Fourteen cross combinations were made using male parents: Australian trifoliate, Flying Dragon, Troyer Citrange, Swingle Citrumelo with five different female parents. Ten individuals per cross combination (two trees per individual) were investigated and ten fruit were measured on each tree. Measurements taken were: yield, fruit mass, fruit width, fruit length 1 (shoulder to shoulder) and fruit length 2 (tip to tip), brix and juice percentage. Variance components with the source of variance being between families, within families and within trees as well as intra-class correlation coefficients were determined for the quality measurements. Statistical analyses were done using SAS/STAT and XLSTAT.

Results and Discussion

The ANOVA over the males showed significant variations among the three males used, for only three of the traits investigated, namely yield, fruit length 1 and fruit length 2. The ANOVA over the females showed significant variations among the five females used, for only two of the traits investigated namely yield and brix. Variance components and intra-class correlation coefficients determined for the quality measurements showed less variance between families than within the families and within the trees.

Conclusions

Although Australian trifoliate was able to induce elongated fruit in its progeny it also gave larger tips which is negative. Swingle Citrumelo (717) as male parent was able to impart the reduction of tip length. Broad sense heritability was variable among traits and families. High heritability was found for brix and yield.

References

Keywords

Rootstock, breeding, Citrus, cultivar, lemon, internal quality, yield, heritability

IS CITRUS PEEL THICKNESS AN EFFECT OF THE ROOTSTOCK, SCION OR ENVIRONMENT?

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Introduction

Development of cultivars with high and stable genetic potential for quality is one of the main goals of a fruit-breeding programme. However, the genotype's phenotypic expression of a trait in a specific environment consists of genotypic main effects (G), environment effects (E) and the interaction of the two factors. Furthermore, the effects on yield and quality are influenced by complex interrelationships between the roots and canopy of the plant. The objective of this study was to determine whether it is possible to systematically partition the reaction of the scion-rootstock combination (stion) into scion and rootstock reactions with regard to quality aspects, and more specifically with regard to peel thickness.

Materials and Methods

Data of superior locally bred and imported genotypes within the mandarin, grapefruit, mid-season oranges and Valencia groups, grafted onto four different rootstocks and evaluated over five seasons, were included in an additive main effects and multiplicative interaction (AMMI) statistical model (Gauch, 1992) with two multiplicative terms.

Results and Discussion

The results indicated that scions played the major role within mandarins and were highly susceptible to the environment, while rootstocks had little influence. Rootstocks were the main contributor to the variance with regard to peel thickness in grapefruit and Valencia, but scions were the most susceptible to genotype by environment interaction.

Conclusions

It is possible to systematically partition the reaction of the stion into scion and rootstock reactions with regard to quality aspects, and more specifically with regard to peel thickness. It was found that Genotype-by-Environment-Interaction (GEI) was significant with regard to rootstock grafted to very different scion groups, and that rootstock evaluation should be specific to each mega-environment (scion group). Further partitioning of the phenotype into a scion G, E and GEI as well as a rootstock G, E and GEI for the same phenotype as that of the stion is possible.

References

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Keywords

Citrus, Genotype-by-Environment-Interaction (GEI), peel, internal quality

The effect of composted biochar on compost properties and mineralisation

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Introduction

Pyrolized carbon (biochar) is a widely used soil conditioner and a well-known sorbent (Lehmann and Joseph 2015). The investigation into the possible use of biochar by farmers as a filter for agri-processing waste waters posed a problem of spent filter disposal. We suggest that spent biochar may be incorporated into composts and subsequently used as a compost with greater soil C sequestration potential. However, research is required to assess the effect that biochar could have on the composting process and final product properties. The aim of this study was to investigate the feasibility of composting fresh organic residues together with biochar, specifically focusing on the effect of type and amount of biochar on the composting process and mineralisation of the composts..

Materials and Methods

Two contrasting biochars produced from different feedstocks (pine and eucalypt wood) and pyrolysis temperatures were applied at two application rates (10% and 20% DW) to green and animal waste mixtures. The effect of the biochars on the composting process was determined by monitoring temperature, C/N ratio, pH, EC, and microbial activity. The mineralisation of C, N and P was evaluated in a two-month incubation study.

Results and Discussion

The lower production temperature, pine biochar, applied at 10% (d/w) was found to be more suitable for the composting process due to higher composting temperatures, lower C/N ratios and increased microbial activity. In terms of mineralisation, it was found that eucalypt char inhibited respiration when applied to soils, and that both types of biochar, regardless of quantity or composting, increased N immobilization. Composting did however improve P mineralisation in both biochars, especially composted eucalypt char which showed greater improvement (14.6% and 24.83% more) relative to composted pine char.

Conclusions

Both biochars showed the ability to be successfully composted and used as soil amendment with good C sequestration capabilities. However, pine biochar is better in terms of enhancing the composting process as it results in higher temperatures and increased microbial activity. Eucalypt however, would be the best option for phosphorus mineralisation and building soil C stocks.

References

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Keywords

Biochar, compost, mineralisation, sustainable agriculture.

WATER USE OF CROPS AND NUTRITIONAL WATER PRODUCTIVITY OF SELECTED GRAIN LEGUMES FOR FOOD PRODUCTION, NUTRITION AND HEALTH IN POOR RURAL COMMUNITIES

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Introduction

Legumes are rich sources of proteins and contain appreciable amounts of micro-nutrients, making them ideal for increasing dietary quality in rural areas. Water is the major challenge in rainfed agriculture hence efforts have been directed to increase water productivity. There is a need to incorporate nutrition aspects into studies of crop and water productivity to tackle the challenge of malnutrition. The aim of the study was to determine water use and nutritional water productivity (NWP) of selected legume crops for improved production, nutrition and health.

Materials and Methods

Field trials were conducted during the 2015/16 season at FHE using four legumes (dry beans, groundnuts, bambara groundnut and cowpea). The experimental design was a randomised complete block design, with three replications. Data collected fortnightly included plant growth, physiological and soil water content. At harvest, data collected included yield and yield components. Water use (ET) was calculated as a residual of the soil water balance. Water productivity (WP) was then obtained as the quotient of economic yield by water use. Thereafter, samples were analysed for nutrient (energy, protein and fat) and micro-nutrient (calcium, zinc and iron) content. Results of nutrient content (NC) and WP were then used to compute NWP.

Results and Discussion

Economic yield was highest and lowest for bambara groundnut (1.97 t ha-1) and cowpea (1.24 t ha-1), respectively. Measured water use (ET) values were 644 mm (bambara groundnut), 552 mm (groundnut), 520 mm (cowpea) and 479 mm (dry beans). Results of water productivity (WP) showed that bambara groundnuts and dry beans were the most productive (0.30 kg m-3) while groundnuts and cowpea were the least productive (0.28 and 0.23 kg m-3, respectively). Results of NWP, varied with crop but NWP energy, fat and protein was highest in groundnuts (≈ 3700 kcal kg m-3, 300 g m-3, 160 g m-3) respectively.

Conclusions

Results observed showed that bambara groundnut performed better with respect to yield and water productivity. With regards to NWP, groundnuts were the most superior compared to other legumes. Results will be confirmed by a second season experiment.

References

Keywords

Food and nutritional security, yield, nutrition

THE EFFECT OF FRUIT TO FRUIT VARIATION, HARVEST DATE, TREE AND ORCHARD EFFECTS, AND CULTIVAR DIFFERENCES ON WATER VAPOUR PERMEANCE OF NECTARINE FRUIT

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Introduction

Moisture loss is a serious problem in nectarines and it affects the post-harvest quality of most cultivars. Moisture loss results in loss of saleable weight and a shriveled appearance. The ease with which a fruit loses moisture is called the water vapour permeance (P'H2O). The aim of this study was to quantify contributions to the total P'H2O from sources such as fruit to fruit differences, cultivar, tree and orchard effects as well as harvest date.

Materials and Methods

The study was conducted in the 2014/2015 and 2015/2016 growing seasons using five farms around the Western Cape Province for sampling each cultivar. Three cultivars were used i.e. 'Alpine', 'Summer Bright' and 'August Red'. A complete randomized design with five orchards and five trees per orchard was used. On each sampling date the P'H2O of each fruit was calculated by placing the fruit in an airflow of 0.5 m s-1 and an average RH of 60%, and the rate of weight loss from each fruit was determined once over a 16h period. Pulp temperature, ambient temperature and relative humidity were logged with iButtons. Fruit surface area was calculated assuming the fruit shape to be that of a sphere and data were analyzed using components of variance analysis in Dell Inc. (2015) STATISTICA, version 12.

Results and Discussion

The peel of 'Summer Bright' nectarine was generally more permeable to water vapour compared to 'August Red' and 'Alpine'. This is despite the fact that 'Summer Bright' is not susceptible to post-storage shrivel. In addition, the P'H2O of the fruit increased as the harvest date approached. Fruit to fruit differences were the biggest contributor (>45%) to the total variation in P'H2O overall and in each of the three cultivars, harvesting date made the second largest contribution (>35%), cultivar differences explained more than 7%, orchard effects explained only 3% while tree differences did not contribute to the total variation. The large fruit to fruit variations make it difficult to effectively manage the fruit so as to reduce moisture loss and shrivel.

Conclusions

There was an increase in peel permeability with increasing fruit maturity for all three cultivars. Although fruit to fruit differences were the main contributor to the total variation in P'H2O there is need for further research to establish the extent to which other factors such as position of fruit within the canopy, fruit contact with shoots, exposure to sunlight, and size and shape of the fruit influence the fruit P'H2O.

References

Keywords

moisture loss, peel permeability, shrivel, P'H2O

RESPONSES OF GREEN BEAN GROWTH TO NEMARIOC-AL PHYTONEMATICIDE

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Introduction

The root-knot (*Meloidogyne* species) nematodes, with a wide range of host plants, are aggressive and most crops cannot be successfully produced unless nematode numbers are suppressed. The green bean (*Phaseolus vulgaris*) is highly susceptible to *Meloidogyne* species. Phytonematicides are being investigated to manage nematodes, as alternatives to withdrawn synthetic chemicals. However, phytonematicides could induce phytotoxicity. This has been resolved in other crops by developing the Mean Concentration Stimulation Point (MCSP), which is established empirically with the aid of a computer-based model called the Curve-fitting Allelochemical Response Dosage (CARD). The MCSP is plant-specific and should therefore be established for each crop prior to successful use of phytonematicides. The objective of this study was to determine the MCSP values of Nemarioc-AL phytonematicide on green beans under greenhouse conditions.

Materials and Methods

Seeds of green bean were sown in 30-cm diameter pots, containing pasteurised loam soil and river sand at 3:1 (v/v) ratio. A day after emergence, seedlings were inoculated with 5000 eggs and second-stage juveniles of *M. javanica*/seedling, irrigated with 500 ml water every other day and fertilised once using 5 g 2:3:2 (22) NPK and 3 g 2:1:2 (43) Multifeed fertilisers per seedling. Treatments, namely 0, 2, 4, 8, 16 and 32% Nemarioc-AL phytonematicide, were arranged in randomised complete block design, with 10 replicates. At 56 days after initiating the treatments, plant and nematode variables were assessed and subjected to analysis of variance. Significant treatment means were further subjected to the CARD model.

Results and Discussion

Nemarioc-AL phytonematicide significantly affected chlorophyll content and root galls, with the CARD model providing an MCSP value of 2.112%. The overall sensitivity value of green bean to this phytonematicide was one, suggesting that the crop was highly sensitive to the product (Mashela et al., 2015). In other studies (Mashela et al., 2015) Nemarioc-AL phytonematicide was shown to be highly effective in reducing nematode numbers at concentrations as low as 2% and, therefore, the material would be suitable for managing nematodes. However, it is imperative that the application interval be empirically determined for this product on green beans.

Conclusions

Nemarioc-AL phytonematicide has the potential for being successfully used in managing nematode population densities in green beans.

References

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Keywords

Cucumis myriocarpus, phytotoxicity, *Cucumis africanus*

Effects of organic and inorganic fertilisers on the growth of Pseuderanthemum atropurpureum, soil fertility and leachate composition

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Introduction

Runoff from agricultural lands and nurseries contains varying, but significant amounts of N and P. Both are considered 'limiting nutrients' in freshwater ecosystems, and an increase in these may cause eutrophication due to a substantial increase in phytoplankton biomass. The aim of this study was to establish, if use of organic fertilisers in nurseries could potentially be less detrimental to freshwater ecosystems and more beneficial for plant growth and soil fertility.

Materials and Methods

This study was carried out in a tunnel at Randles Nursery, Durban. The experiment was laid out as randomized block design with seven treatments replicated three times in a 4x3x2 factorial design. Rooted *Pseuderanthemum atropurpureum* cuttings were transplanted into 3L bags containing a commercial blend of composted pine bark and river sand (Gro) or a mix consisting of one part topsoil, one part compost and one part river sand (v/v) (Randles). Two organic, commercial fertilisers (one pelleted (6:1:3), one liquid (4:1:3)) as well as two inorganic (one granular slow release (7:1:3) and one liquid (6:1:3)) were used at ½ recommended rate, recommended rate and 2 x recommended rate. Plant growth parameters determined included height, number of leaves, leaf size and leaf chlorophyll content. Leachate was collected, using the pour through extraction technique, for Total phosphate (TP), Orthophosphate (PO43-) analysis and phytoplankton identification, after filtration, using a scanning electron microscope.

Results and Discussion

Height was not significant among treatments, with the highest value of 40.39cm recorded for organic (6:1:3) in Randles potting mix and the lowest at 19.84cm in the Gro control. Number of leaves was significant overall at $p<0.05$, but not leaf size. The only significant difference for leaf chlorophyll a content was between organic (6:1:3) and Gro control. Fertiliser concentration and growth media significantly influenced the amount of TP and PO43- leached. Orthophosphate was found to have the highest value for organic pellet (6:1:3), inorganic liquid (6:1:3) and inorganic granular (7:1:3) treatments, all applied at twice the recommended rate and grown in 'Gro' growth media. Diatoms were the only phytoplankton organisms identified under the scanning electron microscope.

Conclusions

As not many significant effects between organic and inorganic treatments on plant growth parameters were identified, half the recommended rate should be applied and preferably a growth medium like Randles used, given the rather high TP and PO43- concentrations in leachate.

References

Keywords

fertilizer, nutrient runoff, growth media, eutrophication

POSTHARVEST ‘FORELLE’ MEALINESS INFLUENCED BY CANOPY POSITION, RIPENING RATES AND POLLINATION

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Introduction

Preliminary studies show ‘Forelle’ pear canopy position and total soluble solids (TSS) relate to mealiness development during ripening. This study explored ripening rates and mealiness development as well as irradiations and fruit surface temperature differences within the canopy. This study further aimed to establish whether pollination influences tissue structure and mealiness development.

Materials and Methods

Fruit surface temperature and irradiance of five canopy positions were measured. Fruit of five positions were harvested at two maturities (optimum and post-optimum) and evaluated after storage (8, 12, 16 weeks at -0.5 °C) and ripening (4, 7, 11 days at 20 °C). Flowers of shoulder height were emasculated and hand cross pollinated with ‘Early Bon Chretien’ pollen, while some flowers were only emasculated without receiving any pollen. Maturity indices, ethylene and CO_2 production were measured after harvest, cold storage at -0.5 °C and 7 days of ripening at 20 °C.

Results and Discussion

Outside canopy fruit were more mealy, had the highest fruit surface temperature and highest percentage exposure to sunlight. The large temperature variations experienced by outer canopy fruit may have negatively affected fruit metabolism, eventually, leading to fruit being highly sensitive to mealiness development. Inside fruit mealiness remained constant for both harvest maturities regardless of cold storage and ripening times. Maximum mealiness differed for outer canopy sides for various storage and ripening times. Fruit diameter of inside canopy from second harvest did not differ significantly from harvest one outside-east fruit, but have significant differences in mealiness. The study by Muziri et al. (2016) reported that cell size exhibit a positive relationship with mealiness percentage and fruit that become mealy have a higher percentage of less dense tissue cavities. This study also suggests that fruit factors/cellular structures that are formed prior to ripening may therefore play a role in mealiness development. Hand cross-pollenated fruit on the eastern side of the canopy were significantly less mealy when compared with un-pollenated / emasculated fruit. The lower incidence of mealiness in pollen treated fruit can possibly be attributed to a greater hormone balance, as a result of viable seeds. Parthenocarpic fruit most often have calcium deficiency symptoms (Bangerth and Schröder, 1994) and calcium plays an important role in the fruit texture (Blanpied et al., 1978).

Conclusions

Outside canopy fruit had the highest surface temperature, sunlight exposure and mealiness. Cross pollination seems to result in lower mealiness incidence. Tissue density measured via x-ray CT processing and correlations will aid in describing these differences in canopy position and mealiness further.

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Keywords

Canopy position, ‘Forelle’ mealiness, harvest maturity, irradiance, pollination

POTENTIAL ON AND OFF-SITE IMPACTS OF LARGE AGRICULTURAL INVESTMENTS AND SMALL-SCALE FARMERS IN KENYA AND MOZAMBIQUE

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Introduction

AFGROLAND is a research project investigating changing global agro-food-energy systems, land use patterns, production models, natural resource management, food security, and national/global governance caused by the local influx of foreign large agricultural investments in Africa. This paper assesses and contrasts the potential on- and off-site environmental impacts and crop production potentials of large agricultural investments (LAIs) and small-scale farmers (SSFS) in both Mozambique and Kenya.

Materials and Methods

Off-site environmental impacts are estimated using a Life Cycle Assessment (LCA) and water footprint assessment. The off-site impact indicators considered were eutrophication, global warming potential, non-renewable energy consumption, and blue and green water consumption in a life cycle assessment framework. On-site impact indicators and crop production potentials were estimated using the APSIM model. The APSIM model was calibrated using site-specific soil properties, meteorological data and management practices. Information on local management practices was gathered from LAIs and SSFs through the use of semi-structured interviews, resource allocation maps and site-visits.

Results and Discussion

Preliminary results indicated that off-site environmental impacts were greater for LAIs compared with SSFs per unit area and unit of production. Inversely, on-site environmental impacts are greater for SSFs compared with LAIs due to the lack of access to inputs such as fertilizers and pesticides. Actual crop yields are also closer to potential yields for LAIs than for SSFs due to better scientific management indicating higher resource use efficiency.

Conclusions

Understanding agricultural production systems and their potential impacts on surrounding ecosystems and on the production potential of the land, provides important information on how yield gaps can be reduced, food security improved, sustainable practices implemented, and how the environment can be protected. Such research also has the potential to highlight key issues experienced throughout sub-Saharan Africa and mitigate future threats to production systems for both large and small-scale producers through improved policy formation and dissemination of critical findings to farmers and extension officers.

References

Keywords

APSIM, Kenya , large-agricultural investments, LCA, Mozambique, small-scale farmers, water footprint

Evaluating combinations of calcium and boron formulations on reduction of sunburn on ‘Golden Delicious’ and ‘Granny Smith’

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Introduction

Sunburn has significant financial implications on profitability for the export apple industry, as sunburnt fruit is unaccepted when exported to the United Kingdom. Sunburn incidence is expected to increase in future, with climate change (IPCC 2007). To reduce sunburn, which can be 40% for some cultivars, an affordable and sustainable alternative is needed. Lötze and Hoffman (2014) reported that a combination of calcium (Ca) and boron (B), applied in combination as pre-harvest foliar applications, consistently reduced sunburn on ‘Golden Delicious’ apples. In this experiment, the efficacy of the Ca/B combination with alternative formulations were evaluated on Granny Smith and Golden Delicious.

Materials and Methods

The trials were performed on a commercial farm in Elgin. Six combinations of foliar Ca/B were applied from 28 days after full bloom on ‘Golden Delicious’ and ‘Granny Smith’, on a weekly basis for 6 weeks using different formulations. At harvest, sunburn was visually classified using an adapted sunburn classification guide (Schrader et al. 2003).

Results and Discussion

For ‘Golden Delicious’, the 0.5g.L-1 Spraybor with 6.5g.L-1 Calcinit treatment had significantly lower class 1 and higher class 0 percentages than the control. This indicated an effect of formulation in addition to the Ca/B combination in reducing sunburn. There were no significant differences between treatments for ‘Granny Smith’ – indicating a cultivar effect.

Conclusions

Results confirmed that a combination of Ca and B reduced sunburn incidence of class 1 fruit, but it was cultivar dependent. Efficacy of the treatment was also dependent on formulation of the Ca and B.

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Keywords

‘Malus domestica’, foliar application, sunburn incidence

IDENTIFYING THE BEST SOYBEAN CULTIVARS FOR THE DIFFERENT CLIMATIC REGIONS

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Introduction

The national soybean cultivar trials were introduced in 1978/79 to support local soybean producers to identify and select adapted cultivars for their specific climatic regions. This was done in a bit to increase yields following the growing protein deficit in South Africa. The trials facilitate cultivar comparisons for agronomic and economic performance. The chosen cultivar should be well adapted for the particular soil and climate conditions involved with a high probability for a superior yield.

Materials and Methods

A number of cultivar selection trials for soybeans are done yearly at different localities called multi environmental yield trials (MET's). MET's are costly and thus the best cultivar selections for a specific environment are of the utmost importance. Two different techniques namely the Genotype plus Genotype by Environment (GGE) biplots and the method of yield probabilities were used. Yield probabilities as a percentage of the mean yield are useful in the selection of cultivars in multi-environmental trials (MET's) for different regions and circumstances.

Results and Discussion

The impact of the correct cultivar selection are being demonstrated in the following example. During the 2015/16 production season the mean yield of the best four cultivars for the cool region (2901 kg ha-1) was approximately 641 kg ha-1 higher than the mean yield of the poorest four cultivars (2260 kg ha-1). This relates to R4 166.50 ha-1 at a seed price of R6 500 t-1. If only 20 % of the crop in Mpumalanga alone is produced (240 000 ha for 2015/16) with the four best cultivars as opposed to a random selection of cultivars, the increased yield amounts to more than R199 992 000 per annum.

Conclusions

Therefor the best cultivar selection for a specific climatic region can have a significant financial impact for the producer.

References

Keywords

Climatic regions, multi environmental yield trials, Genotype by Environment

Determinination of Fusarium resistance in wheat germplasm

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Introduction

Fusarium head blight (FHB) is one of the most damaging wheat and barley diseases in the world. In South Africa, this disease occurs in the wheat irrigation areas (Kriel & Pretorius, 2008). This disease can be severe when inoculum is present together with planting of susceptible cultivars, high humidity during anthesis, no-till practices and maize-wheat crop rotation. High yield losses may occur and seeds may contain mycotoxins (Nicholson et al., 2007). There are no chemicals registered in SA to control this disease (Croplife, 2016). Therefore, a Winter Cereal Trust Fusarium project was initiated to improve the resistance of the current commercial cultivars by using phenotypic and marker-assisted based backcross pre-breeding.

Materials and Methods

Twelve resistant donors were imported from the USDA and were evaluated in the field for Fusarium resistance together with three cultivars namely Sumai 3, Frontana and Gamenya that were used as resistant and susceptible controls respectively. All the entries were inoculated during anthesis with different Fusarium isolates and were evaluated by using the CIMMYT scale (Ireta & Gilchrist, 1994).

Results and Discussion

Over a three-year period, six donors showed resistance, five donors showed moderate resistance (including Frontana and Sumai 3), two donors were susceptible and two donors were very susceptible (including Gamenya) in the field. Five of these donors were included in a backcross pre-breeding programme. Over twenty SSR markers linked to well characterised FHB resistance genes/QTL from specific donors have been used across the different cross combinations since 2013. Currently, the developed material is at BC2F1 generation. Selections were made based on the presence of at least one major gene/QTL (Fhb1, Fhb2 Fhb4, Fhb5, 3A, 4A, 4D and 7D QTL) for FHB resistance confirmed by the presence of both flanking markers. Based on initial marker data, most of the families contain different FHB resistance genes/QTL in combination with targeted rust resistance genes. These promising lines will be top-crossed with one another to stack several different FHB resistance genes/QTL and rust resistance genes into single lines, to truly establish a diverse FHB resistant germplasm pool.

Conclusions

It is expected in years to come that a number of potentially successful FHB resistant irrigation cultivars will become available in South Africa, directly as a result of this diverse FHB resistance pre-breeding programme. These resistant cultivars should, however, be used as part of an integrated FHB management strategy, in combination with other control practices, to successfully control potential future outbreaks of FHB.

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Keywords

Fusarium head blight, CIMMYT, SSR markers, pre-breeding programme

Effect of chemical scarification on seed germination of Hibiscus coddii subsp. barnardii

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Introduction

In the search for new ornamentals, indigenous plants are preferred as these are already adapted to local growing conditions (Middleton, 2012). One such potential ornamental plant is the Sekhukhuneland endemic Hibiscus coddii subsp. barnardii. This perennial, herbaceous plant with bright, red-orange flowers would be suitable for growing as a pot plant or small shrub, especially in sunny rockeries (Craib, 2003). The small, hard seeds produced by the plant are difficult to germinate, therefore, the effect of different sulfuric acid (H_2SO_4) concentrations and duration of scarification on seed germination was studied.

Materials and Methods

Seeds were incubated in H_2SO_4 (98%, 50% and 25%) for 10, 20, 30 and 40 minutes respectively. The concentration of H_2SO_4 that resulted in the highest germination percentage was further used to determine the effect of duration of scarification on germination. Seeds were incubated in 98% H_2SO_4 for five to 40 minutes with five minute increments. Non-scarified seeds and seeds imbibed in distilled water were used as the controls. Scarified and non-scarified seeds were germinated on moist filter paper bridges and in moist vermiculite under controlled conditions. Radicle protrusion (2 mm) on filter paper and appearance of cotelydons above the vermiculite were considered as seed germination and emergence respectively. All treatments were repeated three times with ten seeds per treatment. Various germination parameters, such as germination/emergence percentage (GP/EP) and germination/emergence index (GI/EI) were calculated. Data was analysed with the SAS and GenStat packages.

Results and Discussion

The best germination response on both filter paper and vermiculite cultures was observed in seeds scarified with 98% H_2SO_4. Parameters such as GP and EI were significantly different from all other H_2SO_4 treatments and the controls. For seeds germinated on moist filter paper, duration of scarification (10 to 40 minutes) in 98% H_2SO_4 showed no significant differences in GP and GI, except for the five minutes treatment and the controls. For GP and EI, a similar trend was observed for seeds germinated in vermiculite.

Conclusions

Scarification with 98% sulfuric acid (from 10 to 40 minutes) significantly improved seed germination and seedling emergence of H. coddi subsp. barnardii.

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Keywords

germination index, germination percentage, ornamental plants, scarification, sulfuric acid

Investigating the impact of projected timing of climate departure on crop yield over West Africa

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Introduction

The impact of climate change is projected to affect food security in the future. West Africa is one of the most vulnerable regions owing to its low adaptive capacity and has suffered significantly from climate change impacts with large impacts on food production. Moreover, Mora et al. (2013) projects climate departure from historical range early in the tropics with the capacity to aggravate the current risks (e.g. decline in agricultural production) and introduce new ones. Climate departure refers to a point in time when the climate of a place will cross a threshold such that the new climate norm was an extreme in comparison to the currentclimate. However, there is a gap in knowledge on how the timing of climate departure from historical range could affect crop yield over West Africa. The present study seeks to investigate the projected timing of climate departures from historical range and their impact on crop yield over West Africa. It also examine how timely response to climate change impact may help improve crop yield over the region.

Materials and Methods

Crop suitability models (EcoCrop) is used to evaluate the response of crops to different climate and climate extremes over the region. Climatic and crop data are be obtained from the Climate System Analysis Group (CSAG), World climate data (WorldClim) and the Food and Agriculture Organisation-Agro Ecological Zone respectively over the region.

Results and Discussion

Climate is the main driving mechanism of all biological processed, and also affects all aspects of human life. Thus, the influence of an unprecedented change in climate may impact the ecological, social, economical and livelihood of a region (Mora et al., 2013). Thus, the changing climate could affect human life via changes in food and water availability and supply, agricultural yield and produce, heat stress, spread of infectious water borne diseases and the economy (IPCC, 2013). Also, extreme changes are projected to happen, with a projected temperature increase in the near future due to the increase in greenhouse gas emission. The study further revealed that across the globe, the African continent will be the most vulnerable to climate change.

Conclusions

The study will improve our understanding on the timing of climate departures from historical variability and impact may have on crop yield over West Africa. It will also aid our knowledge and assist policy and decision makers in their decision making on adaptation timescale and the most suitable of adaptation strategies to be employed over the region.

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Keywords

Climate Departure, crop yield , West Africa

THE EFFECT OF DIFFERENT NITROGEN SOURCES ON THE YIELD AND WATER USE EFFICIENCY OF RAINFED MAIZE (Zea mays L.) GROWN IN A SEMI-ARID REGION

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Introduction

Water and nitrogen are regarded as the most limiting factors of crop production under rain-fed cropping conditions. The objective of this study was to determine the effect of different nitrogen sources on the yield and water use efficiency (WUE) of dryland maize grown in a semi-arid region.

Materials and Methods

Maize field trials were conducted during the seasons of 2014/2015 and 2015/2016 under rain-fed conditions north of Coligny in the Northwest Province of South Africa. The soils, with the capacity of an effective plant rooting depth of greater than 1200 mm, were mainly an Avalon soil form. Trials were planted in a completely randomized design and replicated six times on experimental plots that were 0.8 ha in size. Maize was fertilized with 34 kg potassium sulfate ha-1, applied as a pre-plant application and 340 kg 5:3:2(20) + 0.25% Zn + 2% S ha-1 at planting. Treatments comprised of three different N fertilizer sources viz. ammonium nitrate (ANO, 19.5%N), calcium nitrate (CN, 15.5% N) and urea (UREA, 46% N) applied as a single top-dress application of 60 kg N ha-1 at the V6 stage. Agronomic practices were applied with the objective to create optimum growth conditions, allowing for maximum water uptake and yield. Soil water content was measured every14 days using a neutron probe and evapotranspiration (ET) was calculated with the soil water balance equation described by Hillel (1980). The data was subjected to analysis of variance (ANOVA) using STATISTICA.

Results and Discussion

During the 2014/2015 season no statistical significant differences in grain yield and WUE were observed between treatments. Grain yield ranged between 3591 and 3883 kg ha-1 and WUE between 5.7 and 6.4 kg ha-1 mm-1 for UREA and CN respectively. During 2015/2016 the average yield of 4901 kg ha-1 measured for CN and 4792 kg ha-1 for ANO were both significantly ($P<0.005$) higher than the 4491 kg ha-1 measured for UREA. The average WUE of 10.8 kg ha-1 mm-1 for CN was significantly higher ($P<0.007$) compared to the 10.4 kg ha-1 mm-1 for ANO and 10.2 kg ha-1 mm-1 for UREA.

Conclusions

These results confirm existing literature (Adriaanse, 1990) that when nitrate containing fertilizer-N products are used to top-dress maize in semi-arid climates, there is a high probability of increased grain yield, in this case between 8 and 9.1% if compared to urea. In addition these trials showed WUE increase of between 6 and 12% when nitrate sources are compared to urea.

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Keywords

Ammonium nitrate, calcium nitrate, top-dress, urea, water use efficiency

INOCULATION AND PHOSPHORUS APPLICATION A NECESSITY FOR SOYBEAN PRODUCTION IN MOZAMBIQUE

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Introduction

Soybean utilization is expanding in Mozambique creating the challenge of increasing production by over 40,000 metric tons from the present 50,000 metric tons per year. Management interventions on soils resources both inorganic and organic are necessary to increase the current average production from 1.3 tons ha-1 per unit area production among the smallholder farmers. Nitrogen (N) and Phosphorus (P) are necessary for optimal production especially with inoculation of Bradyrhizobium spp. on fields with no recent history of the legume production. However, yields of inoculated or fertilizer N supplied soybean may be constrained in P deficient soils. The objective of this study was to evaluate the responses of two soybean cultivars to inoculation, P and starter-N application, and their interactions on nodulation, growth, yield components and grain yield.

Materials and Methods

~~.~~ A study was conducted ~~in~~ at three locations across Mozambique over two seasons of 2011/2012 and 2012/2013. Two soybean genotypes (Storm and TGx 1904-6F) were used in the study. The experimental design was a split plot with P rates (0 and 40 kg P ha-1) as main plot, inoculation application as subplots and N rates (0 and 40 kg N ha-1) as sub-sub plots with four replication per treatment. At the end of the season, biomass samples from three replicates of each treatment and both seasons from Angonia and Ruace were analyzed to determine P and N in the above ground residues. Data on yield and yield components was analyzed as a combined and individual location using PROC GLM in SAS 9.4 with season and location as random effects.

Results and Discussion

Inoculation increased nodulation in both soybean varieties but the effect of P on nodule formation was not consistent across sites and variety. Nodulation decreased with starter-N but increased with inoculant and P combination. Input application affected pod numbers and plant height distinctively across sites although seed size increased combinations. Inoculation and P application increased grain yield and their combination resulted ~~resulting~~ in highest grain yields among treatments across sites. Yield increase for inoculant + P treatments ranged from 0.2 tons ha-1 (20%) to 2.1 tons ha-1 (91%) compared to the check.

Conclusions

Grain yields were higher for inoculant or P treatments alone than starter-N. More studies are required to understand the better timing for starter-N application to enhance effective nodulation, nitrogen fixation and higher yields for soybean production in Mozambique.

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Keywords

Bradyrhizobium, Nodulation, Storm, Variety, Yield, Zamboane.

EFFICACY OF THE ENTOMOPATHOGENIC NEMATODE STEINERNEMA YIRGALEMENSE FOR THE CONTROL OF FOUR LEPIDOPTERAN STEMBORERS

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Introduction

Busseola fusca, Chilo partellus, Sesamia calamistis and Eldana saccharina are economically the most important lepidopteran stemborer species in Africa. These species can cause an estimated yield loss of 10% but can also lead to total crop failure in some cases. After reports of B. fusca developing field resistance to Bt maize in South Africa, the importance of alternative, sustainable control practices for stemborers have been recognized. The objective of this study was to determine the potential of the entomopathogenic nematode (EPN), Steinernema yirgalemense, as an effective, alternative management tool for the control of active stemborer larvae under laboratory conditions.

Materials and Methods

Active larvae of all four stemborer species were reared on artificial medium in the laboratory at ARC-Grain Crops Institute. A bioassay was performed in multi-well trays by inoculating 12 larvae of each stemborer specie with 100 S. yirgalemense IJs/larva. Each treatment was replicated five times. The control treatment for each stemborer specie consisted of larvae inoculated with water only. Inoculated larvae were incubated at 25°C and the mortality rate determined after 48 and 72 hours, respectively. Data were analyzed using the Abbott's correction factor to compensate for natural mortality.

Results and Discussion

Chilo partellus and E. saccharina exhibited a 100% mortality rate after 48 hours, which differed significantly from B. fusca (Venda (60%) and Vaalharts (53%) population) and S. calamistis (22%). After 72 hours B. fusca (Venda and Vaalharts populations) showed a mortality rate of 81.6% and 80%, respectively, which was significantly higher than that of S. calamistis at 31.7%.

Conclusions

Steinernema yirgalemense showed potential to control all four stemborers species under laboratory conditions. However, since EPNs were able to infest some of the B. fusca and S. calamistis larvae, greater success might be achieved by using higher nematode inoculum rates (> 100 IJs/insect). Steinernema yirgalemense showed the highest potential for development as a biological control agent of C. partellus and E. saccharina was the most susceptible to S. yirgalemense. The high mortality rates caused by S. yirgalemense can probably be attributed to their effective penetration and development rate in both C. partellus and E. saccharina larvae. These trials will be repeated to confirm results obtained from this study.

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Keywords

Entomopathogenic nematode, lepidopteran stemborer species, Steinernema yirgalemense

A greenhouse assessment of coal mine stockpiled soils: Arbuscular mycorrhizal fungal spore density and colonization in maize (Zea mays) trap cultures

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Introduction

Coal continues to be a key mineral resource for the generation of energy in South Africa. However, open-cast coal mining impairs the post-mining land use capability of the soil, as well as alter biodiversity of the soil. Of the vast soil microbes, arbuscular mycorrhizal fungi (AMF)—in symbioses with plant roots—is essential for nutrient uptake and growth of most vascular plants. Successful establishment of this symbiosis could serve as an indicator of proper soil management practice and the soil's ability to support plant growth. This study investigated AMF spore density and colonisation in maize (Zea mays) trap cultures grown in stockpile soils obtained from three South African opencast coal mines

Materials and Methods

Stockpiles were randomly sampled at depths of ≤ 20 cm (topsoil) and >20 cm (subsoil), and used for mycorrhizal trap culture experiments in the greenhouse. Following a 12-week post germination period, AMF spore density in pot soils was enumerated, while plants roots were assessed for AMF colonisation and diversity by using classical staining and targeted amplification and sequencing of the nuclear rRNA gene of the Glomeromycota phylum

Results and Discussion

AMF spore density was significantly different ($P<.05$) between soil samples and highest in topsoil from unmined soils (control soil). The AMF spores were morphologically identified as belonging to the genera Acaulospora, Gigaspora and Scutellospora. DNA-based detection revealed that AMF colonisation was more associated with topsoil than with subsoil. Furthermore, species of the genus Paraglomus were the only colonisers of the maize roots in all soils, suggesting either a very low diversity of viable AMF spores, poor support for the establishment of root-AMF symbioses or the presence of a single maize (host)-specific AMF symbiont in these soils.

Conclusions

In conclusion, AM fungal spore density and mycorrhization was more associated with the topsoil of the stockpiles. This suggest that soil depth (stockpile height) is a factor which must be considered during coal mining operations. However, further studies are needed to investigate the effect of stockpile storage duration on the density, survival and viability of AM fungal spores in topsoil stockpiles.

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Keywords

Arbuscular mycorrhizal fungi, Soil health bio-indicator, Soil management, Mining, Bio-diversity

SUSTAINABLE INTENSIFICATION THROUGH ROTATIONS WITH GRAIN LEGUMES IN SUB-SAHARAN AFRICA: A REVIEW

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Introduction

Diversification and intensification through inclusion of grain legumes in cereal-based cropping systems represents a key technology in the drive towards the sustainable intensification of agriculture in sub-Saharan Africa (SSA). We conducted a review of literature to the residual effects of grain legumes in cereal-based systems of SSA.

Materials and Methods

We systematically searched the Web of Science for relevant literature.

Results and Discussion

We retrieved 43 unique publications providing 99 observations comparing continuous cereal performance with that of a grain legume-cereal rotation. The overall mean yield increase of 0.8 t grain ha-1, equal to an increase of 64% of the continuous cereal yield, as well as the consistent responses observed at sites differing in climate or soil fertility provide strong support that cereal yields are enhanced after grain legumes. The variability in residual effects is large and is affected by agro-ecology, cereal type, and N fertiliser applications, but not by the type of grain legume preceding the cereal. N application to cereals reduces the residual effects of grain legumes, but they are still substantial at higher N levels. The sustained benefits with large N applications indicate the importance of other rotational effects of grain legumes. While mechanisms for improved soil P availability after legumes have been studied, it remains uncertain how important these are in farmers' fields. Grain legumes are unlikely to have a major influence on the availability of nutrients other than N and P. Legumes can affect soil pH, but this impact is small and may be positive or negative. Beneficial impacts on soil organic matter content can occur if legumes contribute to greater cereal yields, but studies generally report no such impacts, perhaps due to the limited duration of most studies. Evidence of impacts on weeds is limited to striga, which is a major threat to cereal production. Studies on the impacts on nematode pressure in cereals do not provide evidence of consistent impacts, probably because legumes act as a host for some of the key nematode genera harming maize. The impact on the pressure of other pests and diseases in cereals is likely important, but evidence on this from SSA is almost entirely absent. Future research on N2-fixation by grain legumes and residual N benefits should focus on explaining the wide variability observed between sites. In addition, there is a clear need for more detailed mechanistic studies to assess the relevance of non-N effects of legumes, particularly in relation to pests and diseases in cereals.

Conclusions

References

Keywords

Keywords: cereals; nitrogen fixation; phosphorus; biotic factors; residual benefits; smallholder farmers

SHORT-TERM EFFECTS OF TILLAGE, CROP ROTATION AND CROP RESIDUE MANAGEMENT ON THE SOIL QUALITY OF TWO EASTERN CAPE ECOTOPES

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Introduction

Conservation agriculture (CA) is being promoted as a sustainable method of crop production that can help restore, maintain and improve soil health. Recent CA work in the Eastern Cape has shown the potential of CA components in improving soil health indicators. However, no studies have investigated either the individual or the interaction effects of the CA components on overall soil health and function. The objective of this study was to use the Soil Management Assessment Framework (SMAF) to evaluate the short-term effects of crop rotation and crop residue management under no till on the soil health of the Alice Jozini and Phandulwazi Jozini ecotopes in the Eastern Cape.

Materials and Methods

The SMAF was used to evaluate the effects of CA components on soil health from CA trials established on the two ecotopes in 2012. Samples were collected before and after 3 years of CA treatment application. Soil organic carbon, microbial biomass carbon, extractable P and K, soil pH, electrical conductivity, bulk density, aggregate stability and β-glucosidase activity were measured and used in the calculation of the SMAF soil quality index (SQI)(Andrews et al., 2004).

Results and Discussion

Crop residue retention and no till treatments significantly improved most of the soil quality indicators and the overall SQI. Higher levels of soil organic C, microbial biomass C, mineral N, extractable P and K, BG activity and macro-aggregates were recorded in the no-till and crop residue retention treatments. Crop rotation alone did not have a significant impact on soil quality indicators and overall SQI. It, however, significantly influenced the mineral N release and soil respiration (CO_2-C) at each ecotope. The interaction of tillage, crop rotation and residue management was not significant on most measured parameters and the overall SQI.

Conclusions

The SMAF-SQI revealed that generally crop rotations coupled with residue retention and reduced tillage improved the overall soil health of the two ecotopes after 3 years and indicated their potential to further improve overall soil quality in the long term. The maize-wheat-soybean rotation with residue retention under no-till resulted in the greatest improvement of overall soil quality of the two ecotopes.

References

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Keywords

Conservation agriculture (CA); Soil management assessment framework (SMAF); Soil Quality Index (SQI)
Acknowledgements National Research Foundation (NRF) for funding the research

Calibration and testing of AquaCrop for selected sorghum genotypes

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Introduction

Predicting yield response to water is important in rainfed agriculture. Crop models are critical tools in prediction of crop environmental responses. AquaCrop crop model’s selling points are robustness, and simplicity. Minimal calibration in AquaCrop permits non–research users to predict crop environmental responses using minimal, easy to obtain data measurements. The objective of this study was to calibrate and test AquaCrop for three sorghum genotypes. In part, this study aimed to investigate whether minimal calibration (ten step calibration procedure) proposed for non–research AquaCrop users was sufficient in predictions of sorghum yield response to water.

Materials and Methods

AquaCrop was calibrated and tested for three sorghum genotypes (PAN8816, Macia, Ujiba, IsiZulu) grown during 2013/14 and 2014/15 planting seasons at three planting dates (early, optimal and late planting dates) under rainfed conditions. Variables considered during model evaluation included canopy cover, biomass and yield. Correlation, root mean square error (RMSE), and Willmott's d–index (d) were considered in model testing and evaluation.

Results and Discussion

The model was able to simulate CC ($R2 \geq 0.710$; RMSE $\leq 22.73\%$; $d \geq 0.998$), biomass accumulation ($R2 \geq 0.900$; RMSE$\leq 10.45\%$; $d \geq 0.850$), harvest index ($R2 \geq 0.902$; RMSE $\leq 7.17\%$; $d \geq 0.987$) and yield ($R2 \geq 0.945$; RMSE $\leq 3.53\%$; $d \geq 0.783$) well for all genotypes and planting dates. AquaCrop over–estimated biomass and crop yield. The relatively good simulations produced by the ten step calibration confirm AquaCrop’s simplicity and suitability for use in places where extensive data sets may be unavailable.

Conclusions

Biomass and yield overestimation resulting from the use of the ten step calibration procedure suggests that other parameters (canopy sensitivity to water stress and water stress coefficient) are required to improve canopy and yield predictions for sorghum genotypes. Furthermore, water productivity, a conservative parameter in sorghum yield prediction may require to be queried for sub–Saharan Africa produced genotypes.

References

Keywords

modelling, parameterization, minimum calibration, validation, sorghum, water availability

MOLECULAR MARKERS IN HORTICULTURE: A TOOL FOR THE MODERN PLANT BREEDER AT THE AGRICULTURAL RESEARCH COUNCIL-TROPICAL AND SUBTROPICAL CROPS

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Introduction

Plant breeders use traditional methods of crossing, screening and selection in order to develop new and improved cultivars with desirable traits of interest. In the case of fruit and nut trees, this process can take many years as traits are evaluated upon maturity over a number of seasons. Consequently, the time taken from initiation of breeding to commercialisation of new cultivars is extensive. Molecular markers offer a supplementary tool to speed up the breeding process by allowing for earlier selection of promising cultivars. Additional applications of molecular markers include the provision of information on the genetic diversity present within breeding populations and the degree of genetic relatedness between cultivars, thereby allowing breeders to make informed decisions on the selection of mating parents. Markers can also be used to potentially identify the breeding parents of progenies from open pollinations and to verify varieties based on DNA fingerprints.

Materials and Methods

At the Agricultural Research Council-Tropical and Subtropical Crops, two types of molecular markers are being evaluated for their application in breeding programmes, i.e. Simple Sequence Repeat (SSR) and Sequence Related Amplified Polymorphism (SRAP) markers.

Results and Discussion

To date, these markers have been tested using commercially-important fruit crops (litchi and citrus), nuts (macadamia) and indigenous fruit (kei apple), with varying degrees of success. For litchi, it was found that SRAP markers were more suitable than SSR markers in distinguishing between cultivars. In contrast, for citrus, SSR markers were capable of distinguishing between groups of cultivars but difficulties were encountered when attempts were made to distinguish within groups. For macadamia, neither SRAP nor SSR markers generated meaningful genetic profiles, however, efforts are ongoing in attempts to resolve this. Results from the application of SRAP markers with kei apple are encouraging but remain to be correlated with morphological parameters.

Conclusions

The results from studies conducted indicate the value of the application of molecular markers in breeding programmes. The information gained can be useful in identifying suitable crosses, maintaining core collections and in cultivar verification. Certain crops such as macadamia require optimisation of methods in order to generate meaningful information for use by plant breeders.

References

Keywords

Induced polyploidy in Guava (Psidium guajava) and its effects on selected horticultural characteristics

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Introduction

Psidium guajava L. (Family: Myrtaceae), or guava, is one of the most important fruit crops cultivated primarily in developing countries and its importance is increasing due to its high nutritional value and yields and affordable price on the market. In the Mpumalanga and Limpopo Provinces of South Africa, guava trees are particularly susceptible to wilt disease and other soil borne pathogens, as well as nematodes. In this study, the ultimate aim was to use induced polyploidy as a breeding tool in order to develop both tetraploid breeding parents from which seedless triploid selections could be produced as well as rootstocks with potential resistance/tolerance to guava wilt disease and/or rootknot (*Meloidogyne* spp.) nematode.

Materials and Methods

Polyploidy was induced using single node shoot cultures of ‘TS-G2’ which were incubated with various colchicine concentrations over time. Tetraploid shoots were verified using flow cytometry. Various characteristics such as prolfieration rate, plant stature stomatal size and density, leaf shape etc. were studied. Induced polyploids and diploids were also evaluated for nematode tolerance/resistance by inoculating the plants with 1000 J2 eggs of *Meloidogyne* species and assessed after 56 days for the number of egg masses and number of eggs and J2 per root system.

Results and Discussion

Nodal cultures treated with colchicine resulted in polyploid induction for all treatments except the lowest (no polyploid induction) and highest (lethal) colchicine treatments. Polyploidy had a negative effect on both shoot elongation and proliferation *in vitro*. Polyploid plants were morphologically distinct and *in vitro* plantlets were shorter than the diploids with larger leaves. Differences in characteristics such as leaf indices (leaf shape; thickness) as well as stomatal density and size were observed in the polyploid plants compared with the diploid controls. With regard to the studies on nematode tolerance, no discernible difference between the induced polyploids and the diploid progenitors was observed 28 days after inoculation.

Conclusions

Polyploidy was successfully induced and verified and polyploid plants were morphologically distinct. Since there appeared to be no significant difference between the diploids and polyploids for nematode susceptability, the nematode challenge methodology will need to be optimised. *In vitro* shoot cultures of diploid and polyploid lines will furthermore be challenged with the toxin produced by the guava wilt disease-causing organism, *Nalanthamala psidii* to determine if there is any degree of tolerance/resistance to the fungus. Flower morphology and pollen viability studies on polyploids compared with the diploids will be carried out to determine breeding parent potential when the trees bloom.

References

Keywords

Psidium guavaja, *in vitro* propagation, polyploidy, improvement, nematode

Soil nitrogen behaviour in cereal-legume cropping systems

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Introduction

Considering the cost of Nitrogen (N) and environmental concerns (e.g. nitrate leaching) to pollute rivers, streams, dams and oceans, N use efficiency of cropping systems is of particular interest (Przednowek, 2003).

Materials and Methods

The experiment was laid out in a split plot layout, within randomized complete block design with three replications and three treatments or cropping systems Soil nitrogen (N) was sampled three times during the growing period.It was sampled at three different depths (0-20cm, 20-40 and 40-60 cm). Nitrogen was extracted from 10g soil with 100ml 2M KCL and determined by distillation as discussed by Jensen (1996). Data was statistically analysed by analysis of variance (ANOVA) with IBM SPSS

Results and Discussion

In all N levels sub plots, ammonium and nitrate were evenly distributed at 20 and 40 cm depth, during first sampling amongst all cropping treatments and the differences were not significant at $p>0.05$. At 60 cm depth it was more concentrated in sole oat and intercropping and was less concentrated in sole mungbean. At 0, 30, 90 kg ha1- subplots ammonium was concentrated at 40 cm and least at 60cm during second sampling. the results showed some movement down the profile of ammonium although it was not significant. Ammonium was more concentrated at 60 cm in all cropping systems except 30 kg N ha1- during last sampling, intercropping system where it was more concentrated at 20 cm. At 30 kg N ha1- there was a pattern namely more concentration of nitrate at 20 then 40 and 60 cm depth in all cropping systems. At 120 kg N ha1- nitrate was more concentrated at 60 cm depth in all treatments uniformly. At 0, 30, 60 and 90 kg N ha1- ammonium was more concentrated at 60 cm depth significantly in all cropping systems but 30 and 90 kg N ha1- where it was marginally more at 60 cm than 20 and 40 cm depth. At 120 kg N ha1- ammonium was marginally concentrated at 40cm depth in sole oat. Intercropping sub plots had least concentration during this period in all depths. In sole mungbean it was concentrated at 60 cm and least concentrated at 20 cm depth. During this period in all subplots nitrate was significantly concentrated at 60 cm decreasing with depth in all cropping system

Conclusions

Nitrate does move down the soil profile more than ammonium. Nitrate movement within soil profile can be arrested in cereal-legume intercropping than in sole cropping.

References

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Keywords

cropping systems, nitrogen mobility, intercropping, soil profile

EFFECT OF PLANTING TECHNIQUES (HORIZONTAL AND VERTICAL) PLANTED WITH 2, 3 AND 4 INTERNODES UNDERGROUND ON SWEET POTATO PRODUCTION

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Introduction

Sweet potato (Ipomoea batatas) is propagated using vine cuttings. Farmers usually use any length of vine cutting that is available or convenient to handle. Some researchers suggest planting at an angle or horizontally to produce more yield. some others, however, recommend vertical planting. There is a need to test the new cultivars in order to determine the best planting technique and number of nodes put in the soil that would maximize sweet potato yield and quality. Therefore, the objective of the study was to evaluate the different planting techniques planted with different number of nodes underground on ARC sweet potato cultivars promoted in South Africa.

Materials and Methods

The experiment was done at ARC-VOP, Roodeplaat. Planting techniques tested were horizontal and vertical planting of the cuttings with 2, 3 and 4 internodes underground. The cultivars tested were Bophelo, Ndou and Blesbok. The experiment was a 2x3x3 factorial laid out in randomised complete block design and replicated 3 times to give 54 experimental plots. Fertilizer application consisted of 800 kg/ha 2:3:4 before planting and a top dressing of 150 kg/ha N (in the forms of LAN) at 4 weeks after planting. Total root yield, marketable yield and above ground biomass were recorded and analysed using SAS 9.4.

Results and Discussion

The results revealed that for the above ground biomass there were significant differences ($p < 0.05$) between the cultivars used, the number of nodes underground, and the interaction of technique and number of nodes. Likewise, there was significant difference ($p < 0.05$) in total yield between the cultivars and also the interaction between planting technique used and number of nodes underground. The horizontal technique with 3 nodes underground had the highest total yield (32,88 t/ha) followed by the vertical technique with 4 nodes underground (25,31 t/ha). In terms of marketable yield there was significant differences between the cultivars.

Conclusions

Horizontal planting technique with 3 nodes underground produced the highest total and marketable yield; therefore it is recommended that farmers use this method. This will ultimately increase farmer’s returns on investments, contributing to poverty alleviation especially to small holder farmers.

References

Keywords

Blesbok, Bophelo, internodes, planting technique, sweet potato vines

ENHANCING CABBAGE (BRASSICA OLERACIA L. VAR. STAR 3301) PRODUCTION THROUGH APPLICATION OF 'VERTE GUANO'

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Introduction

Verte Guano is an Organic liquid Seabird Guano Fertilizer high in Phosphorus (P) and various other macro and micro nutrients. Phosphorus is used by plants for healthy root development. Verte Guano can be applied as a foliar feed, or straight to the soil. However, little is known about the effects of Verte Guano on leafy vegetables. As such it was decided to evaluate the product's effect on growth and yield parameters of cabbage under open field conditions.

Materials and Methods

The study was conducted as a RCBD with three dilution levels of Verte Guano: 0ml/20L, 500ml/20L and 750ml/20L of water replicated four times. Drip pipes with 60cm inter-hole spacings were used and seedlings were planted using the in-row spacing of 60 cm as guided by the drip pipe line. The product was applied manually on a weekly basis with a Knapsack sprayer from two weeks after transplanting. Data on growth parameters (plant height and numbers of leaves prior to head formation) were recorded continuously on a biweekly basis and yield parameters (head mass, circumference and diameter) were collected at harvest.

Results and Discussion

There was a significant increase in plant height at the 4th week of application. The dilution level of 750ml/20L was significantly different from the control but not significantly different from the dilution level of 500ml/20L on the 4th, 10th and 12th week of application. Significant increases in number of leaves were observed on the 12th week of application when the crop was already physiologically mature. There was a non-significant difference in head mass, head circumference and head diameter across all dilution levels of Verte Guano.

Conclusions

Preliminary findings of the study demonstrate that Verte Guano organic fertilizer has no effect on yield parameters of cabbage. More studies are needed to evaluate its impact on nutritional quality.

References

Keywords

Verte guano, dilution levels, cabbage, growth and yield parameters

RAINWATER HARVESTING AND CONSERVATION TECHNIQUES FOR IMPROVED PRODUCTION OF LEAFY VEGETABLES IN DRY AREAS OF SOUTH AFRICA

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Introduction

South Africa is generally a water scarce country, with low and erratic rainfall distribution and high rates of atmospheric evaporative demand. This limits the production of vegetables predominantly under dryland conditions, contributing to increased levels of hunger and malnutrition amongst the rural communities who are the primary beneficiaries of dryland crop production as a mean of food security. Optimization of rainfall utilization is therefore required to maximize crop productivity under such conditions. This can be achieved through the implementation of rainwater harvesting and conservation (RWH&C) practices.

Materials and Methods

A field trial was set-up in a semi-arid area of South Africa to test the effect of various RWH&C practices (in-field with a bare catchment – IRWHB, in-field with a plastic catchment – IRWHP and tied-ridging – TR, all combined with mulch) on yield of two selected leafy vegetables (amaranth and Swiss chard), during two diverse rainfall seasons. The experiment was laid out using a factorial arrangement in a randomized complete block design, with three replications. The following data were recorded and analysed using GenStat statistical software, version 14: fresh marketable yield, dry mass, leaf area index, soil water content, leaf chlorophyll content and leaf stomatal conductance. Means for the different treatments were compared using Duncan’s multiple range test at the 5% level of significance.

Results and Discussion

Results revealed that in a normal rainfall season (350-600 mm), the implementation of TR was sufficient to improve the harvestable yield of both amaranth (13% increase) and Swiss chard (3% increase), while during the dry season (< 350 mm) maximum yield was obtained with the use of IRWHP or IRWHB (28% increase for amaranth and 33% for Swiss chard) in comparison to the conventional cultivation practice. The Root zone profile soil water content was significantly higher under IRWHP and IRWHB throughout the growing season as compared to the conventional flat cultivation practice.

Conclusions

This study provides first time insight on the application of RWH&C practices to improve the productivity of leafy vegetables cultivated under dryland conditions in South Africa. Implementation of rainwater harvesting practices was demonstrated for the first time to optimise rainfall utilization during both a normal and dry rainfall season for leafy vegetables. More research should be done to expand knowledge in this field for other leafy vegetables.

References

Keywords

in-field, tied ridges, mulch, dryland, food security.

UNLOCKING THE POTENTIAL OF CROP WILD RELATIVES USING PREDICTIVE CHARACTERIZATION

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Introduction

Crop wild relatives (CWR) are wild plant species which are genetically close to cultivated crops and have the potential to be used in breeding programmes to improve the yield, resistance to biotic and abiotic stresses and the nutritional quality of these crops. One of the aims of the SADC Crop Wild Relatives Project, co-funded by the African, Caribbean and Pacific Group of States – European Union (ACP-EU) co-operation programme on science and technology, is to identify and prioritize CWR of food and fodder crops that grow in South Africa, in order to develop *in situ* and *ex situ* conservation plans and identify traits for use in crop improvement programmes. A list of 435 genera of food and fodder crops important for South Africa was compiled. A priority list of 258 CWR species was drawn up in this project. The project then aims to demonstrate the potential role of a South African sorghum and cowpea CWR in plant breeding using predictive characterization.

Materials and Methods

Predictive characterization assigns potential traits to germplasm accessions based on the ecogeographical conditions of the accessions' place of occurrence. It is predicted that South Africa will become dryer and warmer, therefore heat and drought tolerance will become more important in breeding programmes. The South African National Biodiversity Institute (SANBI) occurrence datasets for sorghum and cowpea were analysed with DIVA and CAPFITOGEN computer software. Specific ecogeographical parameters were used to produce an ecogeographical land characterization (ELC map), and the occurrence data was then matched to areas where drought and heat tolerance could have evolved based on the areas' specific ecogeography.

Results and Discussion

SANBI identified, compiled and provided 331 occurrence data records for sorghum CWR and 661 records for cowpea CWR. Fourty-six sorghum accessions and 29 cowpea accessions were selected. These CWR grow in areas that are more arid and warmer than the optimal conditions for cowpea and sorghum.

Conclusions

A set of wild relatives of sorghum and cowpea populations that grow in more marginal areas that have a high likelihood of containing drought and heat tolerance traits that can be exploited in pre-breeding programmes for increased drought and heat tolerance, has been identified

References

Keywords

Breeding, Crop wild relatives, Cowpea, Predictive characterization, Sorghum

Heterosis studies for yield in South African experimental popcorn hybrids under fungicide spray and non-spray conditions.

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Introduction

Globally, popcorn (Zea mays var everta) is specialty maize of economic significance. However, in South Africa, there are limited commercial hybrids that are available for commercial production. A study was undertaken to develop locally adapted popcorn hybrids for commercial production. The value of the hybrids lies on its improvement in performance over its parent inbred lines and currently grown commercial hybrids. A study was therefore conducted to determine value for cultivation of the new experimental popcorn hybrids.

Materials and Methods

Fifty-one experimental hybrids and a commercial control hybrid P618 were planted at three research stations (Cedara, Ukulinga and Dundee), in KwaZulu-Natal during 2015/16 summer, alongside their 20 inbred line parents. Hybrid trials were laid out as 4 x 13 α-lattice design, with two replications at each site, while parents' trials were laid out as a randomised complete block design (RCBD) with two replications. Cultural practices applicable to maize were followed under rain-fed conditions with supplementary irrigation. The hybrids were grown under both fungicide spray and non-spray conditions. A basal compound fertilizer 2:3:4 (NPK) was applied at 200 kg ha-1. The crop was top-dressed with lime ammonium nitrate (LAN, 28% N) at 200 kg ha-1 at four weeks after emergence. Grain yield data was collected and analysed using CROPSTAT statistical package. Standard heterosis was determined relative to the commercial hybrid and the inbred line parents.

Results and Discussion

The study indicated that yield of popcorn can be improved significantly by applying a fungicide spray. The results showed that sprayed hybrids had higher yield than the non-sprayed, ranging from 25% at Dundee, 32% at Ukulinga and 62% at Cedara. The trend is consistent with disease levels that were observed at the sites. The disease pressure was highest at Cedara and least at Dundee. Hybrids displayed high heterosis exceeding 300% over their inbred parents under sprayed conditions. At least 15 hybrids were superior to the commercial hybrid. These have value for cultivation and would be recommended to farmers in South Africa.

Conclusions

The hybrids that exhibited high value for cultivation would be extensively tested and recommended for commercial production.

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Keywords

Heterosis, hybrid, maize inbreds, popcorn

AN IRRIGATION CONTROL SYSTEM WITH A WEB-BASED INTERFACE FOR THE MANAGEMENT OF EUCALYPTUS SEEDLINGS IN A NURSERY

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Introduction

INTRODUCTION Commercial forestry nursery managers currently use a timer-based system to irrigate their planting stock. However, this method does not always result in efficient scheduling of irrigation due to over-irrigation leading to water wastage, leaching of nutrients and an environment prone to pests and diseases. Thus, an automatic measurement and control irrigation system using soil water content sensors may be a more suitable alternative. In this study, the effectiveness of an automated irrigation system was investigated in an air temperature controlled greenhouse.

Materials and Methods

MATERIAL AND METHODS Decagon EC-5 (Pullman, USA) dielectric soil water content sensors were laboratory-calibrated against the gravimetric method using a coir/pine-bark/vermiculite media mix. A factory supplied calibration equation was compared to the laboratory determined equation. Using containers with Eucalyptus dunnii seedlings to test the methodology, a datalogger was programmed to control irrigation for low, medium and high watering treatments using lower and drained-upper soil water content limits. A solenoid valve was automatically switched on or off based on the measured media water content. The measured near real-time data were displayed using an open web-based system. The data could be viewed or downloaded using the internet or a web-enabled cellphone.

Results and Discussion

RESULTS AND DISCUSSION The Decagon EC-5 sensors were successfully calibrated using the growing media, and provided a better estimation of media water content than the manufacturer-supplied calibration equation. The automated irrigation system was effective at controlling growing media water content for Eucalyptus dunnii seedlings. As expected, the high watering treatment seedlings had the highest growth rates, although this treatment also had increased leaching of nutrients from the media. In contrast, the low watering treatment seedlings showed the lowest growth rates, but these seedlings were more robust and resistant to water stress.

Conclusions

CONCLUSIONS This study showed that the automated irrigation system, based on measurements of media water content, can be used with success in scheduling irrigation for Eucalyptus seedlings. Such system can be adapted for use with other nursery propagation material and media, with potential savings in water usage.

References

ACKNOWLEDGEMENTS The ICFR stakeholders are thanked for their funding support. The UKZN Teaching and Learning Office funded the web-based system. Assistance from ICFR staff Dr L. Titshall, Dr S. Dovey, Mr I Gordon, Mr E. Ngubo and Ms Bezuidenhout is gratefully acknowledged. Mr. B Pollard of Sunshine Seedlings is thanked for providing seedlings.

Keywords

KEYWORDS: Media, Microclimate control, near-real time, sensor

SOIL QUALITY INDICATORS AND THEIR SPATIAL VARIABILITY ON A CONTINUOUSLY CULTIVATED FIELD AT THE RESEARCH SITE OF THE UNIVERSITY OF LIMPOPO EXPERIMENTAL FARM

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Introduction

Studies of soil quality in relation to continuous cultivation are necessary as they reveal soil functioning within the ecosystem for sustainable management of land resources. Studies have documented that soil properties vary across farm fields, causing spatial variability in crop yields (Rockstrom et al., 1999; Gaston et al., 2001). This investigation was conducted to assess the spatial distribution of soil quality indicators on a continuously cultivated field of a student research block at the Unversity of Limpopo Experimental Farm.

Materials and Methods

Equal grids of 50 m X 50 m were created in a cultivated field. Prior to sampling surface, hardness was measured on field. A soil sample was collected from each grid at two depths of 0 – 20 cm and 20 – 40 cm. Samples were analysed for clay content, aggregate stability, water content, soil pH, electrical conductivity, phosphorus content an organic carbon. Spatial distribution maps for soil quality indicators were then produced using ArcGIS software 10.3.

Results and Discussion

Results revealed spatial variability on all most all measured soil quality indicators except for surface hardness. Values of clay content for the top soil had a range of 12 to 48% in the different grids which is a good indication of variability within field. However moisture content was low showing a highest amount of 2.54 %. Soil phosphorus was relatively high which might be due to constant addition of fertilizers on the field.

Conclusions

The measured soil quality indicators were spatially distributed in the field. This will assist with site specific management strategies for the indicators that need attention. The results further showed that the field could be capable of sustaining crop production.

References

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Keywords

Continuous cultivation, spatial distribution, site- specific management strategies.

SPATIAL AND VERTICAL DISTRIBUTION OF SELECTED PHYSICO-CHEMICAL PROPERTIES IN TREATED WASTE-WATER-IRRIGATED FIELDS

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Introduction

Due to increased drought incidents, the availability of high quality water for irrigation in South Africa is becoming increasingly scarce. Water re-use has received acceptable attention as a water conservation practice in agriculture. However, the impact of waste-water on physico-chemical properties in soils subjected to different management styles is not documented. The objective of this study was to determine the distribution of selected physico-chemical properties in soils of different management systems.

Materials and Methods

Four 15 ha fields were identified, namely, cultivated field (CF) in its second year of cultivation and irrigated with treated waste-water; fallowed field (FF) in its fifth year of fallowing after three year irrigation with treated waste-water; virgin field (VF) which was never cultivated nor irrigated with treated waste-water and research block (RB) which is used for student research and is irrigated using borehole water. Equal grids of 100 m × 100 m were created in all fields and a soil profile were opened to 100 cm depth in each grid. About 1 L soil samples were collected from five depths. Samples were analysed for clay content, moisture content, pH, electrical conductivity, organic carbon and phosphorus.

Results and Discussion

Results showed that all variables were significantly different among all fields with organic carbon (OC) showing high differences between VF and CF. The differences might be due to weak soil structure in CV (Rasmussen and Collins, 1991). Significant increases in OC were observed in FF soil depth, where OC increased with soil depth. The two fields also had different soil pH and electrical conductivity. Phosphorus content was significantly affected by the nature of field and soil depth.

Conclusions

Cultivation and irrigation with treated waste-water affected the selected physico-chemical variables as revealed in CF and FF. Management styles either increased or decreased the physic-chemical properties of the soil, with the effects being ameliorated through fallowing of the waste-water treated fields.

References

Rasmussen, P.E. and H.P. Collins. 1991. Long-term impacts of tillage, fertilizer, and crop residue on soil organic matter in temperate semiarid regions. Advances in Agronomy 45:93–134.

Keywords

Water reuse, vertical distribution, amelioration, fallowing

Selection of osmotolerant and effective rhizobial strains on symbiotic nitrogen fixation efficiency in soybean under water deficit stress

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Introduction

Symbiotic nitrogen fixation (SNF) is severely affected by water deficit. In soybean this interaction is short-lived leading to the elimination of the rhizobial partner and a reduction in SNF and yield. Understanding the contribution of an osmotolerant rhizobial partner to this process could enable manipulation of this process to prolong active SNF, improving yields and turnover for the farmer during water deficit stress.

Materials and Methods

To confirm identity of the strains 16S rDNa PCR amplification and sequencing analysis was conducted. Salt tolerance of the different strains was assessed in yeast extract mannitol (YEM) broth supplemented with different concentrations of sodium chloride ranging from 0.5%-3%. All strains were tested for drought tolerance at different drought levels simulated by PEG6000 in YEM. The correlation between the in-vitro osmotolerance of rhizobia and symbiotic effectiveness under water deficit is currently being investigated. Soybean plants were grown in vermiculite growth medium under greenhouse conditions. The plants were stressed using two water deficit regimes; 30%, and 60% VWC respectively and inoculated with different strains. The effect that water deficit and contribution of the rhizobial partner has on the growth and development of the plants will be investigated by weighing fresh and dry mass of all the plants organs including root nodules. The water potential of both leaves and nodules will be measured using a pressure bomb and pshycrometer respectively. The nitrogenase activity will be measured using the acetylene reductase assay. Furthermore, RNA will be extracted to compare gene expression under water deficit inoculated with strains of differing osmotolerance.

Results and Discussion

A 1450 bp PCR product was amplified from all strains. The decrease in water potential resulted in growth reduction of all tested strains and differences to osmotic stress were obtained among the strains. The B.japonicum WB74-1 strain was less tolerant to salt and did not grow in salt concentrations higher than 0.6% NaCl (100mM). Strain SMH12 was however able to withstand salt concentrations of 0.5M NaCl. The growth of strain SMH12 was least affected by PEG and showed to be the most osmotolerant strain.

Conclusions

These results will be further used in investigation of osmotic stress tolerance of S.freddi and impact on drought reduction in symbiosis with soybean. The selection of efficient strains among osmo-tolerant strains may contribute to the formulation of inoculants for arid regions.

References

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Keywords

Nodule, Soybean, water deficit, osmotolerance

INTRODUCTION OF OYSTER MUSHROOM FARMING TO POTENTIAL GROWERS IN SOUTH AFRICA

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Introduction

The demand to grow oyster mushrooms is growing steadily. This is mainly due to a documentary recently shown on National Television's Channel SABC2 during which emerging farmers were encouraged to venture into mushroom cultivation. To date more than a 200 requests for training were received. Currently, the City of Johannesburg (CoJ) as part of their Blue Economy Programme, plans to construct 100 mushroom production units within the city's boundaries.

Materials and Methods

A new participatory approach was followed over a three-day or five-day period. In 2015, learners from five Provinces in South Africa were selected for training and 16 officials from the CoJ responsible for the implementation of the programme received training using the new course layout.

Results and Discussion

Theory and practical sessions were alternated. Learners were introduced to mushrooms in general with a tasting session. Both small-scale and large-scale oyster mushroom production farms and techniques were discussed, with great emphasis on the use of quality spawn and general hygiene. Other aspects that were dealt with were potential substrates and substrate preparation, mushroom growth room structures as well as atmospheric control within these. Pests and diseases and the prevention thereof were discussed in detail. Farm management, food health and safety, and nutrition and health were addressed. Packaging options and the drying of mushrooms were demonstrated. Different legislations regarding finance, labour and environment, and different farm certification schemes were mentioned. A baseline study is conducted so that progress of active growers can be monitored after implementing these technologies. During this session, learners also have to draw village/area maps to familiarise themselves with their distances from substrate sources, spawn producers and potential markets. An introduction towards starting your own business which addressed recordkeeping, buying basics, costing, stock control, marketing and business planning were put into practice. As assignment the potential farmers were asked to start preparing a business plan which will enable them to source start-up financial support. The new course in oyster mushroom farming was well received by learners.

Conclusions

The course was well received and the learners appreciated that questions and participation were encouraged and they felt strongly that the training would aid them in future ventures. As part of mentorship an email group was formed and a newsletter established to encourage two-way communication between these potential farmers and principal mentors, and to keep them up-to-date with relevant information needed to develop their own farms.

References

Keywords

farm management, oyster mushrooms, training

EFFECT OF TIME, TILLAGE AND CROPPING SYSTEMS ON GLOMALIN PRODUCTION BY ARBUSCULAR MYCORRHIZA IN WESTERN CAPE SOILS

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Introduction

Arbuscular mycorrizal fungi play a major role in stabilizing soil through improved soil aggregation. Both the hyphae and a glycoprotein named glomalin, which is excreted, play a major role in stabilizing soil and building the carbon load. In this study the effects of tillage and cropping systems over time on easily extractable glomalin (EEG) were determined.

Materials and Methods

A long-term tillage/crop rotation trial was started in 2007 at Langgewens near Moorreesburg and Tygerhoek near Riviersonderend Research Farms of the Western Cape Department of Agriculture. Three crop rotations consisting of wheat monoculture, wheat-canola-wheat-lupin (four sequences) and wheat-medic-wheat-medic (two sequences) systems were included. Tillage treatments were: Zero tillage (ZT) soil left undisturbed and planted with a star-wheel/disc planter, no-till (NT) soil left undisturbed until planting and then planted with a tined planter, minimum–till (MT) soil scarified to a depth of 100mm to 150mm in March/April and conventional-till (CT) soil scarified in March/April, then ploughed before planting, and planted with the no-till planter. Five sub-samples to a depth of 150 mm per treatment combination were collected mid-season from 2012 until 2015. Sub-samples of 250 g of soil were collected from the main sample for glomalin extraction and quantification. EEG was extracted from soil using a modified method as described by Janos in 2008 and the EEG concentration (mg EEG/g soil), was determined according to the Bradford assay with bovine serum albumin as standard and water as control. The values for the standard readings were calculated and plotted against their concentration using a scatter graph with linear regression values.

Results and Discussion

Over the study period, zero tillage treatments at Langgewens and Tygerhoek performed better than other tillage treatments regarding the EEG levels. At Langgewens the wheat-medic-wheat-medic systems outperformed the other cropping systems. At Tygerhoek the zero-tillage: Wheat-canola-lupin-wheat treatments performed the best although canola and lupins are considered non-mycorrhizal. On average higher concentrations of EEG were extracted from Tygerhoek than Langgewens. The EEG levels varied seasonally but increased over time.

Conclusions

These variable results need to be compared to soil analyses data to identify the driving factors in these trials. Notable is that overall, the EEG concentrations at both localities increased over time. It is suggested that a more in-depth study be conducted that also include spore counts and root colonization.

References

Keywords

crop rotation, easily extractable glomalin, mycorrhiza, soil tillage, time

POTENTIAL OF THE COSMIC RAY NEUTRON PROBE AS AN IRRIGATION MANAGEMENT TOOL FOR POTATOES

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Introduction

Potato growers in South Africa are recently experiencing steep increases in water and electricity costs. Effective irrigation management can help save irrigation water and energy. Irrigation scheduling tools such as capacitance probes have become quite popular, user friendly and convenient to use. However, these point measurement tools may not account for spatial variability in the field and result in false readings. The Cosmic Ray Neutron Probe (CRP) is an alternative instrument that can measure soil water content (SWC) of fairly large areas (about 30 ha). However, our previous work has shown that some calibration issues still remain and therefore further assessment of the usefulness of the CRP as an irrigation scheduling tool was needed. Our first objective was to improve calibration of the CRP in an effort to improve its accuracy to measure soil water content. Secondly, we aimed to assess the usefulness of the CRP as potential new irrigation scheduling tool.

Materials and Methods

Two potato centre pivot fields in Limpopo were monitored during the 2015/16 growing seasons. The possibility of improving CRP calibration by the inclusion of all water sources, including plant biomass water, was investigated. Biomass samplings were conducted several times during the growing season on each field. Crop biomass development over time was estimated by fitting an equation to the observed data points. Biomass water at any point throughout the season was thus inferred and included in the calibration procedure. The CRP data were compared with hourly data collected from eight Echo capacitance probe (ECP) monitoring stations randomly installed across the field.

Results and Discussion

CRP accuracy was improved by the inclusion of plant biomass water in the calibration procedure. The two measurement methods followed similar SWC trends over the growing season. However, some uncertainties still remained. After varying the CRP measurement depth throughout the season, CRP estimations of SWC data displayed a better correlation with the ECP SWC data.

Conclusions

Inclusion of plant biomass water in the CRP calibration procedure and the variation of the CRP measurement depth greatly improved its accuracy to measure SWC. However, the CRP’s shallow measurement depth is of concern. The usefulness of the CRP as an irrigation scheduling is still uncertain and the combined use of the CRP and a simulation model to infer the SWC of deeper layers in the soil is being investigated.

References

Keywords

INFLUENCE OF DEGREE OF SOIL DISTURBANCE ON CROP PRODUCTIVITY, YIELD AND QUALITY OF WHEAT AND CANOLA WITHIN CROPPING SYSTEMS IN THE WESTERN CAPE

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Introduction

One of the principles of conservation agriculture is to minimise soil disturbance to the absolute minimum to ensure good seed-soil contact and early seedling development. The effect of soil disturbance may however differ between crops as well as localities. The aim of this presentation is to evaluate the effect of degree of soil disturbance within different cropping systems on crop performance in the grain producing areas of the Western Cape.

Materials and Methods

Long-term trials were initiated in 2007 at the Langgewens (Moorreesburg, Swartland) and Tygerhoek (Riviersonderend, Rûens) Research Farms to evaluate the effect of soil disturbance and crop rotation in combination with maximum stubble retention on soil quality and crop performance. Three crop rotations namely: continuous wheat (WWWW), medic-clover/wheat/medic-clover/wheat (McWMcW) and lupin/wheat/canola/wheat (LWCW) were allocated to main plots and replicated four times. 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. In this presentation, the effect of degree of soil disturbance within the three cropping systems on crop productivity, yield and quality during the 2015 growing season will be covered.

Results and Discussion

At Langgewens zero-till resulted in higher (P=0.05) wheat grain yields (2557 kg ha-1) compared to no- (2076 kg ha-1), minimum- (2035 kg ha-1) and conventional-till (2085 kg ha-1). Wheat grain yields at Tygerhoek were not influenced by the tillage treatments included in the study. Zero-till at Tygerhoek resulted in significantly the lowest canola yields. Degree of soil disturbance did not influence canola yields at Langgewens. At both Langgewens and Tygerhoek wheat grain protein content was lower (P=0.05) in zero-till compared to the other tillage treatments. Canola oil content was not influenced by tillage at Tygerhoek, however at Langgewens zero-till resulted in significantly the highest oil content.

Conclusions

Excluding zero-till at Langgewens, results from the 2015 growing season shows that degree of soil disturbance did not influence wheat grain production. The effect of degree of soil disturbance on grain protein is negligible as grading will not be influenced. Canola tends to respond positively to soil disturbance.

References

Keywords

canola, canola oil, wheat, wheat protein

EVALUATING DIVERSITY AMONG SOUTH AFRICAN SWEETPOTATO GENOTYPES USING MORPHOLOGICAL AND SIMPLE SEQUENCE REPEAT MARKERS

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Introduction

In order to breed for sweetpotato varieties with higher nutritional content, knowledge on the extent of protein content, flowering ability, and genetic relatedness of the sweetpotato genotypes within the germplasm collection is a pre-requisite. The aims of the current study were: 1) to assess the genetic diversity present among sweetpotato collections using protein profiles, agronomic traits and simple sequence repeat markers; and 2) to select genetically complementary parents from different heterotic groups for breeding.

Materials and Methods

A trial was conducted involving 73 genotypes selected from the Agricultural Research Council-Vegetable and Ornamental Plants' sweetpotato germplasm collections using a randomized complete block design with two replicates. Data on phenotypic traits, β-carotene and protein content were collected using 45 descriptors (CIP, AVRDC, IPBGR, 1991). Thirty sweetpotato parental genotypes, selected based on their flowering ability and heterotic patterns, were fingerprinted using 10 simple sequence repeat markers (Hu, et al., 2004). Analysis of variance and multivariate cluster analysis were performed using GenStat version1.2 and XLSTAT, respectively.

Results and Discussion

Significant ($P<0.001$) differences were found among the genotypes for root protein content, dry matter content and β-carotene content. The storage root yield of genotypes varied from 0 to 4.11 kg/plant. Principal component analysis involving 45 morphological traits suggested that 17 traits were important and main contributors in the grouping of the genotypes. The tested genotypes were grouped into three major clusters. Of the 73 genotypes assessed, 5% flowered abundantly and 15% had an intermediate flowering rate. The dendrogram based on the tested SSR markers allocated the genotypes into two heterotic groups aligned to the geographical origin of collection. Overall, the analyses enabled selection of 24 parental sweetpotato genotypes (in two heterotic groups) with flowering ability and possessing complementary agronomic traits with high, intermediate and low protein levels for further crosses.

Conclusions

High variability was detected among test genotypes for protein, dry matter and β-carotene contents of storage roots, showing that there is great potential for genetic improvement. Flowering ability is one of the key traits to be considered in the selection of suitable sweetpotato breeding parents. Morphological and molecular markers are complementary tools to establish heterotic groups useful in sweetpotato breeding to exploit heterosis.

References

CIP, AVRDC, IPBGR. 1991. Descriptors for sweetpotato. Huamán, Z., Editor. International Board for Plant Genetics Resources, Rome, Italy. HU, J., NAKATANI, M., LALUSIN, A. G. AND FUJIMURA, T. 2004. New microsatellite markers developed from reported Ipomoea trifida sequences and their application to sweetpotato and its related wild species. Scientia Horticulturae, 102, 375-386.

Keywords

flowering ability, heterotic groups, simple sequence repeat markers, morphology, protein content, sweetpotato

EVALUATION OF PROGENIES OF DIALLEL CROSSES BETWEEN ORANGE-FLESHED AND CREAM-FLESHED SWEETPOTATO: HAS PROGRESS BEEN MADE?

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Introduction

Sweetpotato roots combine high edible energy and micronutrients making them ideal as a food security crop in developing countries. In South Africa, the Agricultural Research Council–Vegetable and Ornamental Plants (ARC-VOP) is involved in the breeding of sweetpotato, mainly for increased root yield and higher beta-carotene content. The objective of this study was to evaluate the progenies from diallel crosses between three orange-fleshed and two cream-fleshed cultivars in two distinct environments.

Materials and Methods

Five F1 progenies of each of the 25 families were evaluated in two environments (Roodeplaat and Empangeni) over two seasons alongside the parents in a randomized complete block design with three replicates. Data on marketable and unmarketable fresh root yield and number of roots were collected. Root β-carotene content (RBCC) was estimated using a colour chart (Burgos et al. 2009). The means per family were calculated and used to perform analysis of variance and determine the genotype by environment interaction using GGE Biplot using SAS 9.4. Means of individual progenies were also calculated towards selection of useful genotypes for the traits of interest.

Results and Discussion

Significant differences ($P<0.001$) in marketable fresh root yield (MFRY) and total fresh root yield (TFRY) were found for year (Y), locality (L), genotype (G) and the various interactions. RBCC was significant ($P<0.001$) for all factors, except Y*L*G and L. TFRY of progenies ranged from 0.24 to 1.03kg/plant, and RBCC from 0.05 to 7.939 mg/100g. Significantly higher root yield was produced by cream-fleshed parents Ndou and Monate than any of the other families. The genotype comparison biplot indicated the families Ndou x W-119, Khano x Ndou and Resisto x Ndou as ideal for RBCC. However, none of those corresponded with high yielding families MonatexW-119, Monate x Ndou, W-119 x Khano and Khano x Ndou. Progenies of Resisto, Khano and W-119 had the highest RBCC, but shown to have poor general combining ability for root yield (Naidoo et al., 2016). The best selected individual progenies for TFRY and RBCC were W-119 x Khano(4), Resisto x Khano(4), Khano x Ndou(1) and W-119 x Ndou(1).

Conclusions

The approach was moderately successful to realise lines with both high TFRY and RBCC. A small number of progenies with a combination of the traits of interest were selected. The findings contribute to informed selection of parental and hybrid lines to be used in future sweetpotato breeding.

References

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Keywords

β-carotene, cluster analysis, gge biplot, sweetpotato, yield

TESTING THE EFFECT OF AFRIKELP ORGANIC ABIOTIC STRESS PRODUCT ON THE GROWTH AND PRODUCTION OF SWISS CHARD UNDER FIELD CONDITIONS

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Introduction

Swiss chard is a popular leafy vegetable grown by communities and commercial farmers in South Africa. One of the biggest challenges that the farmer faces in the production of Swiss chard, is input costs i.e. fertilizer. The ARC was approached by Afrikelp (PTY) LTD to test the effect of Afrikelp® LG-1 under field conditions with regulated irrigation on the production of Swiss chard. Afrikelp® LG-1 is an extract from seaweed which, after purification, contains a large number of auxins and cytokinins. Auxins and cytokinins are natural growth regulators that exist in all plants and aid in the development of the shoots and roots of the plants.

Materials and Methods

Swiss chard seeds were treated with different concentrations (2,4 or 6 ml/100g seed) of Afrikelp® LG-1 and allowed to germinate in the seedbed. Seedlings were then planted according to standard practice in the field and irrigated using drip irrigation. For selected plants field treatments included soil (15 litre/ha) and foliar (3 litre/ha) application of Afrikelp LG®-1 and control (not treated). Plant chlorophyll, plant height and the wet/dry mass of plant leaves were recorded every two weeks. After the final harvest the root length of each plant was measured.

Results and Discussion

Significant increase in chlorophyll content were observed over time in both the treated and untreated plants. No discrimination was observed between control and treated plants that indicated that the Afrikelp® LG-1 had any extraordinary effect on the foliar development. The treatment with Afrikelp® LG-1 had a significant effect on the plant height especially between the different application events, where the biggest difference observed was between the first and second application event. No significant differences could be observed between the control and treated plants over time with regard to root length although significant differences were observed over time for plant height. For the different seed treatments of Afrikelp® LG-1, significant differences were observed in dry mass. Although Afrikelp® LG-1 contains concnetrations of auxins that aids the development of roots, no significant differences in root length were observed between the treatments in Swiss chard under this trial conditions.

Conclusions

Although some differences were observed it was clear in the experiment that the Afrikelp® LG-1 treatment did show the desired effect on Swiss chard treated plants and seeds. It is recommended that such treatments should be tested on other common planted vegetables to verify these results or indicate clear advantages of using such a product.

References

Keywords

Afrikelp® LG-1, cytokinins, Swiss chard

Comparing different water footprint methodologies

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Introduction

Several water footprint (WF) methodologies have been proposed aiming to improve water resource management and create consumer awareness. The methodologies differ notably in terms of their approaches and results. This study aimed to better understand the usefulness of the information that these different methodologies provide.

Materials and Methods

WFs for carrots, cabbage, beetroot, broccoli and lettuce produced on the Steenkoppies Aquifer were calculated according to the Water Footprint Network (WFN) (Hoekstra et al., 2011), the hydrological (Deurer et al., 2011) and the LCA (Pfister et al., 2009) methodologies. The outcomes were assessed to determine whether they can improve water management or successfully be used to create awareness. The knowledge hierarchy, which distinguishes between data, information, knowledge and wisdom (Rowley, 2007), was used to better understand the usefulness of the WFs determined according to each method.

Results and Discussion

According to the knowledge hierarchy, volumetric WFs according to the WFN approach can be classified as data, because they are not informative unless interpreted within the local environmental context. The hydrological and LCA methodologies aim to interpret volumetric WFs in the environmental context to provide information that will guide consumers to make wise decisions on their water use. These methodologies attempts to model the vast number of complexities associated with the systems in which the water is used. Considering the complexity of ecological, social and economic systems that are affected by water use and the trade-offs that are often required in decision making, it is unlikely that an undisputable number can be calculated to inform consumers to make wise decisions about their water use. This is supported by concepts from the knowledge hierarchy, which indicate data can be programmed, but wisdom cannot be programmed (Rowley, 2007).

Conclusions

This study on WFs has indicated that the WFN is the most useful, because it is quantitative and can be used in different information systems. However, the WFs according to the WFN cannot be used as labels for consumer awareness raising. Consumers need all levels of the knowledge hierarchy (data, information, knowledge and wisdom) to make educated decisions about the products they buy.

References

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Keywords

Water Footprint Network, Life Cycle Assessment, Hydrology, Knowledge hierarchy. We would like to acknowledge the WRC and the NRF for funding this project and for general guidance from the WRC.

Mean concentration stimulation point of Nemarioc-AL phytonematicide for cucurbita pepo under microplot conditions

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Introduction

Alternatives to methyl bromide, used in the management of root-knot (*Meloidogyne* species) nematodes in squash (*Cucurbita pepo*) comprise, amongst others, phytonematicides. However, these products as allelochemicals are potentially phytotoxic and non-phytotoxic concentrations, referred to as the Mean Concentration Stimulation Point (MCSP) value, have to be empirically-developed for each plant species. The MCSP values will be the concentration to be used at every irrigation, which will in future be required to determine the irrigation interval and the dosage model (Mashela et al., 2015) of the phytonematicide in squash production. The objective of this study was to determine the MCSP value of Nemarioc-AL phytonematicide for squash under microplot conditions.

Materials and Methods

A pot trial was established under microplot conditions by planting seeds of *C. pepo* 'caserta' directly in 20-cm-diameter pots. Each pot was filled with steam-pasteurised loam and sand, mixed with Hygromix-T at 2:1:1 (v/v) ratio. The treatments, namely, 0.0, 0.8, 1.6, 3.2, 6.4 and 12.8% Nemarioc-AL phytonematicide were arranged in a randomised complete block design, with 10 replicates. Seedlings were each inoculated with 5000 *M. incognita* eggs and second-stage juveniles (J2) and irrigated with 250 mL chlorine-free tapwater. At 56 days after applying the treatments, plant and nematode variables were collected, fruits and shoots were dried, weighed and subjected to analysis of variance using Statistix software. Significant plant variables were further subjected to the CARD model.

Results and Discussion

Nemarioc-AL phytonematicides had highly significant effects on dry shoot mass and dry fruit mass, contributing 15 and 63 % in total treatment variation (TTV) of the two respective variables. Dry shoot mass and dry fruit mass both exhibited a quadratic relationship with concentration of the phytonematicide. The model explained the relationship by 73 and 91% in dry fruit mass and dry shoot mass respectively. Concentrations for optimum dry shoot mass and dry fruit mass were 44.36 and 3.59 respectively using the relation $x = Xz = -b1/2b2$. Using the relation MCSP = Dm + (Rh/2), MCSP was equal to 11.85 % for Nemarioc-AL phytonematicide on butternut squash. Dry shoot mass had k value of zero and dry fruit mass had k value of zero, with the overall sensitivity ($\sum k$) of squash being equivalent to zero.

Conclusions

In conclusion, the MCSP value of Nemarioc-AL phytonematicide on *C. pepo* was rather high and the study should be validated.

References

Mashela, P.W., Dube, Z.P. and K.M. Pofu (2015). Phytotoxicity of soil-amended phytonematicides and related inconsistent results on nematodes suppression. In Meghvansi, M.K. and A. Vorma (eds.). Organic amendments and soil suppressiveness. Springer International Publishers.

Keywords

Cucumis mariocarpus, root-knot nematodes, nematode management, organic amendments.

RESPONSES OF CUCURBITA PEPO CULTIVAR ‘CASERTA’ TO NEMARIOC-AL PHYTONEMATICIDE

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Introduction

Butternut squash (*Cucurbita pepo*) is highly susceptible to the root-knot (*Meloidogyne* species) nematodes and, therefore, nematode population densities should be managed for the economic production of this cultigen. The available Nemarioc-AL phytonematicide requires a specific concentration for use on each cultigen, which has been referred to as the Mean Concentration Stimulation Point (MCSP). The MCSP is empirically-developed for each cultigen using the Curve-fitting Allelochemical Response Dosage (CARD) computer-based model. The objective of this study was to develop the MCSP value of Nemarioc-AL phytonematicide for *C. pepo*.

Materials and Methods

Seeds of cv. ‘Caserta’ were sown in 25-cm-diameter pots filled with pasteurised sand and loam at 3:1 (v/v). After seedling emergence, each was inoculated with 5000 eggs and second-stage juveniles (J2) of *M. incognita*. Treatments, comprising 0.0, 0.8, 1.6, 3.2, 6.4 and 12.8 % Nemarioc-AL phytonematicide, were arranged in a randomised complete block design, with 10 replicates. Plants were fertilised with 3 g 2:2:2 (43) Multifeed and irrigated every other day with 250 ml water. At 56 days after inoculation, plant and nematode variables were subjected to analysis of variance, with the significant means subjected to the CARD model to generate the biological indices for MCSP.

Results and Discussion

Dry shoot mass and dry fruit mass, each plotted against concentrations of the phytonematicide, exhibited a quadratic relationship. The ANOVA model explained 73% and 91% of the relationship between phytonematicicde concentration and dry fruit mass and dry shoot mass, respectively. Using the relationship biological indices from the CARD model MCSP was 11.85 %, which was relatively high when compared with that of other crops (Mashela et al., 2015). Also, the overall sensitivity (∑k) of squash to the phytonematicides was zero, which depicted a high susceptibility level.

Conclusions

Cucurbita pepo appears to be relatively sensitive to the Nemarioc-AL phytonematicide and additional studies would be necessary to determine the MCSP under controlled conditions.

References

Mashela, P.W., Dube, Z.P. and K.M. Pofu 2015. Phytotoxicity of soil-amended phytonematicides and related inconsistent results on nematodes suppression. In Meghvansi, M.K. and A. Vorma (eds.). Organic amendments and soil suppressiveness. Springer International Publishers

Keywords

Cucumis myriocarpus, root-knot nematodes, nematode management, organic amendments.

SCREENING OF TWELVE SWEET POTATO CULTIVARS USED IN BIOFORTIFICATION PROGRAMME AGAINST MELOIDOGYNE SPECIES

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Introduction

Biofortified sweet potato (*Ipomoea batatas*) cultivars contain a considerable amount of nutrients required to counter malnutrition. The degree of nematode resistance in most sweet potato cultivars with promising nutrient levels is not documented. The objective of this study was to investigate the host-status of sweet potato cultivars to *Meloidogyne javanica* under greenhouse conditions.

Materials and Methods

Cuttings of cultivars ‘Letlhabula’, ‘Monate’, ‘Blesblok’, ‘Ndou’, ‘W119’, ‘199062.1’, ‘Ribbok’, ‘Bophelo’, ‘Bosbok’, ‘Mvuvhelo’, ‘Impilo’ and ‘Beauregard’ were raised in 25-cm diameter pots containing pasteurised loam and sandy soil at 3:1 (v/v). The 12 cultivars, as treatments, were arranged in a randomised complete block design, with six replications. Pots were placed on greenhouse benches at 30 cm intra-row and 25 cm inter-row spacings. Two weeks after planting, each cutting was inoculated with 6000 eggs and second-stage-juveniles (J2), fertilised with 2.2 g N, 0.9 g P and 1.9 g K using 2:3:2 (26) NPK fertiliser. Irrigation was accomplished using 250 ml water/plant every other day.

Results and Discussion

At 56 days after inoculation, the reproductive potential (RP) of *M. javanica* was greater than one in all cultivars except for ‘Bosbok’ and ‘Mvuvhelo’, where RP was equal to zero. Zero RP values suggested non-host status, whereas RP values above one suggested good host status. Therefore, ‘Bosbok’ and ‘Mvuvhelo’ were not hosts to *M. javanica*, whereas all other tested cultivars were. The existence of resistance in some sweet potato cultivars in this study agrees with the finding of nematode-resistant genotypes against *Meloidogyne* species observed in other countries (Carvantes-Flores *et al*., 2002). Reproduction potential is considered a reliable tool suitable for screening to provide preliminary observations on host-status. However, it cannot be used to make inferences on the degree of nematode resistance since it does not provide information on host-sensitivity.

Conclusions

Cultivars ‘Bosbok’ and ‘Mvuvhelo’ were non-hosts to *M. javanica*, whereas all other tested cultivars were hosts. Therefore, there is some nematode resistance potential in South African sweet potato cultivars. However, it is still necessary to establish the host-sensitivity of the two resistant cultivars to *M. javanica*.

References

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Keywords

Nematode reproduction, host status, sweet potato

COMPARATIVE PERFORMANCE OF RED SWEET PEPPER CULTIVARS GROWN IN A SHADENET STRUCTURE VS TEMPERATURE CONTROLLED PLASTIC TUNNEL

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Introduction

Incorrect selection of cultivar leads to profit loss due to variability in yield and quality characteristics of red sweet peppers. Growing environment can influence the yield, overall quality and bio-active compounds of peppers at harvest and after post-harvest storage. The study was aimed at evaluating the performance of red sweet pepper cultivars grown in a shade-net structure vs temperature controlled plastic tunnel in terms of yield and quality.

Materials and Methods

The study was conducted in a 40% black & white shade-net structure and temperature control plastic tunnel (TC) at the Agricultural Research Council-Vegetable and Ornamental Plants (ARC-VOP), Roodeplaat during October to May 2016. The TC was equipped with a pad and fan cooling system. The plantlets were transplanted 35 days after seeding, using 10 L plastic bags filled with sawdust as growing medium. The type of hydroponic system used was the standard open bag system. For each production structure, eleven red sweet pepper cultivars (Clair, Double-up, King Arthur, Maranello, Marletta, Nemalite, Rhemus, Selene, Star6657, Tamarin and Telmo) were laid-out in a randomised complete block design with three replicates. Data were subject to analysis of variance using the statistical program GenStat® version 11.1.

Results and Discussion

The highest total and marketable yield were obtained with cultivar Marletta, although not significantly different to Maranello, Tamarin, Telmo and Double-up in TC condition. Telmo, Star6657 and Nemalite produced more unmarketable yield under TC condition due to high numbers of fruits prune to blossom-end rot (BER) and wilting compared to other cultivars. There was no significant difference in unmarketable yield among all the cultivars evaluated in the shade-net. Marletta, Star6657, Maranello and Double-up obtained the highest total yield compared to other cultivars in the shade-net. The highest marketable yield was recorded with Marletta and Doubleup although Double-up did not differ significantly to Maranello under shade-net. King Arthur, Telmo, Tamarin, Nemalite, Star 6657, Clair, Rhemus and Selene showed low total and marketable yield due to high incidence of fruits exhibiting BER, wilting, deformed and sunscald under shade-net structure.

Conclusions

Results identified the highest marketable yielding cultivars as Marletta, Maranello and Double-up under shade-net while Marletta, Maranello, Tamarin and Double-up obtained the highest marketable yield in TC condition. Results emphasize the importance of cultivar selection and that high yield and quality of red sweet pepper cultivars can only be obtained by selecting the correct cultivar for shade-net and TC condition.

References

Keywords

Marketable yield, open bag hydroponic system, unmarketable yield

Protein quality versus protein quantity in South African commercial bread wheat cultivars

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Introduction

Class bread wheat in South Africa is primarily graded according to protein content, hectolitre mass and falling number with a difference of approximately ZAR250 (South African Rand) per ton separating the five grades. In a study conducted on wheat from the three major production regions of South Africa, the ability of protein quality and - quantity to predict bread-making quality was assessed.

Materials and Methods

Seed of wheat cultivars recommended for the three production regions of South Africa were obtained from the national cultivar evaluation programme of 2012 and 2013. Milled samples were analysed for grain and flour protein content, wet gluten and loaf volume. Type and concentrations of proteins were measured with SE-HPLC analyses and all the parameters were correlated with loaf volume.

Results and Discussion

Grain protein content was not the primary factor determining loaf volume, according to results from cultivars recommended for production under irrigation. These cultivars had protein levels equivalent to grade B3 but produced loaf volumes within the allowed 10% deviation of the quality standard. In irrigated wheat high loaf volume correlated positively with flour protein, wet gluten, grain protein, alveograph strength and dough strength. High loaf volume of dryland wheat of the summer rainfall region correlated positively with wet gluten, flour protein, grain protein, dough strength and alveograph strength. Dryland wheat from the winter rainfall region with high loaf volume correlated strongly with dough strength, flour protein content, wet gluten, hectolitre mass, grain protein content, peak time minutes and alveograph strength. In irrigated wheat, only small glutenin proteins correlated with low flour protein, -grain protein and -loaf volume. Low grain protein of dryland wheat from the summer rainfall region and high grain protein of dryland wheat from the winter rainfall region correlated positively with insoluble large glutenin. Both groups also correlated negatively with insoluble small glutenin and soluble- and insoluble albumin/globulin. Glutenin concentrations were highest in dryland wheat from the winter rainfall region, α/β, γ gliadin concentrations in dryland wheat from the summer rainfall region and albumin/globulin concentrations in irrigated wheat.

Conclusions

Although results from this study warrant a more detailed study it is evident that numerous variables, of which environment is the most important, influences quality of bread wheat in all three production regions.

References

Keywords

Bread-wheat, quality, protein content, protein quality environment

White root growth dynamics of bearing apple trees in Elgin

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Introduction

White root growth peaks dynamics have been quantified (Eissenstat et al., 2006), but only a few papers reported on findings in the Southern Hemisphere (Australia (Cripps, 1970)). A CID root scanner was used to quantify white root growth dynamics over three growing seasons in the Elgin area. Root dynamics showed a bimodal seasonal pattern for ‘Golden Delicious’, ‘Cripps Pink’ and ‘Fuji’ trees. The summer root growth peak agreed with existing literature, but commenced later. The summer peaks were smaller than the post-harvest peaks and agree with literature. The root growth peak in June started shortly after harvest, and continued through winter - differing from previous reports.

Materials and Methods

Commercial, bearing orchards of three apple cultivars were selected. Root activity was monitored using MR tubes and a root scanner. Acrylic butyrate tubes (1.05 m) were installed parallel to the tree row, 40 cm from the tree base at an angle of approximately 45°. Image collection was performed bi-weekly to monthly over this period. White root tips were counted manually and quantified according to date and tree phenology.

Results and Discussion

The dynamics of apple white root growth patterns of bearing trees from three different scions, on the same root stock, on contrasting soil types in the same climatic region, followed a bimodal pattern, with the first flush early summer and the second, larger flush, after harvest (autumn/winter).

Conclusions

The long autumn/winter root flush is unique and differs from existing reports. This may have implications for management due to the significant effect of root growth on the carbon balance of the tree. Other local apple producing areas with higher chilling accumulation e.g. the Ceres and Free State areas have not been included in this study. Soil temperatures in these areas were reported to be lower in winter and may influence the onset, duration and end date of the winter white root peak.

References

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Keywords

Root Scanner, root peaks, winter flush

Variance in the dormancy progression of apples in South Africa.

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Introduction

Apple trees that do not receive adequate chill during winter do not fully release endodormancy resulting in decreased bud break, uneven and delayed blooming that impacts negatively on tree formation and yield. The aim of this study was to produce a robust data set of apple bud dormancy patterns spanning five years and representing the diverse geographical and climatic apple growing regions of South Africa in order to quantify and describe the progression of dormancy of apple buds grown under conditions of inadequate chilling.

Materials and Methods

Fourteen one-year-old shoots (35cm) of “Granny Smith’ and ‘Royal Gala’, on either Seedling or M793 rootstock, were randomly harvested at regular intervals from bud set until bud swell for 5 consecutive years (2005 – 2009). Shoots were harvested from 24 commercial orchards across all four of the apple growing regions in South Africa. The shoots were forced (25°C, continuous light) and the time to 50% budbreak was recorded and used as indication of the depth of dormancy. Dormancy progression curves (DPC) were plotted by fitting a two linear joint line model representing the entrance and exit from dormancy. From the model 9 variables were calculated and a three-way ANOVA was performed. Multivariate cluster analysis was used to identify groups of farms with similar dormancy patterns. Climatic data (Richardson chill units) were calculated using data from temperature loggers.

Results and Discussion

Results from this analysis assembled the orchards into three distinct dormancy clusters. The first cluster (FS) represents most of the DPC from the Free State area, identifying them as similar but different from the other regions. Cluster 2 (CE) consists mainly of DPC from the Ceres region. Cluster 3 (LK/EGVV) combined the Langkloof curves with the curves from the Elgin/Grabouw/Vyeboom/Villiersdorp region, indicating that the dormancy progression in these two areas was similar. The three clusters differed significantly in terms of all the variables except for the date of their dormancy turning point. Of the three clusters only the FS cluster shows a DPC typical of sufficient cold accumulation, although it is not the region that recorded the most chill units. The curves from the CE and LK/EGVV clusters portray a much shallower maximum dormancy turning point and a protracted release period, the latter being very prominent in the LK/EGVV cluster.

Conclusions

Apple trees grown in South Africa show diverse dormancy progression across the 4 geographical production areas. The DPC cannot be explained in terms of chill accumulation (Utah model).

References

Keywords

apple, bud dormancy, dormancy progression, chill accumulation, cluster analysis

Influence of tillage, crop rotation and residue management on soil microbial biomass carbon and selected soil enzyme activities in two ecotopes of the Eastern Cape Province.

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Introduction

Biological parameters are sensitive soil indicators used to assess management changes over a short-term. In this study, microbial biomass carbon (MBC) and activities of fluorescein diacetate hydrolysis (FDA), β-glucosidase, arylamidase and acid phosphates were used to assess the short-term effects of tillage, crop rotation and residue management at Phandulwazi and UFH experimental sites.

Materials and Methods

The field trials were laid in a split split-plot design. The main plots were no-till (NT) and conventional tillage (CT); sub-plots were four crop rotations; maize-fallow-maize (MFM), maize-fallow-soybean (MFS); maize-wheat-maize (MWM) and maize-wheat-soybean (MWS). The sub sub-plots were allocated to residue management; residue removal (R-) and residue retention (R+). Soil samples were taken at 0-5, 5- 10, and 10-20 cm depths from each plot in November 2014 after a full cycle of crop rotations for monitoring of soil biological parameters.

Results and Discussion

Tillage × crop rotation × residue interaction was only significant with MBC at 10-20 cm depth at both sites. At Phandulwazi, no-till significantly increased MBC at 0-5 cm and 10-20, FDA at 0-5 cm, β-glucosidase at 5-10, arylamidase at 0-5 and 5-10 cm compared to CT. However, at UFH, no-till significantly ($P<0.05$) increased MBC at 10-20 cm, β-glucosidase at 5-10 and 10-20 cm as well as arylamidase at 0-5 and 5- 10 cm. The MWS rotation significantly ($P<0.05$) increased the activities of arylamidase at both sites. Retention of residues significantly ($P<0.05$) increased the levels of most of the biological indicators with the exception of acid phosphatase. No main effects or interactions ($P>0.05$) were observed on acid phosphatase activity at both sites.

Conclusions

The noted improvements in soil biological parameters show the potential for soil health and quality improvement with the adoption of NT, residue retention and crop rotation. There is, however, need to 91 corroborate the effects of these interventions on specific soil mineral nutrient levels and crop yields.

References

Keywords

Soil biological activity, conservation agriculture, crop residue, soil health, soil organic carbon, soil health

Interactive effects of Nemarioc-AL and Nemafric-BL phytonematicides on tomato cv. ‘htx 14’ under field conditions

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Introduction

International withdrawal of environmentally-unfriendly synthetic chemical nematicides from the agrochemical markets has resulted in the emergence of various alternatives for managing plant-parasitic nematodes. The highly effective Nemarioc-AL and Nemafric-BL phytonematicides contain cucurbitacin A and B, respectively, which have different chemical properties. The efficacy of phytonematicides depends on allelochemicals as active ingredients, which are naturally phytotoxic. Most studies on the two products have been conducted individually under greenhouse and microplot conditions, without any information on the interactive effects of the products under field conditions. The objective of this study was to determine the interactive effects of Nemarioc-AL and Nemafric-BL phytonematicides on the growth of tomato under field conditions.

Materials and Methods

Uniform four-week old seedlings of tomato (*Solanum lycopersicum*) cv. ‘htx 14’ were transplanted with 50 cm inter-row spacings and 60 cm intra-row spacings. This was a 2 x 2 factorial experiment, with the first and second factors being Nemarioc-AL and Nemafric-BL phytonematicides, respectively. Nemarioc-AL and Nemafric-BL phytonematicides were applied individually and also applied in combination and water was the control. Treatments were laid out in randomized complete block design, with 18 replications. Three days after transplanting, seedlings were fertilised with 2:3:2 (26) N:P:K and 2:2:2 (43) Multifeed fertilisers. Plants were irrigated using drip irrigation for 2 hours every other day. Treatments were applied at 17-day intervals. At 110 days after transplanting, plant variables such as stem diameter, plant height, fresh fruit mass, dry root mass and dry shoot mass were collected, prepared and subjected to analysis of variance using SAS software.

Results and Discussion

The interaction was not significant for any of the plant variables measured. The absence of interaction suggested that the two active ingredients acted in tomato plants independently of each other. Nemafric-BL phytonematicide had a significant effect on stem diameter and dry root mass, contributing 67 and 60% in total treatment variation, respectively. However this phytonematicide did not have any effect on fresh fruit mass and dry shoot mass. Nemarioc-AL phytonematicide did not have effect on the plant variables measured. The observed non-effects of Nemarioc-AL phytonematicide on tomato suggested that the tomato plants were operating at saturation phase, whereby there was no growth inhibition or stimulation, as observed in other studies (Mashela *et al*., 2015).

Conclusions

Results of this study suggested that cucurbitacin A in Nemarioc-AL and cucurbitacin B in Nemafric-BL acted independently of each other when the products were applied together. Also, when applied at 17 day intervals, there was no evidence of phytotoxicity.

References

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Keywords

botanicals, nematodes, sustainable management strategies

CROSS COMPATIBILITY BETWEEN SIX PROMISING IMPORTED LITCHI (Litchi chinensis) CULTIVARS.

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Introduction

The ARC-TSC has imported litchi (Litchi chinensis) from Australia and Israel in order to determine the suitability of the different litchi cultivars for South African conditions and also in an effort to extend the South African litchi industry by two weeks (Froneman , et al., 2012). Six of the imported cultivars, ‘Early Delight’, ‘Fay Zee Siu’, ‘HLH Mauritius’, ‘Kaimana’, Kwai May Pink’, and ‘Third Month Red’, were used in reciprocal crossings. The aim of this study was to evaluate the cross compatibility and applicability of the imported lines in the current breeding programme using reciprocal crossing between the six cultivars.

Materials and Methods

The field experiment was carried out at the ARC-TSC orchard (Nelspruit) during the 2015 flowering season. The six imported promising cultivars were used as pollen donors to cross-pollinate the respective female parents. Pollen was extracted from the male flower panicles, during the first male bloom, and kept in the laboratory over night at room temperature. The pollen was extracted and placed inside labelled cryovials and stored at a temperature of -82.5˚C throughout the period of cross pollination to maintain viability of the pollen. Four orchard blocks were used and 24 trees were randomly selected (four per cultivar). One hundred and twenty panicles were randomly picked from the four trees per cultivar. All the panicles selected were covered with mesh to avoid contamination by the other pollination agents. Only 30 flowers were left on the panicle for consistency. The female flowers were pollinated using a small round tip brush and immediately after pollinating, the flower panicles were bagged.

Results and Discussion

Preliminary results show 'Third Month Red' has the highest total number of harvested fruits compared with the other cultivars, however a cross between ‘Third Month Red’ x ‘Fay Zee Siu’ had the highest number of seedling survival compared with all cultivars used as female parents.

Conclusions

Even though the study is still ongoing, the preliminary results indicate that ‘HLH Mauritius’ and ‘Third Month Red’ have a higher cross compatibility compared with K’wai May Pink’, ‘Early Delight’, ‘Fay Zee Siu’ and ‘Kaimana’.

References

Froneman, I. J. et al., 2012. Plant improvement strategies for litchis in South Africa. IV International Symposium on Lychee, Longan and Other Sapindaceae fruits., pp. 65-71.

Keywords

Cross compatibility, Litchi (Litchi chinensis) , Pollination

EFFECT OF REDUCED NUTRIENT CONCENTRATION AND FOLIAR FERTILISER APPLICATION ON HYDROPONICALLY GROWN FRESH MARKET AND CHERRY TOMATOES

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Introduction

In view of the costs of soluble fertilisers and the negative influence of open hydroponic systems on the environment, studies have been undertaken aiming at reducing fertiliser application, while applying foliar fertilisers on yield and quality of hydroponically grown fresh market (FM) and cherry tomatoes.

Materials and Methods

The study was conducted in a 40% black & white shade-net structure at the Agricultural Research Council-Vegetable and Ornamental Plants (ARC-VOP), Roodeplaat during September to February 2015. Five-week-old tomato seedlings (FM cultivar ‘Dominique’ and cherry tomato cv ‘Tinker’) were transplanted into 10 L plastic bags containing sawdust as a growing medium. Plants were treated with four nutrient concentrations [100 (recommended), 75, 50 and 25% of the recommended nutrient concentration) with two foliar fertilizer application treatments added (with and without foliar fertilizer application). Treatment combinations were laid out in a randomised complete block design with three replicates.

Results and Discussion

Marketable yield and number of marketable fruits of FM tomatoes were not significantly different at 50, 75 and 100% NC, while the highest total yield was obtained at 100% NC. The highest total yield and marketable yield of cherry tomatoes were obtained from plants fertigated at 75 and 100% NC, which were not significantly different compared to 50 and 25% NC. Increasing the NC had no effect on fruit and leaf mineral content, except that an increase in NC reduced fruit and leaf Ca content. Foliar fertiliser application did not have an effect on yield of cherry and FM tomatoes. Foliar fertiliser improved the K, P, Mg and Zn fruit content of cherry tomatoes compared with untreated plants while in FM tomatoes foliar fertiliser did not have an effect.

Conclusions

Results showed that, compared to the recommended NC (100% NC), reduced NC had positive effects on the yield and fruit mineral content of FM and cherry tomatoes. It is, therefore, recommended that the NC in the cultivation of FM tomatoes can be reduced to 50% of the recommended NC, while for cherry tomatoes, it can be reduced to 75% of the recommended NC without negative effect on the yield and quality of tomatoes. This will result in a cost saving of 25 and 50% for farmers on fertiliser input costs on cherry and FM tomatoes, respectively.

References

Keywords

Fruit mineral content, marketable yield, Solanum lycopersicum, unmarketable yield

Water, nitrogen and phosphorous use efficiencies in seed potato under centre pivot irrigation

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Introduction

Within framework of a WRC-funded project on quantifying and managing agricultural nitrogen and phosphorous pollution, a case study was conducted nearby Christiana in the Western Free State with the objective of quantifying N and P losses from potato production systems, their economic importance and to measure deep drainage below the potato plants' rooting system in sandy soils. The detailed field data will be used to upscale the results using simulation modeling.

Materials and Methods

The trial was conducted on two intensively managed potato fields differing in soil texture and grown to Mondial variety. A total of 300 - 325 kg N, 154 kg P and 237 - 245 kg K were applied by broadcasting, band placement, fertigation and foliar feeding. Field measurements of soil, crop and weather parameters were conducted throughout the growing season. Experimental plots marked in four replicated blocks per field were used for destructive sampling measurements. A Decagon DG3 drain gauge installed at 60cm soil depth was used to collect drainage water samples which were analyzed for nutrient composition.

Results and Discussion

Tuber yield was 82 to 99 tons fresh matter per hectare (equal to 13.2 to 18.5 tons dry matter). Water use efficiency averaged 3.5 g potato per liter water (from irrigation + rainfall), nitrogen use efficiency averaged 51.7 g potato per gram nitrogen applied and phosphorous use efficiency averaged 106.8 g potato per gram phosphorous applied. Deep drainage (below 60 cm depth) ranged from 125 to 244 mm. The irrigation water from the Vaal river which supplied the fields contained 1.15 mg nitrate and 0.46 mg phosphate per liter respectively whilst the values in the deep drainage water ranged 52 - 747 mg nitrate per liter and 0.01 - 14.22 mg phosphate per liter. In South Africa, a threshold of < 10 and < 0,025 mg per liter is used for nitrate and phosphate respectively as the maximum acceptable levels in underground and surface waters. Losses of up to 175 kg N per ha and 2 kg P per ha were measured in drainage water.

Conclusions

The high levels of nitrate measured in the drainage water shows the risk of pollution of underground water sources by potato production on sandy soils, which can ultimately lead to eutrophication of (sub-) surface water bodies. We expect there is potential for improving resource use efficiencies by optimizing the application of input resources. The study produced preliminary results and another trial is planned for 2016/17 season.

References

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Keywords

Water use efficiency, Nitrogen use efficiency, Phosphorous use efficiency, Eutrophication, Deep drainage

FUNCTIONAL TRAITS FOR STRATEGIC WEED MANAGEMENT IN VINEYARDS

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Introduction

Using functional traits to relate weed communities to farm management has been proposed as an approach for designing effective weed management strategies (Navas, 2012). Functional traits (characteristics that mediate an organism's interactions with its environment) explain why different weed species occur under different conditions, and can therefore be used to understand whether altering farm conditions could alter the weed community in ways that reduce weed competition and/or promote ecosystem services. This aim of this study was to identify whether farm management is associated with the functional composition of weed communities in South Africa's Cape Winelands region.

Materials and Methods

Weeds were surveyed on vineyards under a wide range of weed management approaches, including organic management, integrated management, and herbicide-dominated management. Information on the timing and intensity of management actions was collected, along with key soil, climate and landscape parameters. The functional composition of the weed community was calculated from weed species cover using species traits published in the TRY trait database (Boenisch and Kattge, 2014), and related to environmental and management variables using ordination and regression modelling.

Results and Discussion

The functional composition of vineyard weed communities varied in relation to management approaches, indicating that the functional types of weeds present can be influenced through farm management. The different weed communities observed during this study suggest several possible ways in which weed management could be adapted to promote certain functional types of weeds.

Conclusions

Taking a functional trait approach to farm weeds reveals new possibilities to adapt weed management to minimise the negative impacts of weeds, and to maximise the benefits of weeds for biodiversity and ecosystem services.

References

Boenisch G, Kattge J. 2014. TRY Database. https://www.try-db.org/TryWeb/Home.php Navas M. 2012. Trait-based approaches to unravelling the assembly of weed communities and their impact on agro-ecosystem functioning. Weed Research 52:6, 479–488.

Keywords

weeds, functional traits, agroecology, integrated weed management, organic

Degree of nematode resistance in sweet potato cultivar ‘Mvuvhelo’ to Meloidogyne incognita

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Introduction

A previous host-status screening trial of 12 sweet potato (*Ipomea batatas*) cultivars in South Africa suggested that cultivars 'Bophelo', 'Bosbok' and 'Mvuvhelo' were non-hosts to the root-knot nematode, *Meloidogyne incognita* race 2 (Pofu et al., 2016), with limited information on their degrees of nematode resistance to this nematode species. The objective of this study was to confirm the host-status and determine the host-sensitivity of sweet potato cultivar 'Mvuvhelo' to *M. incognita* race 2 under greenhouse conditions.

Materials and Methods

Cuttings were planted in 20-cm diameter plastic pots containing pasteurized loam soil and Hygromix-T at 3:1 (v/v) ratio. Cuttings were irrigated every other day using 300 ml water and at two weeks after planting, clones were fertilised using 2 g NPK 2:3:2 (22) and 2 g N:P:K 2:3:2 (43) Multifeed with various other nutrient elements without Ca. The initial nematode population densities (Pi) used for inoculation on established cuttings comprised 0; 25; 50; 125; 250; 625; 1250 and 3125 eggs and second-stage juveniles (J2) of *M. incognita* race 2. These were arranged in a randomised complete block design, with five replicates. The nematode-susceptible cv. ‘Beauregard’ served as a standard for inoculum infectivity. The final nematode population densities (Pf) and plant growth variables were collected 56 days after inoculation, prepared and subjected to analysis of variance.

Results and Discussion

In plant-parasitic nematodes, nematode resistance is described using two concepts, namely, host-status and host-sensitivity. Host-status is described using the concept of a reproductive factor (RF = Pf/Pi). Generally, when the RF values are less than one at all levels of inoculation, as observed in cv. 'Mvuvhelo', the plant is a non-host. When the RF values are below one, J2 failed to develop, which is an indication that the J2 failed to establish a feeding site (Seinhorst, 1967). Host-sensitivity describes the degree of plant response to nematode infection which could, in context of density-dependent growth (DDG) patterns, be stimulated, neutral and inhibited plant growth. In the current study, infection of *M. incognita* race 2 at various inoculation levels had neutral responses on growth of 'Mvuvhelo'.

Conclusions

'Mvuvhelo' was resistant to *M. incognita* race 2 and therefore, is suitable for use in crop rotations intended to manage population densities of this nematode race.

References

Pofu, K.M., Mashela, P.W., Laurie, S.M. and Oelofse D. 2016. Sweet potato genotypes with Meloidogyne-resistance in South Africa for potential inclusion in biofortification plant breeding programmes, Acta Agriculturae Scandanavica- Section B Plant and Soil, dx.doi.org/10.1080/09064710.2016.1220613.

Keywords

Ipomea batatas, *Meloidogyne incognita*, resistant host, tolerant host, susceptible host.

BIOLOGY AND GERMINATION CHARACTERISTICS OF UROCHLOA MOSAMBICENSIS AND UROCHLOA PANICOIDES

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Introduction

Urochloa panicoides P. Beauv. (liverseed grass) is an annual grass weed occurring mainly in summer cropping systems. U. mosambicensis (Hack.) Dandy.(bushveld grass) is a perennial grass that can remain dormant for six to 12 months after harvest. Both these grass weeds are strong competitors for water, sunlight, space and nutrients, resulting in crop yield losses if not controlled effectively. The objectives of this study were to determine emergence patterns and germination percentages, as well as to evaluate chemical spray programs for effective control of these two grass weeds.

Materials and Methods

Two field sites with natural infestation of U. panicoides and U. mosambicensis were used to lay out a complete randomized design of quadrants to monitor weed emergence patterns. Six different herbicide spray programs were also tested on three different growth stages of the grass weeds (5, 10 and 30 cm height) in glasshouse trials.Visual observation to determine efficacy (% of control) were done daily after application.Seed of both species were collected at ten different localities and these samples were submitted to the Department of Agriculture, Forestry and Fisheries' Seed Evaluation division to determine germination percentages and number of viable seeds.

Results and Discussion

Urochloa panicoides showed two significant emergence peaks at the end of November 2015 and again at middle February 2016 in the Ventersburg locality. However, U. mosambicensis emergence only peaked once in the beginning of March 2016. The same tendencies were observed at the Bethlehem locality. Germination percentages were very low, indicating the presence of a mechanism of dormancy. Paraquat effectively controlled U. panicoides at all growth stages and no re-growth was observed. Spray programs with glyphosate and acetochlor gave 100% control nine days after application. Where grasses were taller (30 cm) control was less effective especially for the spray programs consisting of herbicides in the Triketone group.

Conclusions

Both these grass weed species are prolific seed producers and when conditions are favourable have the ability to grow vigorously and shed seed during the maize growing season. Although only 50% of the seed are viable, the numbers are still high enough to ensure significant infestation levels where these grass species prevail. To ensure effective control, grass tufts should be sprayed before it reaches plant heights of greater than 30 cm.

References

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Keywords

Control, dormancy, efficacy, height, herbicide

GROWTH STAGE INFLUENCES THE RESPONSE OF CONYZA BONARIENSIS TO GLYPHOSATE

Presenter: M.W Malatji (GROWTH STAGE INFLUENCES THE RESPONSE OF CONYZA BONARIENSIS TO GLYPHOSATE)

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Introduction

Growth stage of weeds determines their response to herbicides. Significant variation in weed growth stage is more relevant to cropping systems based on minimum to zero soil disturbance. Tillage operations in annual cropping systems introduces soil disturbance as a regular occurrence that contributes to greater uniformity in the age/size of weeds. In recent years reduced tillage practices have been adopted at a higher rate than ever before. The objective of the study was to determine how growth stage of the weed Conyza bonariensis influences its response to glyphosate, and if it may be a contributing factor to the evolvement of resistance.

Materials and Methods

Populations of Conyza bonariensis that previously were proven as glyphosate-sensitive (Hatfield and George localities) and glyphosate-resistant (Vredefort and Swellendam localities) were selected for this experiment. The four glyphosate application timings based on weed growth stage (4 true leaves, 6 to 8 true leaves, 12 to16 true leaves, bolting to 20 cm tall), four populations, and six rates of Roundup Turbo (0, 225, 450, 900 1800, and 3600 g ae/ha). Twenty-one days after treatment, all the plants including dead ones were clipped at the soil surface, and fresh mass recorded before being over-dried to constant weight at 650C and later weighed to obtain the dry biomass for each population. Follow-up experiments included treatments consisting of adjuvants for promoting glyphosate efficacy.

Results and Discussion

In all the populations, plant mass was reduced the most at the youngest stage (4-leaf stage). In contrast, older plants (bolting to 20 cm tall) the level of tolerance significantly increased. This suggests that variation in growth stage could promote the evolvement of glyphosate resistance, because treatment of older plants with glyphosate could be tantamount to undeliberate selection for resistance by effectively under-dosing due to the dilution factor in older/bigger weeds.

Conclusions

The response of Conyza bonariensis to glyphosate is significantly dependent on growth stage. Conyza bonariensis plants should be controlled at earliest stages possible with glyphosate. This would also apply to other herbicides and weeds. Best practice for mitigating herbicide resistance is to use combinations of different mechanisms of action herbicides to ensure that plants do not survive herbicide treatments.

References

Keywords

Adjuvants, Conyza bonariensis, glyphosate, growth stage

EFFECT OF DEFICIT IRRIGATION ON YIELD, QUALITY AND PHYTOCHEMICALS IN TWO LETTUCE (LACTUCA SATIVA L.) CULTIVARS AT HARVEST

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Introduction

Lettuce (Lactuca sativa L.) is of particular interest in nutrition due to good its content of antioxidants and phytochemicals, flavonols, ascorbic acid, chlorophyll and carotenoids (Llorach et al. 2008: 1028). Consequently, this results in vegetable growers' attention being caught by the lettuce crop, which is becoming increasingly important as a vegetable in salads within the country. However, South Africa is a water scarce country with a highly inconstant climate and highly constrained freshwater resources (WRC, 2015). Therefore, this study seeks to determine the minimal water requirement for lettuce production without compromising quality of the crop through deficit irrigation (DI) practice.

Materials and Methods

A field experiment was conducted at the Agricultural Research Council Vegetable and Ornamental Plant, Pretoria (25059IIS, 28035IIE). The trial was laid out in a randomised complete block design (RCBD) and replicated three (3) times. Treatments applied consisted of two (2) lettuce cultivars (Vera and Lollo Bionda) subjected to three management allowable depletion levels- MAD (25% of control, 50% and 75% MAD). Leaf area, whole weight, marketable yield and unmarketable yield were determined at harvest, six weeks from transplanting. Phytochemicals (ascorbic acid, phenols, and antioxidants) were also analysed at harvest. The obtained data was statistically analysed using Genstat.

Results and Discussion

There were interactions between cultivar and deficit irrigation for whole weight, leaf weight and Marketable yield. Cultivar, Vera had similar leaf weight and marketable yield when subjected to 25% MAD and 50% MAD compared to Lollo Bionda, which was not adversely affected by an increase in MAD and responded to unmarketable yield. There were interactions between cultivar and MAD of antioxidant activity (DPPH) and total phenols. For implementation of MAD, Vera cultivar is recommended over Lollo Bionda since yield was not affected by 25% MAD at 50% MAD. Vera yielded higher DPPH and total phenols when compared to Lollo Bionda at all MAD levels. There was no interaction between cultivar and MAD for ascorbic acid. Vera produced high ascorbic acid over Lollo Bionda and the difference was notable at 25% MAD.

Conclusions

Generally, Lollo Bionda yielded high more compared to Vera, but performed poorly when there were increases in MAD. Vera showed to have higher phytochemicals as compared to Lollo Bionda. Therefore, for implementation of deficit irrigation, Vera is recommended since it gives good morphological yield and phytochemicals at 50% MAD which will save 25% water for the farmer.

References

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Keywords

Deficit irrigation, Lettuce, DPPH, Phenols, Marketable yield, Unmarketable yield and Whole weight.

Elemental composition and fertiliser value of hair waste from different ethnic groups

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Introduction

Large quantities of hair waste are produced and disposed of at landfill sites, which could cause groundwater pollution with nitrates (Gupta, 2014). High nitrogen composition in hair suggests that the wastes could improve soil fertility. Different hair types could differ in elemental composition which affect decomposition and elemental release and their contribution to environmental pollution and potential to improve soil fertility. The objective of this study was to determine elemental compositions of different hair types, their nitrogen fertiliser value for spinach.

Materials and Methods

African, White and Indian hair wastes were sampled from different salons in Pietermaritzburg, without distinguishing age, sex, health status, livelihood etc, and analysed for nitrogen (N), phosphorus (P), sulphur (S), bases, micro-nutrients and heavy metals. An incubation experiment was carried out to determine the release patterns of N of the three hair types. The hair wastes were mixed with soil at rates equivalent to 0, 200, 400 and 800 Kg N ha-1 and incubated for 84 days, with destructive sampling at day 0,28,56 and 84. A greenhouse experiment evaluated the effect of hair type and pre-incubation time (0, 28, 56 and 84 days) on yield parameters and uptake of nutrients by spinach (Spinacia oleracea).

Results and Discussion

Waste Indian and White hair had similar levels of N, which were higher than African hair. Potassium concentration was lower for White hair than the other two African hair had greater Al, Mn, Zn and Co than White and Indian hair. There were no differences in all other elements among the hair types . Incubation of the three hair types resulted in the release of inorganic N (NH4-N and NO3-N), in the order: Indian > African > White, indicating the potential of the hair to supply these nutrients to crops (Zheljazkov et al., 2008). African hair resulted in higher dry-matter and N uptake than White hair when pre-incubated for 28 days. There were no differences for the 56 and 84 day pre-incubations.

Conclusions

The hair waste differed in composition of N, C, K, Ca, Co, Zn, Mn, Al. The mineralisation of N from the hair types was in the order: Indian > African > White. Pre-incubated human hair waste supplies enough N for spinach with African hair requiring a shorter pre-incubation than White.

References

Zheljazkov VD, Stratton GW, Sturz T. 2008. Uncomposted wool and hair-wastes as soil amendments for high-value crops. Agronomy Journal 100:1605-1614. Gupta A (2014) Human hair “waste” and its utilization: gaps and possibilities. Journal of Waste Management 2014: 1-17.

Keywords

Elemental composition, human hair, incubation, nitrogen release

Effect of nitrogen application and leaf harvesting on yield and quality of beetroot (beta vulgaris)

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Introduction

Beetroot (*Beta vulgaris*) is an important vegetable crop for both tuber and leaf consumption. However, insufficient supply of N can decrease plant N content, reducing photosynthate production (Boussdia et al., 2010) and thus, reduce plant growth and decrease quality of harvestable materials (Mikkelsen and Hartz, 2008). The aim of this study was to assess the effects of nitrogen (N) application and leaf harvesting percentage on the yield and quality of beetroot tubers and leaves.

Materials and Methods

The study was conducted at the Agricultural Research Council (ARC) - Vegetable & Ornamentals Plants (VOP) under 40% white shade-net structure. Beetroot plants were subjected to five levels of N (0, 60, 90, 120 and 150 Kg/ha) combined with three leaf harvest percentage (0%, 30% or 50%).The experiment was laid out in a randomised complete block design with three replicates. The first leaf harvest was initiated 35 days after transplanting (DAT) and the second harvest was at 80 DAT during the termination of the experiment. Data was collected on leaf fresh mass, leaf dry mass, leaf number, leaf area, tuber fresh mass, tuber dry mass, tuber diameter, tuber length) and bio-active compounds (anti-oxidants, total phenols, anthocyanins and total proteins).

Results and Discussion

Nitrogen application at 120 and 150 kg.ha-1 increased leaf fresh mass, leaf dry mass, leaf number, leaf area, and tuber fresh and dry mass, including tuber diameter and length. Magnesium (Mg) and iron (Fe) leaf content, and N tuber content were significantly improved by the application 120 kg.ha-1 N. Leaf harvest percentage did not have a significant effect on leaf yield, bioactive compounds or leaf and tuber mineral content. However, tuber dry mass was significantly reduced by the 50% leaf harvest. Leaf harvest at 30 or 50% increased concentration of total protein content of beetroot tubers while an increase in N application decreased concentration of total proteins.

Conclusions

The yield was correspondingly lower with the application of lower N levels. The N application of 120 kg.ha-1 and 30% leaf harvest is recommended for the improvement of yield and quality of both tubers and leaves of beetroot.

References

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Keywords

Beetroot, Nitrogen application, yield and quality

INFLUENCE OF NITROGEN APPLICATION ON YIELD, LEAF COLOUR AND ASCORBIC ACID OF LEAFY LETTUCE CULTIVARS GROWN IN CLOSED HYDROPONIC SYSTEM

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Introduction

Lettuce has gained popularity and often included in mixed salads. Salads are considered as healthy food, hence the increase in their consumption. However, the nutritional quality of lettuce can be affected by pre- and post-harvest management. Nitrogen (N) is one of the essential macronutrients in lettuce production for vegetative growth, increased yield and nutritional value of the plant. Visual quality and taste as the most important quality attributes, are directly influenced by N availability. The aim of this research was to evaluate the effects of N application on yield, leaf quality and nutritional content of leafy lettuce cultivars at harvest.

Materials and Methods

The study was conducted at the ARC-VOPI during the winter season (June to July 2015), under 40% white shade-net structure. Three leafy lettuce cultivars (Multigreen 1, Multigreen 3 and Multired 4) were subjected to six N concentrations (0, 60, 90, 120, 150 and 180 mg L-1 N) in a closed hydroponic system. The treatment combinations were replicated four times and arranged in a split-plot design. Ammonium nitrate was used as a source of nitrogen. The pH of the nutrient solution was maintained at a range of 6.0 to 6.5 using phosphoric acid. Spacing was 20 x 15 cm on 24 hydroponic tables. Thirty days after transplanting, data was collected included; fresh and dry leaf mass, leaf number and area, fresh and dry root mass, leaf colour (L*, a*, b*), leaf mineral content, and leaf ascorbic acid (AsA). Data were analysed using analysis of variance with GenStat version 11.1. Fisher's protected LSD test at a significance level of 5% was used to determine differences among the cultivars.

Results and Discussion

Nitrogen concentration of 60-180 mg L-1 increased marketable yield of cultivar Multigreen 1, Multigreen 3 and Multired 4, however, the increase in N level did not affect the fresh and dry root mass. The highest amount of AsA was found at the lower N levels, i.e. <90 mg L-1, while AsA decreased at higher N concentrations. In vegetables, colour is considered as a major quality trait, and the occurrence of yellowness was higher in lettuce without N fertilization, indicating a loss of visual quality. Leaf mineral content increased with an increase N application.

Conclusions

Yield and quality of leafy lettuce is depended on the amount of N supplied. Concentration of 90 mg L-1 N may be recommended for leafy lettuce cultivars grown in a closed hydroponic system for improved yield and quality.

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Keywords

Ammonium nitrate, gravel film, Lactuca sativa L., mixed salad, nutritional quality

Modelling the impact of extreme weather events under future climate change on maize yield: an intercomparison between existing and modified modelling solutions

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Introduction

The severity and frequency of extreme weather events are expected to increase, therefore it is imperative to have crop models that are able to accommodate such events. Suggestions have been put forward that most of the existing crop models need an overhaul or an update in order for them to produce reliable results that can be used by policy developers for future planning.

Materials and Methods

In this study, CropSyst model was modified in order to take into account the impacts of extreme drought and heat. The performance of the existing Cropsyst model and the modified version were tested under extreme drought and heat. Representative Concentration Pathway of 8.5 was then used to generate climate data at different time slices representing current, near and far future climate scenarios (1991-2010, 2021-2040 and 2041-2060). The two validated models were then used to run simulations at these different time slices. During validation the models predicted more or less the same during the period when there was optimum rainfall.

Results and Discussion

During the year when there was an extreme drought, results showed that the inclusion of an extreme event module to the modified Cropsyst version improved yield predictions by approximately 30% under extreme weather events in comparison to the existing CropSyst model. The results indicated that the existing crop model predicted yields that were higher by a range of 15 to 30% compared to the modified CropSyst model. In future scenario simulations, a high coefficient of variation was noted with grain and aboveground biomass simulations carried out by modified CropSyst model in comparison to the existing CropSyst model. This demonstrated the ability of the modified Cropsyst model to capture a wide range of environments to which the crop was under stress.

Conclusions

The improved CropSyst model simulated well under extreme weather events and can be a promising tool for supporting agricultural management strategies and policy decisions at multiple scales, from farm to the continent level. We recommend an expansion of predictions using the modified modelling solution for various crops across all South African agro-ecological zones.

References

Keywords

Extreme events, policy, climate change, Cropsyst, maize production

UNDERSTANDING THE FATE OF NITROGEN FERTILIZER USING STABLE ISOTOPE AND CONSERVATIVE TRACER TECHNIQUES

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Introduction

There is a growing concern over increased non-point source nitrogen (N) pollution, as confirmed by deteriorating water quality in numerous catchments around the globe. Poor water quality has been associated with intensive agricultural activities in many cases. Soil water N sampling techniques, such as suction cups and wetting front detectors, can be used to measure leaching concentration, but not the leaching load. The aim of this study was to estimate N leaching using weighing lysimeters, stable isotope and conservative tracer techniques and modelling.

Materials and Methods

Two experiments were set up at the University of Pretoria Experiment Farm, Hatfield, Pretoria. The first experiment consisted of two weighing field lysimeters and a Decagon D3 drain gauge. Volumetric and matric potential water sensors and suction cups were inserted at 15, 30, 50 and 70 cm depths in the lysimeters and also close to the drain gauge. The water samples collected from the drain gauge, suction cups and wetting front detectors were analyzed for nitrate and bromide (NO3- and Br-) concentration, and used to calibrate the models (HYDRUS 1D and APSIM). The second experiment consisted of six plots each with an area of 4 m2, into which two sets of suction cups, wetting front detectors, tensiometers and capacitance sensors were installed at 25 and 50 cm depths. Soil samples collected in the plots before and after the trial, together with plant samples collected at tillering, flowering and physiological maturity, and the N fertilizer used were analyzed for natural abundance of 15N to determine fertilizer use efficiency (FUE). Bromide was also applied as a conservative tracer for the second experiment.

Results and Discussion

Bromidemovement provided a NO3- leaching potential for the trial site and is useful for model parameterization. Observed data and calibrated HYDRUS 1D and APSIM simulated data had a good MSE, RMSE, r2 and r values close to one. Results from comparisons of the drain gauge and weighing lysimeter leaching loads will be presented.

Conclusions

Use of stable isotopes provides an effective way to determine FUE. Both models were able to predict N leaching load following initial calibration with Br- data. Properly calibrated models help in understanding N leaching which can assist with adaptive management decisions for farmers, especially on fertilizer application and managing irrigation.

References

Keywords

stable isotopes, nitrogen, tracer, APSIM, HYDRUS 1D

INFLUENCE OF LATE NITROGEN APPLICATION ON ‘NADORCOTT’ MANDARIN FRUIT QUALITY

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Introduction

Nitrogen (N) application influences citrus tree growth, yield, as well as fruit appearance and quality. Adequate availability of N during the critical stages of flower initiation and fruit development is important to support optimal yield however over application could negatively impact citrus fruit quality parameters such as rind colour (Iglesias, 2001) as well as the susceptibility to rind disorders. The objective of this study was to determine the influence of application of N on the late mandarin ‘Nadorcott’ during the II and III period of fruit growth i.e. later during fruit development.

Materials and Methods

Nitrogen was soil applied N (LAN) at 50 and 100 kg·ha in March and April on 10 trees per treatment, in addition to N applied by the producer in commercial orchards of ‘Nadorcott’ mandarin (Citrus reticulata Blanco). Fruit were cold stored at -0.6 °C and 4 °C for 30 days to determine impact on chilling vs. non-chilling rind disorders in addition to measuring external (colour) and internal (TSS:TA) quality.

Results and Discussion

Fruit colour over two seasons was not significantly affected. Furthermore, there was no increase in rind disorders. The negative impact of N on colour development is well documented in citriculture and the results were unexpected.

Conclusions

Late application of N did not to affect mandarin fruit quality at a commercial level and the results indicate a possible advantage of later N application in mandarin cultivars without negatively affecting external or internal quality.

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Keywords

Mandarin, rind disorders, nitrogen

IMPROVING TRANSPLANTING SURVIVAL OF MORINGA OLEIFERA SEEDLINGS THROUGH SUPPRESSING GROWTH USING INDOLE ACETIC ACID

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Introduction

Moringa oleifera is a multi-use plant in developmental projects in marginal communities of Limpopo Province. However, survival challenges of seedlings had been encountered due to its high growth rates, which results in etiolated stems and death of seedlings. Also, during establishment *M. oleifera* seedlings have shown symptoms of stunted growth and leaf chlorosis. The objective of this study was to use various concentrations of indole acetic acid (IAA), to modulate growth of *M. oleifera* seedlings.

Materials and Methods

Uniform one-month-old hardened-off *M. oleifera* seedlings were transplanted into 20-cm-diameter plastic pots containing pasteurised loam soil and Hygromix-T at a 3:1 (v/v) ratio. They were treated with one of ten IAA concentrations, namely, 0.0, 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8, 25.6 and 51.2 mg.mL−1 in distilled water, arranged in a randomised complete block design, with five replications. Treatment commenced a week after transplanting, with IAA and G49 wetting agent and sticker being applied weekly. At 80 days after initiating the treatments, plant variables were collected and analysed, with significant treatment means further subjected to lines of best fit.

Results and Discussion

The effects of IAA concentrations were significant for plant height, leaf number, dry root mass and stem diameter, with treatments contributing 54, 73, 78 and 81% in total treatment variation (TTV) of the respective variables. The density-dependent growth had a stimulation effect at low concentrations, with leaf number, plant height and stem diameter over increasing IAA concentrations exhibiting positive curvilinear quadratic relationships. The dry root mass exhibited a negative curvilinear quadratic relationship with IAA concentration. In the current study, most plant variables and increasing concentrations of IAA had density-dependent growth (DDG) patterns as shown in other plant species subjected to increasing concentrations of plant-derived products (Mashela et al., 2015). In most trees, root flushes alternate with shoot flushes, which could explain the improved shoot growth at the expense of root growth in *M. oleifera* seedlings in the current study. The DDG patterns allowed for the establishment of an optimum concentration and, therefore, the IAA concentration that could be used to suppress plant growth. Using IAA at a concentration of above 3.55 mg.mL-1 suppressed growth of *M. oleifera* seedlings and this could be used for improving transplanting survival of seedlings.

Conclusions

Transplanting survival of *M. oleifera* could be improved by applying IAA above the optimum concentration level of 3.55 mg.mL−1.

References

Mashela, P.W., Dube, Z.P. and K.M. Pofu. 2015. Managing the phytotoxicity and inconsistent nematode suppression in soil amended with phytonematicides. In: Meghvansi MK, Varma A (eds.). Organic amendments and soil suppressiveness in plant disease management, Soil Biology Volume 46, Germany: Springer-Verlag: Heidelberg.

Keywords

Density-dependent growth, marginal communities, plant growth

Responses of Beta vulgaris growth to Nemafric-BL phytonematicide application under microplot conditions

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Introduction

Alternatives to methyl bromide, used in the management of root-knot (*Meloidogyne* species) nematodes in beetroot (*Beta vulgaris*), includes phytonematicides which may be phytotoxic to crops since they rely on allelochemicals as their active ingredients. Nemafric-BL phytonematicides, made from the dried fruit of *Cucumis africanus*, could be highly phytotoxic to crops they are protecting against nematodes. Mashela et al. (2015), using the Curve-fitting Allelochemical Response Dosage (CARD) model (Liu et al., 2003), established a non-phytotoxic concentration, referred to as the Mean Concentration Stimulation Point (MCSP), which is crop-specific. The objective of this study was to determine the MCSP of Nemafric-BL phytonematicide for *B. vulgaris.*

Materials and Methods

A pot trial was established under microplot conditions by transplanting four-week old *B. vulgaris* cv. 'Detroit Dark Red' seedlings in 20-cm-diameter pots. Each pot was filled with steam-pasteurised loam and sand, mixed with Hygromix-T at 2:1:1 (v/v) ratio. The treatments, namely, 0.0, 0.8, 1.6, 3.2, 6.4 and 12.8% Nemafric-BL phytonematicide were arranged in a randomised complete block design, with 10 replicates. Seedlings were each inoculated with 5000 *M. incognita* eggs and second-stage juveniles (J2) and irrigated with 250 mL chlorine-free tapwater. At 56 days after applying the treatments, plant and nematode variables were collected, bulbs and shoots were dried, weighed and subjected to analysis of variance using Statistix software. Significant plant variables were further subjected to the CARD model.

Results and Discussion

Nemafric-BL phytonematicide had significant effects on fresh bulb mass, dry bulb mass and gall rating. The CARD model showed that the plant variables and increasing phytonematicide concentrations exhibited quadratic relationships. Using the biological indices from the CARD model (Dm, Rh), the MCSP for Nemafric-BL phytonematicide on *B. vulgaris* was determined as 10.2%, with the overall sensitivity (∑k) of 4 units. The computed MCSP for 'Detroit Dark Red' using Nemafric-BL phytonematicide was rather high when compared with that of other crops (Mashela et al., 2015). The overall sensitivity of 4 units of beetroot when nematodes were managed using Nemafric-BL phytonematicide was similar to that of tomato seedlings (Mashela et al., 2015). Generally, plants with overall sensitivity values of less than 5 units are viewed as being moderately sensitive to the phytonematicides, whereas with values above 5 units the plants are highly tolerant (Mashela et al., 2015).

Conclusions

The MCSP value of Nemafric-BL phytonematicide on *B. vulgaris* was rather high and the study should be validated.

References

Mashela, P.W., Dube, Z.P. and Pofu K.M. 2015. 'Managing the phytotoxicity and inconsistent nematode suppression in soil amended with phytonematicides'. Organic amendments and soil suppressiveness in plant disease management, Soil Biology 46: 147-173

Keywords

Fermented crude extracts, nematode population densities

EFFECT OF STEM CUTTING LENGTH, ROOTING HORMONES AND PROPAGATION MEDIA ON ROOTING RESPONSE OF ROSE-SCENTED GERANIUM CUTTINGS

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Introduction

Rose-scented geranium (Pelargonium spp.) is well known for its medicinal and fragrant properties. This plant is propagated though stem cuttings; thus cutting rooting success rate plays a major role in the expansion of the rose-scented geranium farming business. To optimize propagation protocols for this important plant, a study was conducted to evaluate the effect of different cutting length, rooting hormone concentrations and propagation media on rooting and development of rose-scented geranium cuttings.

Materials and Methods

The different treatments used included four different stem cutting length (10 cm, 12 cm, 14 cm and 16 cm), three types of rooting hormones (Dynaroot 1, 2, 3) containing different concentrations of indole-butyric acid as the active compounds and control (without rooting hormone), and two types of rooting media [hygrotex and Pine bark + hygrotex (at 1:1 ratio on volume basis)]. The experiment was set up in a complete randomized design with a 4 × 4 × 2 factorial treatment combination. Cuttings were assessed on root number, length, and fresh weight; stem circumference, leaf number and rooting holding capacity.

Results and Discussion

Stem cuttings of 14 and 16 cm length gave the highest root number (34, 38 and 35.13) and root length of (3.40 and 3.51cm) with no significance. While stem cuttings of 10 cm length gave the highest stem circumference (3.1 cm). Cuttings treated with Dynaroot 3 and Dynaroot 2 showed better root number 33.46, root length 3.54 cm, root fresh weight 0.59 mg as well as root holding capacity 5 and leaf number of 11.08. however control had maximum shoot number (3.79) and stem diameter (3.05).The effect of using hygrotex as a rooting medium did not significantly differ from using hygrotex + pine bark (1:1 v/v) on propagation of rose-scented geranium stem cuttings.

Conclusions

It is recommended that rose-scented geranium be propagated through the use of 14 cm-long stem cuttings treated with Dynaroot 2 rooting hormone. Depending on the cost and availability, hygrotex alone or mixed with pine bark can be used as a rooting medium in the propagation of rose-scented geranium using stem cuttings.

References

Keywords

Dynaroot; growing media; propagation; rooting hormone; rose-scented geranium; stem length

COMPLEXITIES OF ‘HASS’ AVOCADO FRUIT COLOUR CHANGE DURING RIPENING

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Introduction

Avocado fruit, cultivar ‘Hass’, is supposed to undergo a skin colour change from green to purple/black during ripening. Colour change is a parameter used by fruit ripeners, marketers and consumers as a ripeness indicator. However, early season ‘Hass’ avocado fruit from South Africa have been shown to deviate from this by not undergoing the expected change in colour (Mathaba *et al*., 2015). The South African Avocado Growers’ Association (SAAGA) and Postharvest Innovation Fund (PHI) is investing on research of developing an understanding and possible mitigation of this phenomenon. The aim of this study was to investigate pre- and postharvest factors leading to poor skin colour development of ‘Hass’ avocado fruit during ripening.

Materials and Methods

'Hass’ Avocado fruit were harvested during early, mid- and late season from two locations (Kiepersol, Mpumalanga and Tzaneen, Limpopo), from inside and outside the tree canopy, at an orchard block with a slope (from upper and lower slope) during the 2015/16 harvest season. In the 2016 season, an additional girdling trial was laid out at both research sites on an orchard block with a slope. After each harvest, fruit were immediately transported to the ARC-TSC postharvest laboratory for storage and analysis. At the laboratory, fruit were sorted and graded manually and thereafter stored at 5.5°C for 28 days. After withdrawal from cold storage, fruit were ripened at 16, 21 and 25°C. During ripening, ‘Hass’ avocado fruit were evaluated for firmness, skin color (L, C and hue angle) and cold damage.

Results and Discussion

In general, fruit from the Tzaneen area (Limpopo) seemed to show poor skin colour development when compared with fruit from the Kiepersol area (Mpumalanga). The effect of slope showed contradictory results when comparing the two production regions. Kiepersol ‘Hass’ avocado fruit from lower slope showed poor colour development compared with upper slope fruit. On the other hand, Tzaneen ‘Hass’ avocado fruit from upper slope showed poor colour development compared with lower slope fruit. Furthermore, inside and outside canopy ‘Hass’ avocado showed slight differences, with outside canopy fruit showing better skin colour development during ripening. Girdling had no significant effect on ‘Hass’ avocado fruit color development, irrespective of slope and production site. In addition, ripening temperature had no significant effect on ‘Hass’ avocado fruit skin development for early season fruit when compared with mid- and late season fruit.

Conclusions

In conclusion, multiple pre-harvest, physiological and genetic factors seem to play a role in ‘Hass’ fruit colour development. So far, this work has identified harvest time as the main factor affecting fruit colour change.

References

Mathaba, N., Mafeo, T.P., and Kruger, F.J. (2015). The skin colouring problem of ‘Hass’ avocado fruit during ripening. South African Avocado Growers’ Association Year book 38: 51-57.

Keywords

avocado, colour, lightness, chroma, hue angle, firmness

RESPONSES OF CITRUS ROOTSTOCK SEEDLINGS TO NEMARIOC-AL AND NEMAFRIC-BL PHYTONEMATICIDES

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Introduction

Technically, the Mean Concentration Stimulation Point (MCSP) is the concentration of a phytonematicide that stimulates plant growth (Mashela et al., 2015). The Curve-fitting Allelochemical Response Dosage (CARD) model generates biological indices used in the development of MCSP and the sensitivity indices (k values) of the variables. Generally, the lower the overall sensitivity ∑k value, the higher is the sensitivity of the plant to the test product. The objective of this study was to establish MCSP and ∑k values of Nemarioc-AL and Nemafric-BL phytonematicides on citrus rootstock seedlings.

Materials and Methods

Six parallel experiments were conducted using two phytonematicides and three citrus rootstocks. Uniform 5-month-old citrus rootstock seedlings were transplanted into 20-cm plastic pots filled with 3:1 (v/v) steam-pasteurised (300°C, 3 h) river sand and Hygromix-T growing mixture. Treatments, namely, 0, 2, 4, 8, 16, 32 and 64% dilutions of each phytonematicide were arranged in a randomised complete block design, with nine replications. At 84 days after inoculation, plant height and stem diameter were measured and shoots and roots were each oven-dried. Data were subjected to analysis of variance through SAS software and significant plant variables were further subjected to the CARD model to generate density-dependent growth (DDG) curves and their biological indices.

Results and Discussion

Treatment effects were significant on dry shoot mass, dry root mass, plant height and stem diameter for various combinations. The CARD model outputs demonstrated that plant variables each exhibited DDG patterns with increasing concentrations of each phytonematicide. The MSCP and k values for Nemarioc-AL and Nemafric-BL phytonematicides on citrus rootstock seedlings were within acceptable ranges. At the generated MCSP values, the two phytonematicides would not induce phytotoxicity to citrus plants, but would consistently suppress nematode numbers as shown in tomato production (Mashela et al., 2015).

Conclusions

The MCSP and k values suggest that the two products can be successfully used in managing nematodes in citrus production.

References

Mashela, P.W., Dube, Z.P. and K.M. Pofu. 2015. Managing the Phytotoxicity and Inconsistent Nematode Suppression in Soil Amended with Phytonematicides. In: Meghvansi, M.K. and A. Vorma (eds.). Organic Amendments and Soil Suppressiveness in Plant Disease Management, Soil Biology, vol.46. Springer International Publishers Heidelberg, Switzerland.

Keywords

Allelochemicals, Cucumis species, fermented crude extracts, phytotoxicity

EFFECT OF 1-METHYLYCLOPROPENE AND HARVEST TIME ON ‘HASS’ AVOCADO FRUIT SKIN COLOUR CHANGE

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Introduction

‘Hass’ avocado fruit is characterised by high ethylene production and skin color change from green to purple/black during ripening. However, countries importing South African ‘Hass’ avocado fruit report poor color development during ripening. According to Mathaba *et al*. (2015), poor fruit skin colour development during ripening is predominately an early harvest problem when compared with later season fruit. The industry uses 1-Methylcylopropene (1-MCP) to prevent soft landing during storage, with this product inhibiting ethylene activity and ripening. According to Woolf *et al*. (2005), 1-MCP reduced the ripening rate and colour change for late season ‘Hass’ avocado fruit. The aim of this research was to investigate the effect of 1-MCP and harvest time on skin color change of ‘Hass’ avocado fruit during ripening.

Materials and Methods

Avocado fruit of the ‘Hass’ cultivar were harvested during the early, mid and late-season from the Kiepersol area in Mpumalanga. After harvest they were transported to the ARC–TSC postharvest laboratory, where the fruits were sorted, graded and treated with 1-MCP (300ppm) for 18 hours at 5.5°C. Thereafter, they were stored at 5.5°C for 28 days. After withdrawal from storage, fruit were ripened at 21°C (commercial ripening temperature). During ripening, fruit were evaluated for firmness, ripening percentage and skin color (L, C, and hue angle) at 48 hour intervals until fully ripened.

Results and Discussion

In general, ‘Hass’ avocado fruit treated with 1-MCP took longer to ripen when compared with the control (untreated fruit) from all the harvest times. However, 1-MCP had no significant effect on ‘Hass’ avocado fruit colour development through the harvest season. Fruit colour (subjectively determined by eye) reached an average of ±75% colour development from all harvest times, irrespective of 1-MCP treatment. Similarly, objective colour parameters (L, C and h) showed no significant differences through the harvest season, irrespective of 1-MCP treatment. Nonetheless, fruit shelf-life was reduced as season progressed despite no significant colour changes.

Conclusions

In conclusion, the use of 1-MCP was effective in delayed ripening for early, mid- and late season fruit, but with no significant effect on the degree of skin colour change.

References

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Keywords

avocado fruit, *Persea americana*, firmness, lightness, chroma, hue angle, cold damage

Analysis of plant biomass carbon and its relationship with soil carbon stocks under different environmental conditions

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Introduction

Sequestration of atmospheric carbon into soils is one of the effective solutions to compensate for global emissions of carbon dioxide (Paustian et al., 2016). The response of SOCs to crop types is yet to be determined under different environments. The objective of this study was to elucidate the impact of crop type on the allocation of carbon to shoots and roots, and to the soils.

Materials and Methods

A comprehensive analysis was conducted using data extracted from 45 studies involving 391 trials from different environments. Literature was compiled from different academic databases using search engines such as Google Scholar, Refseek, Science Direct, SciFinder, Scopus, Springer Link and Web of Science. Vital general statistical parameters were computed from the data. Boxplots captured the first and third quartiles, median, mean and lower and upper limit values of non-outlier range. Principal component analysis (PCA) and correlation analysis were conducted to depict the trends in the relationship between plant biomass and C variables, SOCs and environmental factors.

Results and Discussion

Grasses had the highest mean plant biomass (19.77 ±1.30 Mg ha-1 yr-1), followed by cereals (9.44±1.30 Mg ha-1 yr-1), fibre (7.90±1.30 Mg ha-1 yr-1), legumes (3.29±1.30 Mg ha-1 yr-1), and oil crops (3.05±1.30 Mg ha-1 yr-1) showing significant differences ($p<0.05$). Among cereals, the highest mean plant carbon accumulation was found in maize (6.3±0.32 Mg C ha-1 yr-1) followed by wheat (2.2±0.32 Mg C ha-1 yr-1). All crops allocated more carbon in their shoots than in roots as shown by root C: shoot C (RC/SC) ratios below 1. The greatest C allocation to roots was found in grasses (RC/SC=0.78), followed by oil crops (0.49), legumes (0.29), cereals (0.24) and fibre crops (0.07). There was a tendency for high plant C stocks to be found under clayey soils of humid areas compared to sandy soils from dry and hot climates. Overall, the results indicated the highest carbon sequestration potential in soils of grasses, followed by oil crops. Maize and wheat are discussed in respect of climate, soil conditions, current land use and expected environmental benefits.

Conclusions

Biomass and carbon accumulation differed among main crops and the relationship between plant biomass and carbon and SOCs is affected by environment. Grass exhibited superior values for biomass and carbon accumulation. To fully exploit carbon sequestration by crops there is need for (1) phenotyping of roots and shoots (2) genetic sequencing of germplasm and (3) accurate tracing of C movement.

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Keywords

Carbon allocation, Cereals, C sequestration, plant biomass, root: shoot ratio, SOCs

Dynamics of long-term cold storage conditions for Fynbos products as relevant for sea freighting

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Introduction

Fynbos cut flowers from South Africa are transported under the conventional fixed open-air exchange vents (AirEx) system which is standard in sea freight and results in 15000 L/hr fresh air exchange. The Fynbos Industry is unable to utilise the new automatic ventilation device (AV+) technology due to absence of information on gas exchange dynamics and gas tolerance limits during storage. Lack of this information is limiting the utilisation of AV+ technology, which is considered to be the future standard technology in sea freight (Maritime Information Services, 2014; Moller, 2014)

Materials and Methods

The study was conducted in the 2014/2015 and 2015/2016 seasons using five farms in the Western Cape Province. Fynbos cut flower products from three genera i.e. Leucadendron, Protea and Leucospermum were used in the experiments. Respiration rate and the feasibility of closed ventilation shipping were evaluated. The LOL was determined using Harvest Watch DCA system and flowers were stored at 2% O2 and +0.4% O2 concentration above the determined LOL. Toxicity due to CO2 was assessed at 15% CO2 which was achieved through gradual and rapid increase. A complete randomized design was used and data analyzed using analysis of variance in Dell Inc. (2015) STATISTICA, version 12.

Results and Discussion

Respiration rates, LOLs and CO2 toxicity tolerances of Fynbos products were significantly different, both within and across the genera. No storage damage due to treatment was observed when CO2 was gradually increased but rapid CO2 increase resulted in lower quality product when compared with the control, especially in Protea. Both the 2% O2 concentration and control products had better vase-life quality when compared with the +0.4% O2 stored flowers. Moisture loss was lower in closed ventilation treated products and some products had better vase-life quality when compared with the control products.

Conclusions

Use of optimal DCA conditions and closed ventilation shipping reduces moisture loss and respiration rate; and ultimately, results in better post-storage quality of studied Fynbos cut flowers. Storage of studied Fynbos cut flower products under DCA requires the development of a product specific protocol and there is a need for further research to develop a system that is suitable for a wide range of Fynbos cut flower products.

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Keywords

Fynbos flowers, dynamic controlled atmosphere, AV+ technology, CO2 toxicity, lower O2 limit.

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Variations in nitrogen fixation, grain yields and water use efficiency of promiscuous soybean genotypes grown under field conditions at two locations in Mpumalanga Province, South Africa

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Introduction

Food insecurity is a chronic problem in Africa and is likely to worsen with climate change and increased population growth (Khan et al., 2012). Climate change has been predicted to increase the variability of agricultural production due to the increasing incidence of events such as drought (Keatinge et al., 2011). In particular, the production of grain legumes is severely restricted by drought through its effects on plant growth, the N2-fixing process (Figueiredo et al., 1999) and grain yields (Souza et al., 2004). Thus, this study was aimed at identifying soybean genotypes with high nitrogen fixation, grain yields, and water use efficiency when grown under rain fed conditions.

Materials and Methods

Nineteen Bradyrhizobium-inoculated and uninoculated soybean genotypes were laid out in a randomized complete block design at two contrasting locations, Marapyane and Nelspruit in Mpumalanga, South Africa. At flowering stage, five plants were sampled from each plot, oven-dried, weighed and ground. The 13C isotopic technique was used to screen for water use efficient genotypes, while the 15N isotopic technique was used to measure the rates of nitrogen fixation in the test genotypes.

Results and Discussion

The results showed significant differences in parameters measured. Grain yields of the genotypes ranged from 430 to 1379 kg.ha-1 at Marapyane and 1643 to 3814 kg.ha-1 at Nelspruit. The percentage of nitrogen derived from the atmosphere (%Ndfa) ranged from 55 to 88 % at Marapyane while at Nelspruit, %Ndfa values ranged from 47 to 88 %. Generally, the plants at Nelspruit recorded higher %Ndfa values and grain yields, however, most genotypes were not water use efficient. The soybean genotypes TGx1987-11F, TGx1987-62F and TGx1989-70F at the Marapyane site, and soybean genotypes TGx1987-11F, TGx1987-62F, TGx1988-9F and TGx1991-18F at Nelspruit were found to combine high nitrogen fixation, grain yield, and water use efficiency.

Conclusions

The genotypes which coupled high nitrogen fixation, grain yields and water use efficiency in the study areas can be suggested for use by farmers in those locations.

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Keywords

%Ndfa, 13C , 15N, Bradyrhizobium, climate change

EVALUATING THE EFFECT OF CULTIVATION PRACTICES ON FRUIT QUALITY AND SUCKER DEVELOPMENT OF SIX NEW QUEEN PINEAPPLE VARIETIES

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Introduction

Six new Queen pineapple varieties, namely, BR338, BR316C, SI087, TA039, GU044 and GU076, are currently under evaluation for adaptability to the Hluhluwe, KwaZulu-Natal, growing conditions. Different cultivation practices were evaluated to find the best practice for each variety. Swelpine® [2-(m-chlorophenoxy), propionic acid] is applied as a standard cultivation practice to shorten fruit crown length and increase fruit size. A study was conducted to determine the effect of Swelpine® [2-(m-chlorophenoxy), propionic acid] application on fruit quality as well as the time it takes for suckers to grow on the mother plant to reach a plantable size.

Materials and Methods

The experiment was conducted in Hluhluwe, KwaZulu-Natal (S2800’50, E32016’30) at the ARC-ITSC. Swelpine® [2-(m-chlorophenoxy), propionic acid] was sprayed at 2 l/ha at 100% dead petal stage to shorten fruit crown length and increase fruit size. The effect of Swelpine® [2-(m-chlorophenoxy), propionic acid] on fruit quality was evaluated against the control treatment (no Swelpine® applied). Suckers were harvested at fruit harvest, as well as at 4 and 8 months after fruit harvest, to determine the optimum time for growth on the mother plant for suckers to reach plantable size quality.

Results and Discussion

Swelpine® application improved fruit mass and decreased crown length of all varieties compared with the control treatment. Fruit treated with Swelpine® had a significantly higher infection of the fruitlet core with Penicilium funiculosum and Fusarium subglutinans and occurrence of waterlogging than fruit in the control treatment. Fruit in the control treatment had a significantly higher Brix % than fruit in the Swelpine® treatment. Previous studies showed that the new Queen pineapple varieties grow more vigorously and have a weaker apical dominance than the 'Natal Queen'. The new Queen varieties had a higher number of plantable suckers at fruit harvest than at 4 and 8 months after fruit harvest. The varieties BR338 and SI087 had the highest percentage of plantable suckers. The results showed that sucker size 3 to 5 harvested at fruit harvest, is less susceptible to natural flowering than size 1 and 2.

Conclusions

Swelpine® application increased fruit yield, but the internal quality of the fruit was negatively affected. Harvesting planting material at fruit harvest is the best cultivation practice for all the new Queen cultivars in terms of plantable sucker quality and quantity.

References

Keywords

Queen pineapple, cultivation practices, fruit quality, plant vigour, sucker development

INITIAL SCREENING OF SOYBEAN FOR MICROSATELLITE MARKERS CONFERRING RESISISTANCE TO SCLEROTINIA STEM ROT

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Introduction

Soybean is among the most important sources of protein providing protein to people of different dietary needs. Soybean importance lies not only on protein production, but also oil which is mainly produced in soybean grain. Unfortunately, soybean is also one of the crops whose production is severely affected by biotic stresses. Sclerotinia stem rot is among the most important biotic stresses that results in the reduction of soybean production in South Africa, affecting our economy and food security. Quantitative resistance of soybeans to Sclerotinia stem rot has been reported (Vuong et al, 2008) in cultivars that are grown in many other countries, but there has been no such study done for soybean cultivars that are currently commercially grown in South Africa. It is therefore important that soybean research does not only focus on increasing yield of soybean in normal conditions, but also under biotic stress conditions.

Materials and Methods

Twenty-nine soybean cultivars that are commercially grown in South Africa were selected; these will be evaluated for tolerance to Sclerotinia stem rot. Thirty microsatellite markers for soybean resistance to Sclerotinia stem rot were selected based on the available literature and on the quantitative trait loci (QTLs) that have been reported to be involved in soybean resistance to Sclerotinia stem rot. Each marker characteristic was evaluated using the SSR database published by Song et al. (2010) to see if it’s suitable for the study. The suggested primers for the markers were tested by amplifying soybean genomic DNA under different conditions. Twenty markers that were selected from the initial thirty were screened against two soybean cultivars that are known to be resistant/ susceptible to Sclerotinia stem rot. These markers will further be screened across susceptible and resistant soybean cultivars that are commercially grown in South Africa

Results and Discussion

Twenty microsatellite markers of thirty that were initially selected showed optimal amplification and a great potential to distinguish between known resistant and susceptible cultivars. The results obtained from the soybean trial against Sclerotinia stem rot will allow for identification of commercial cultivars that can be used as sources of resistance to Sclerotinia stem rot.

Conclusions

The selected markers are expected to distinguish between susceptible and resistant cultivars and will therefore be useful in marker assisted breeding to develop soybean cultivars with an increased degree of resistance to Sclerotinia stem rot.

References

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Keywords

Scerotinia, stem rot, soybean, microsatellite, resistance, quantitative

EVALUATION OF TEPARY BEAN ACCESSIONS FOR DROUGHT TOLERANCE AND YIELD RELATED TRAITS.

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Introduction

Tepary bean (Phaseolus acutifolius A. Gray) is the most drought-tolerant but neglected crop compared to other legumes; and has great potential for high production in dry environments. Limited studies are conducted on the physiological processes and mechanisms that may influence the response of tepary bean to drought. This study evaluated tepary bean genotypes for drought tolerance and yield related traits using phenotypic makers and physiological variables.

Materials and Methods

A two factor experiment was established at the University of KwaZulu-Natal, Controlled Environmental Research Unit (CERU) involving the following: water regime at 3 levels (control, mild, and severe-stress) and 20 genotypes. Treatment combinations were evaluated using a completely randomized design with two replications using 120 experimental units. Mild-stress (MS) and severe-stress (SS) were imposed by withholding water for 15 and 20 days respectively. The control treatment received irrigation thrice a week. Soil moisture content was monitored using the Hydro-Sense II (Campbell Scientific), Data was collected on number of pods per plant, seeds per pod, seed yield and 100 seed weight. Measurements were also taken on chlorophyll content, stomatal conductance, photosynthetic rate, relative moisture content (RMC) and water use efficiency (WUE). Data analysis was done using Genstat software 18th edition.

Results and Discussion

The results showed a significant water regime by genotype interaction with respect to seed yield ($P < 0.001$) and number of pods per plant ($P < 0.001$). The genotype G40069 performed the best under MS for seed yield and number of pods per plant with 11.75g/plant and 31 pods/plant, respectively. The interaction between genotype and water regime with respect to chlorophyll content was significant ($P \leq 0.01$). The genotype effect was significant with respect to stomatal conductance ($P \leq 0.05$). Results indicated a significant interactions among genotypes and water regime with respect to rate of photosynthesis. Genotype G40069 recorded the higher photosynthetic rate of 16.59 µmolCO_2m-2s-1 under SS. RMC was statistically non-significant for all genotypes under different water regime but genotype G40069 had the highest RMC (86%) under SS. The genotype by water regime interaction had a significant effect with respect to WUE.

Conclusions

The findings suggest that there are differences among tepary bean genotypes in their response to drought stress. The study concludes that yield is a good indicator for comparing drought responses in tepary bean. Genotype G40069 performed well under drought conditions and could be a useful source of germplasm for tepary bean improvement. The ability of this genotype to absorb enough moisture under stress conditions enhanced its yield level.

References

Keywords

tepary bean, drought stress, drought tolerance, genotype, yield

EPIGEAL ARTHROPODS IN CONSERVATION AGRICULTURE

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Introduction

Conventional agriculture practices such as continuous tillage leads to the disruption of soil structure and loss of fertile top soil resulting in a reduction of soil productivity. Conservation Agriculture (CA) is recognised as a way to combat soil deterioration brought on by conventional cultivation crop production. CA farming practices not only alter the physical and chemical properties of soil but concomitant changes in pest species and arthropod populations may occur. CA provides a different habitat for supporting pests and may increase, decrease or have no effect on pest or beneficial insect populations. The aim of the study was to evaluate the effect of conservation agriculture on the arthropod biodiversity when practices change from conventional to CA farming.

Materials and Methods

Arthropod data from two seasons were sampled by using dry pitfall traps. Collections took place at 6 localities namely: Ottosdal, Vredefort, Hartbeesfontein, Sannieshof, Kroonstad and Bothaville. A total of 14 sites were selected where well establish CA and conventional farming systems are practised. Thirty traps per site were then monitored for two consecutive weeks over a 4-month period. Diversity indices as well as a T-test for the total number of arthropod morpho-species and individuals were calculated to measure the diversity in the different communities.

Results and Discussion

A total of 38 803 arthropod individuals, comprising 148 morpho-species from 14 orders were collected during this study. There was a significant difference in the mean number of individuals and morpho-species between CA and conventional farming systems.

Conclusions

Arthropod biodiversity in CA systems are greater than in conventional farming systems. CA contribute to a healthier biodiversity and more stable agro-ecosystem. It is important to conduct further studies on ecosystem services provided by the increased number of arthropod groups recorded in CA systems. From the past seasons data, the potential of ecosystem services was observed and need further trials to compile sufficient data.

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Keywords

Soil erosion, biodiversity, arthropods, conventional and conservation agriculture

COMPARING APPLE ORCHARD FLOOR MANAGEMENT PRACTICES USING SOIL ALTERATION INDEX THREE (AI3)

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Introduction

Alteration index three (AI3) quantifies the balance between three microbially-secreted soil enzymes, i.e. β-glucosidase, urease and phosphatase. Internationally, testing has shown that AI3 is 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, AI3 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 test the ability of AI3 to distinguish between management regimes in relation to compost/mulch, ARD/fumigation, and different cover crop treatments, and to soil/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

Generally, better AI3 indices, and by inference, better soil health, were associated with top- than subsoil soils, which reflected gradients in mineralizable substrates across soil layers. Indices were better under mulching than bare soil, confirming the known positive effects of mulching on soil. Indices differentiated between cover crop practices; better AI3 indices were associated with nitrogen fixing cover crop species and species with bio-fumigant properties than a permanent weed cover. Indices distinguished between rootstock genotype response. Lack of distinction between ARD and fumigation treatments was presumably due to microbes in fumigated soils that had reverted back to that in control soils at the time of sampling. Correlations between AI3 and soil chemical and tree parameters were inconclusive, which is probably due to slower chemical and tree reactions to treatments.

Conclusions

These findings attest to the usefulness of AI3 as an indicator of soil health in local apple orchards.

References

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Keywords

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

An overview of crop production practices by small scale farmers in the Eastern Cape Province

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Introduction

Crop production in the Eastern Cape Province is dominated by small-scale farmers for subsistence purposes. Small-scale farming contributes significantly to house-hold food security in the province, since majority of the population relies mainly on agriculture for sustenance (Jane et al., 2010). The paper provides an overview of crop production practices employed by small scale farmers and the influence of indigenous knowledge systems in the different agro-ecological zones in the province.

Materials and Methods

A total of 234 crop producing small-scale farmers were selected using the convenience and purposive stratified sampling procedures. The farmers were interviewed using semi-structured but detailed questionnaires which were adapted during July to November 2012. The focus was on indigenous knowledge systems, cultural and management practices and how these influenced crop type choices, cropping systems, planting dates and pest management strategies. Data was analysed using descriptive statistics.

Results and Discussion

The majority of the farmers produced crops such as maize, cabbage, potatoes, spinach, potatoes, pumpkins, carrots, tomatoes, peas, beetroot, onion, butternut etc. The importance of these crops to the farmers and the benefit they brought ranged from house-hold use, income generation and for animal feed. These were either grown under mono-cropping, intercropping or multiple cropping systems. Famers' reasons for mono-cropping includes the prevention of competition between plant species and that genetically modified plants are not supposed to be planted with other crops. Intercropping and multi-cropping was mostly done for risk aversion, food security and to cut fertiliser costs. Variations in crop type choices were common. An example of the variation in planting dates would be that of maize, where some farmers indicated that they plant in September, others October or November. Similarly, weed and pest management approaches varied, for instance some farmers relied on plant extracts for managing insects and diseases, while others used synthetic insecticides. Still yet others used a combination of botanical insecticides and other chemicals such as diesel while others were not controlling at all though they had a pest problem.

Conclusions

The variation among responding farmers, in planting dates, crop type choices, pest management strategies and cropping systems indicate that there is a need for researchers and scientists to work closely together with small-scale farmers and recommend ways in which these could be harnessed for best practice.

References

Jayne, T.S., Mather, D. and Mghenyi, E. 2010. Principal Challenges Confronting Smallholder Agriculture in Sub-Saharan Africa. World Development, 38 (10): 1384-1398.

Keywords

Crop production practices, small scale farmers, Indigenous Knowledge Systems (IKS)

OVERCOMING THE CHALLENGE OF PHYSICAL SEED DORMANCY IN BAMBARA GROUNDNUT BY SCARIFICATION - A SEED QUALITY STUDY

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Introduction

Bambara groundnut (Vigna subterranea L.) is an underutilized African legume crop. It has a potential to play a significant role as a staple and industrial crop of sub-Saharan Africa, competing with common beans and soybeans under harsh conditions associated with climate change. However, there are challenges associated with successful production of Bambara groundnut. One of these is poor crop establishment due to seed coat induced dormancy.

Materials and Methods

Bambara groundnut landrace seed were characterized by seed coat colour (cream, light brown and brown). A completely randomized design was used to test for seed water activity, moisture content and 1000 grain mass. Standard germination was used to determine the effects mechanical and chemical seed scarification treatments under laboratory conditions according to the standard rules for seed testing. Mean germination time (MGT), germination vigour index (GVI) and seedling size were determined. The laboratory test was undertaken simultaneously as a completely randomized field trial to determine seedling emergence. All experiments were replicated three times and results analysed using Genstat version 17.

Results and Discussion

Water activity, moisture content and 1000 grain mass showed no significant differences among seed lots. There were highly significant differences ($P < 0.001$) between seed colour and scarification as well as interaction of these factors with respect to germination. Brown seeds had the highest (85%) final germination and cream had the least (83%). Imposing chemical and/or mechanical scarification improved germination as compared no scarification. Scarified seeds and brown seeds were the quickest to germinate. There were significant differences between seed colour ($P = 0.035$) and scarification ($P = 0.002$) as well as interaction of these factors ($P < 0.001$) with respect to field emergence.

Conclusions

Seed quality in Bambara groundnut is highly influenced by scarification and seed colour. The practical implications of the study are that producers can use scarification to improve Bambara groundnut germination, however with limited improvement of stand establishment. Further research is still needed to determine seed coat constituents that influence seed quality.

References

Keywords

Germination, scarification, viability, vigour

FIELD SCREENING OF MAIZE GENOTYPES FOR TOLERANCE TO ACIDIC SOILS OF MHLONTLO LOCAL MUNICIPALITY IN O.R.TAMBO DISTRICT, EASTERN CAPE

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Introduction

Maize production rarely accomplishes household food self-sufficiency in the eastern part of the Eastern Cape because most soils are acidic. As a result, many families have to purchase maize during part of the year in order to meet their requirements. To ameliorate soil acidity and achieve maximum crop yields, regular application of lime is required. However, resource-poor farmers do not afford to apply optimum quantities of lime. This study was therefore conducted to explore the alternative option of using acidity tolerant maize varieties.

Materials and Methods

A field experiment was conducted at Mbinja and Mpumaze Villages in Mhlontlo Local Municipality to evaluate ten maize varieties (hybrids and open-pollinated) namely: PAN 6616, PAN 6966, PAN 6P 110, PAN 6Q 408, PAN BG 3492 BT, PHB 32 W 71, PHB 33H 56, PHB 3442, Sahara and Ngoyi. The trial was arranged as a split plot in a Randomised Complete Block Design (RCBD) replicated three (3) times. Main-plots consisted of limed and un-limed plots, while the sub-plots comprised of the ten varieties. Each plot consisted of five rows per variety, measuring 5 m in length.

Results and Discussion

At Mpumaze, a local landrace cultivar, Ngoyi, gave the highest yield of 7,5 tons ha-1 when lime was applied according to recommendations while hybrid cultivar PAN BG 3492 BT gave the lowest yield of 1,79 tons ha-1 when lime was not applied. At Mbinja, the highest yielding cultivar under recommended rates of lime application was PAN 6Q 408 which gave 6,77 tons-1 ha-1, while PHB 3442 gave the least yield of 4,05 tons ha-1 when lime was not applied.

Conclusions

Land-races are normally lower yielding when compared to hybrids, however, Ngoyi out-yielded hybrids under limed conditions at Mpumaze. This could probably suggest that lime effect was not evident after one season of application.

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Keywords

food self-sufficiency, land-races, maize production

THE IMPACT OF A ONCE-OFF PHOSPHATE FERTILIZER APPLICATION ON SOIL NUTRIENTS AND MICROBIAL COMMUNITIES IN GRASS-LEGUME MIXTURE AT LUSHINGTON, EASTERN CAPE, SOUTH AFRICA.

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Introduction

The Eastern Cape Province has approximately 750 000 ha of degraded arable lands (Jordaan, 2010). These lands are of poor grazing quality due to low protein content of pasture grass species. The nutrient deficiency can be addressed by introduction of pasture legumes. The objective of the study was to assess the soil nutrient and microbial properties following a once-off 200 kg ha-1 superphosphate fertilizer application in a grass-legume pasture.

Materials and Methods

The experiment was conducted at Lushington where plots were treated with and without phosphorus (P). Legumes; including Arrowleaf clover (AL) and Lezpedeza (LEZ) were planted during 2007/2008 season using the seeding rate of 40 kg ha-1 for 8 legumes and received a once-off 200 kg ha-1superphosphate. Glyphosate was sprayed for weeds. Treatments were AL-P, AL+P, LEZ-P, LEZ+P and Control (natural grasses). Soil samples were taken from 2012 to 2016 for analyses of N, P, K, Ca, Mg, Zn, Mn, Cu, pH; and assessment of arbuscular mycorrhizal (AM) spore counts, bacterial colony forming units (CFU) and microbial functionality assessment using the Biolog Ecoplate system. Roots of legumes and grasses were also sampled for determination of mycorrhizal colonization.

Results and Discussion

Significant differences ($p<0.0001$) were observed in number of AM fungal spores between years and in treatment-year interaction ($p=0.0105$) and this may be attributed to climatic conditions during the sampling years. There were no significant differences in CFU's, total C utilization but significant differences ($p<0.0001$) were recorded for utilization rate of selected C sources. Similar trend was observed in species evenness and diversity. No AM mycorrhizal colonization was observed in the roots and the suspicion was in glyphosate application on the plots at establishment. Extractable mg kg-1of P, K, Mg, NO3-N, NH4-N, Zn, Mn, Cu, Total cations (in cmolc l-1) and pH (KCL) showed very high significance differences ($p<0.0001$) due to treatment, year and treatment-year interaction effect. Total N (mg kg-1) and C (mg kg-1); Ca (mg kg-1), exchangeable acidity (in cmolc l-1) and id saturation were significantly different amongst treatments. No significant differences were observed as a consequence of year effect in Total C. There were high to very high significant differences ($p=0.0001$ to $p<0.0001$) as a result of treatment-year interaction effect for the latter nutrients excluding N. Nutrient removals were attributed to grazing animals.

Conclusions

A once-off application of superphosphate fertilizer had an effect on soil properties. Concerns on effects of glyphosate on natural mycorrhizal populations in the grass-legume mixture of Lushington were raised.

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Keywords

Legumes, soil nutrients, mycorrhiza

Classification of smallholder farmers for effective rainfall variability management in South Africa

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Introduction

Increased rainfall variability is one of the major challenges facing smallholder farmers in South Africa (Thomas et al., 2007). The impacts are projected to be severe amongst resource constrained households practicing rain fed farming (World Bank, 2007). Extensive research on rainfall variability and water management has been undertaken in southern Africa (SSA) (Mupangwa et al., 2016). The limited adoption of these research outputs and increased farmer diversity warrants use of the farm typology approach (Tshoni, 2015).

Materials and Methods

A household survey was undertaken in Alice and Lambani, Eastern Cape and Limpopo provinces of South Africa respectively. The survey collected data on household demography and economics; asset ownership; crop and livestock dynamics and production. A two-step cluster analysis was conducted using SPSS classifying farmers based on the predominant socio-economic and farming system characteristics. Literature review was conducted to document research recommended rainfall variability and water management strategies within southern Africa. Strategies were then linked to corresponding farmer typologies based on potential compatibility hinged on resource endowment, labor and literacy.

Results and Discussion

The most dominant farmer types were: (1) Old and resource constrained farmers with less household labour and livestock. These farmers are compatible with labour and cost saving strategies like conservation agriculture based techniques which include: mulching, basins, potholing, rotations and use of indigenous crop seeds. Intercropping maximises productivity and reduces risk in small landholdings. (2) Young, labour endowed and food insecure farmers with small farm sizes. They can practice inter- and multiple cropping. Farmers can also use practise organic farming i.e. manure use, alter plant density and cropping dates which is compatible with semi-literacy levels. (3) Formally employed, literate and resource endowed. Resource endowment enables them to purchase improved drought tolerant seed, irrigation and chemicals to reduce transpiration. They can access seasonal forecast information through the internet, television and farmer organisations. Improved literacy enables them to undertake take up integrated pest and nutrient management (Ajani et al., 2013).

Conclusions

Different farmer typologies exist within South Africa and are differentiated by resource endowment, literacy and labor. Resource endowed farmers potentially utilize strategies that need financial resources e.g. improved seed and irrigation. Labor deficient farmers need labor saving strategies like conservation agriculture. Under limited landholding intercropping maximizes productivity and reduces risk. Households with reduced literacy utilize less complex strategies. Research recommends use of focus group discussions with farmers to verify typologies and rainfall variability management strategies. Simulation modelling ascertains the impacts of the intervention of scenarios.

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Keywords

smallholder farmer, rainfall variability, framer typology, rainfall variability management strategies

POTENTIAL TO COMMERCIALIZE AND DEVELOP PRODUCTS FROM INDIGENOUS VEGETABLES: A CASE STUDY OF AMARANTH (AMARANTHUS CRUENTUS L.)

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Introduction

Amaranth (Amaranthus cruentus L.) is one of the indigenous vegetables that has been promoted because of its ability to supply proteins (3.2 g), vitamin A (1.8 mg), vitamin C (36 mg), Ca (305 mg), Fe (3.8 mg) and Zn (0.7 mg) fresh weight nutritional value per 100 g (Yang and Keding, 2009). Amaranth offers comparable nutrients in relation to spinach, yet it is able to survive under harsh climatic conditions. It was also further observed that it can be profitable in small scale production units. However, there is no information on its commercialization. This motivated Nestle, to support its commercialization and product development.

Materials and Methods

Farmers were sourced in North West (Brits) by TechnoServe (TNS), and about 5 ha of land was allocated for growing the crop. Agricultural Research Council-Vegetable and Ornamental Plants (ARC-VOP) provided seeds, offered the commercialisation production guideline and gave technical support for all activities. The leaves were separated from stems and transported to Council for Scientific and Industrial Research (CSIR) for agro-processing which included washing, blanching, drying and grinding to fine powder. The powder was taken to Babalegi factory for making Maggi 2-minute noodles.

Results and Discussion

According to production guideline developed, the expected fresh yield for four harvests were 3, 5.25, 5.25 and 1.5 ton with a total expectation of 15t/ha. Results from the field showed that the first and second harvests were 4.6 and 4.5 respectively. It is important to note that the recorded masses were captured in the afternoon, when they had lost about 20% moisture. The yield could have been 5.6 and 5.4 ton/ha if moisture was not lost for these harvests. Indications from these harvests show that the actual harvests exceeded the estimated. The return on investment of amaranth per ha was approximately R25 059.00 based on an input cost of R50 000.00. The harvested material was processed and used to develop a new locally grown and manufactured consumer product, Maggi 2-minute Morogo noodles.

Conclusions

The production guideline developed on indigenous vegetables is relevant and can be used for commercialization of the crops. Amaranth shows good potential to be commercialized and farmers can be encouraged to cultivate it in order to generate income.

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Keywords

amaranth, production guidelines, Maggi 2-minute Morogo noodles, commercialization

HARVEST MATURITY EFFECT ON MAIZE SEED QUALITY

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Introduction

Seed quality is important for all seed categories, including breeder, foundation and certified seed. The need to harvest seed before harvest maturity is usually associated with plant breeding programmes. Studies to understand seed quality when seed is harvested before harvest maturity are also necessary if seed production occurs off-season. The objective of this study was to determine the effect of harvest maturity and drying method on maize seed quality.

Materials and Methods

Four maize cultivars were planted at three sites in KwaZulu-Natal, South Africa using a completely randomised design, replicated three times. The crop was grown under rainfed conditions with optimum fertiliser application at 40 000 plants/ha. Six cobs were harvested from the inner sampling rows of the experimental plots at two stages of grain maturity, physiological (25% moisture content) and harvest dry (11% moisture content). The early harvested seed was subjected oven-drying (60oC for 24 h) and another seed lot was air-dried (25oC and 60% RH) for seven days. Seed moisture content, water activity, 1000 grain mass and germination were determined according to the International Seed Testing Association (ISTA, 2016) rules. Data were analysed using Genstat, version 17 and differences between means were determined at $P \leq 0.05$.

Results and Discussion

There were no significant differences between sites with respect to all parameters at physiological and harvest maturity. However, there were significant differences between cultivars with respect to all parameters at both physiological and harvest maturity. The water activity of seed at physiological maturity was 0.95 compared with 0.5 at harvest maturity and this was a highly significant difference. When seed was oven dried its water activity was 0.3 compared with 0.54 after air-drying seed. Water activity is an indication of physiological activities associated with key metabolic events for seed quality. Seed germination is a recognised determinant of seed quality. Seed germination level at physiological maturity was 20% compared to 85% at harvest maturity, 83% after air-drying and 10% after oven-drying. Thus, air-drying was a suitable method of drying seed compared to oven-drying.

Conclusions

Maize can be harvested at physiological maturity and air-dried without losing germination quality. Oven-drying seed at high moisture content has a negative effect on germination. Future research should look into different temperatures and methods of artificial drying.

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Keywords

Air-drying, Germination, Oven-drying, Water activity

Propagating African potato by inducing corm buds

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Introduction

African potato (*Hypoxis hemerocallidea*) is facing rapid decline of wild populations due to large scale harvesting, necessitating efficient means of propagation. The species is among popular herbal remedies consumed as immune boosters by people with HIV/AIDS in South Africa. The species had already reached a “declining” status on the Red Data list of South African plants, in 2008. The only viable alternative to unsustainable wild harvesting of the species, is propagation and domestication. African potato has been identified as difficult to propagate because seed dormancy is not easily broken and the species does not propagate easily from corms. Many studies have been conducted to optimize African potato propagation using tissue culture, but there is little to no research on other techniques requiring less infrastructure.

Materials and Methods

African potato corms were classified into three sizes based on their circumference. The three size classes were small (14 – 20 cm), medium (21 – 28 cm) and large (>28 cm) in circumference. Three different cutting methods were used to expose the growth points or adventitious buds on the corms, thus initiating formation of “daughter corms”. The methods were (i) scooping, where the growth tip was removed by hollowing out the corm from the top, using a sharp sterilized knife; (ii) cross-cutting, where the corm was cut horizontally across the growth tip and (iii) chipping, where the corm was cut vertically into four sections. The study was conducted as a pot trial, under a shade net structure (40% shade effect, grey colour), with the growing medium of 50/50 (v/v) red top soil and bark compost.

Results and Discussion

Large corms combined with chipping and scooping produced the highest number of “daughter corms” at the end of the study. The cross-cutting method did not produce “daughter corms” for any of the three corm sizes. At the end of the experiment there were significant differences in terms of number of leaves formed between the small chipped and medium scooped corms as well as the small chipped and small scooped corms. Large chipped corms produced significantly larger “daughter corms” than all three corm sizes in the scooping method.

Conclusions

A simple technique for propagation of African potato corms was developed for resource poor farmers. From this study, it can be recommended that large corms and the chipping method be used for in vegetative propagation of African potato. This is the first report demonstrating the potential of in vivo multiplication of African potato.

References

Keywords

Hypoxis hemerocallidea, in vivo propagation, scooping, cross-cutting, chipping

Appraisal of farmers' sorghum production constraints and variety preferences in the Limpopo Province, South Africa

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Introduction

Participation of farmers in crop breeding programmes is vital for the evaluation and selection of candidate varieties to widen and enhance the adoption and use of newly developed cultivars. The objective of this study was to determine sorghum production constraints, farmers' preferred sorghum traits and ideal varieties under smallholder farming systems in the Limpopo Province of South Africa.

Materials and Methods

A participatory rural appraisal (PRA) was conducted during 2013-2014, involving 311 farmers in two districts and four municipalities known for their sorghum production. The PRA tools used were semi-structured questionnaires, group discussions, key-informants, matrix ranking and transect walks. Both primary and secondary data were collected. The data were analysed using cross tabulations in SPSS statistical software.

Results and Discussion

Results indicated that the production constraints to sorghum production in the study areas, in descending order of importance were bird damage, storage pests (weevils), parasitic weeds (Striga species), drought and postharvest diseases. Respondent farmers indicated that their ideal variety/ies should have good taste, high yield, resistance to bird damage, insect pests (weevils) and diseases, early maturity and drought tolerance.

Conclusions

Incorporating farmer's preferred traits in sorghum breeding programmes would enhance adoption and use of improved cultivars in the study areas.

References

Keywords

Farmers' preferred traits, Limpopo Province, participatory rural appraisal, sorghum

SOIL FERTILITY, YIELD AND FRUIT SIZE OF AVOCADO AS INFLUENCED BY DIFFERENT MULCH TYPES

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Introduction

Mulching is described as the application of any layer of plant or other suitable organic material to the surface of the soil (Wolstenholme et al., 1996). Comprehensive studies have focused on the benefits of mulching avocados in relation to promoting root health, ameliorating tree stress, and improving yield and fruit size and also as a treatment for Phytophthora cinnamomi (Wolstenholme et al., 1996; Moore-Gordon, 1995. Reasons for avocado growers avoiding mulching are cost and availability of mulching materials. However, the benefits of locally available mulching materials on selected soil health indicators, avocado yield and fruit size should be further investigated.

Materials and Methods

A field trial was conducted at ZZ2 orchards (Mooketsi and Politsi), Limpopo, South Africa, to track changes in soil chemical composition, leaf chemical status, fruit size and yield of Hass avocado. The trial was laid out in a complete randomised design with three replications consisting of 15 trees per replication. Treatments consisted of three mulch types, grass, Eucalyptus species raw chips, composted wood chips and untreated control. soil samples were collected at a depth 30 cm and analysed for chemical properties 12 month following mulch application. Yield, fruit size and leaf nutrients status data was collected in April to May 2016. Collected data was subjected to analysis of variance using Statistix 10.0 and Fisher’s least significant different test was used to separate treatment mean at 5% probability level ($p \leq 0.05$).

Results and Discussion

Composted woodchips significantly increased soil potentially mineralizable nitrogen (PMN), P, Ca, K and Mg than other treatments at Mooketsi, while no treatment effect was observed at Politsi. Treatments showed no significant difference on soil NO3-N and NH4-N. Application of raw and composted Eucalyptus wood chips increased leaf N content, followed by grass, while the lowest was recorded on untreated control at Mooketsi, whereas there were no significant changes at Politsi. Similarly, leaf boron content was higher on mulched treatments compared to the untreated control. Composted woodchips gave significantly higher yield (17 ton/ha) at Politsi farm, followed by grass (11 ton/ha), while there was no significant difference between raw chips (9 ton/ha) and untreated control (8 ton/ha). Yield didn’t differ significantly between the treatments at Mooketsi. Treatments showed to have no significant effect on fruit size.

Conclusions

Composted wood chips showed a positive effect on soil chemical composition, leaf Nitrogen and the subsequent yield. Composted Eucalyptus species mulch presented a vital option for long-term soil fertility management and increased yield as a result.

References

Keywords

Keywords: Soil fertility, avocado yield, Mulch

Symbiotic N2 fixation and grain yield of the under-utilized Kersting’s groundnut (Macrotyloma geocarpum Harms) landraces in response to inoculation with Bradyrhizobium sp. under field conditions in Ghana

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Introduction

Kersting’s groundnut is an orphan grain legume that faces extinction partly due to lack of research to improve the crop. This is despite that the seeds have high nutritional value (Ayenan and Ezin, 2016) and the crop exhibits nitrate tolerant symbiosis (Dakora, 1998) and drought tolerance, making it suitable for tropical cropping systems. Presently, there are scanty reports on the N2-fixing potential of existing landraces via symbiosis with rhizobia. This study assessed N2 fixation in eight Kersting’s groundnut landraces in response to inoculation with Bradyrhizobium sp. (B. japonicum CB756 and B. sp. 3267) at three locations (Savelugu, Tamale and Nyankpala) in Ghana.

Materials and Methods

Eight Kersting’s groundnut (Puffeun, Boli, Dowie, Funsi, Sigiri, Heng milk mottled and Heng red mottled) landraces and three levels of inoculation (B. japonicum CB756, B sp. 3267 and control/uninoculated) were laid in a randomized complete block design with four replications at three locations (Nyankpala, Savelugu and Tamale). At the early podding stage of all landraces, five plants were sampled per plot, separated into nodulated roots and shoots, and assessed for nodulation and plant growth. Oven-dried (65oC for 48 hours) shoot samples were ground (0.50 mm sieve) and subjected to 15N isotopic analysis to quantify N2 fixation. Data collected were subjected to analysis of variance using Statistica (version 10).

Results and Discussion

The present study revealed significant variations in the shoot δ15N values of the test landraces due to differences in N2 fixation. The test landraces obtained between 48 – 71% of their N demands from symbiosis, and was evidenced by relatively lower soil N uptake (21 – 49 kg N ha-1) and δ15N values. The amounts of N-fixed by the landraces ranged between 41 to 72 kg N ha-1, and closely mirrored patterns of plant growth. Lower δ15N values resulting from inoculation with either inoculants or non-inoculation translated into greater dependence on symbiosis. The landraces showed variations in their response to inoculation within and between the test locations. The landraces Heng Milk Mottled, Heng Red Mottled, Nakori and Sigiri fixed higher amounts of N in at least two of the locations. Grain yields of the landraces were generally low, and ranged from 164 – 959 kg.ha-1.

Conclusions

Although the N demands of some landraces were largely met through symbiosis, this study opens a window for studies to further research to optimize the process in the test legume by exploring the symbiotic efficacy of indigenous rhizobia nodulating the crop in African soils.

References

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Keywords

Symbiosis, inoculation, Bradyrhizobium, landraces

Host-status and host-sensitivity of beetroot to M. incognita race 2 under greenhouse conditions.

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Introduction

Recognition of health benefits from beetroots (*Beta vulgaris*) is internationally increasing. Most beetroot cultivars used in South Africa have been bred abroad for various attributes, which include nematode resistance. Until 2005 when methyl bromide was completely withdrawn from the agrochemical markets, the use of nematode resistance as a strategic management tool was a non-issue (Mashela et al., 2015). However, the root-knot (*Meloidogyne* species) nematodes have a wide range of species and races, which may differ from country to country. The objective of the study was to investigate the host-status and host-sensitivity of beetroot to *M. incognita* race 2 under greenhouse conditions.

Materials and Methods

Six-week old seedlings of cv. ‘Detroit Dark Red’ were transplanted into 20-cm-diameter pots, filled with steam-pasteurised sand and Hygromix-T at 3:1 (v/v) ratio. The treatments, namely, 0, 50, 75, 125, 250, 500, 1125 and 2625 eggs and second-stage juveniles (J2) of *M. incognita* race 2 were arranged in a randomised complete block design, with 6 replicates. Seedlings were fertilised at transplanting using 5 g 2:3:2 (22) NPK and irrigated every other day with 250 ml water. At 56 days after inoculation, nematode and plant variables were collected and subjected to analysis of variance.

Results and Discussion

In plant parasitic nematology, resistance, tolerance and susceptibility are measured in terms of host-status and host-sensitivity. Host-sensitivity measures the yield loss due to nematode infection. In this study the plant variables were not affected. The host status is described using the reproductive factor (RF), which measures the reproductive potential of a nematode on a given host. A host that allows reproduction of nematodes but does not suffer yield loss is referred to as a tolerant host, while a resistant host is one that does not suffer yield loss where and the reproductive factor is below one. In this trial the reproductive factor values were greater and less than one at low and high initial populations of *M. incognita* race 2, respectively. However, the plant variables were not affected by nematode infection.

Conclusions

Results of this study suggested that this cultivar, 'Detroit dark red', was tolerant to *M. incognita* race 2 and therefore, is not suitable for use in areas with high nematode population densities of this race since they will result in successive crop losses. **????You said there were no losses in the results and discussion - even when populations were high enough to reproduce you said there were no effects on plant variables.**

References

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Keywords

Pathogenic, resistant, root-knot nematodes, susceptible, tolerant

EFFECT OF SELECTED PRODUCTION SITE, WAX PLUS DEHYDRATION AND COLD STORAGE TEMPERATURE ON RIND PITTING DEVELOPMENT ON “TURKEY” SWEET ORANGE

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Introduction

Citrus rind pitting is a physiological disorder that reduces the commercial value and marketability of citrus fruit (Maritz, 2000). The disorder is unpredictable and its incidence and severity varies from season to season and region to region. Alférez et al. (2003) reported that citrus rind pitting may also occur prior to harvest at the time of fruit ripening when temperature and relative humidity decreases and. However, the effect of production site, waxing, dehydration and storage temperature on rind pitting development of “Turkey” is not documented. The current study aims to investigate the effect of these factors on rind pitting development.

Materials and Methods

"Turkey” fruits were harvested from Tzaneen, Groblersdal, Pongola and Musina. Fruits were transported to the postharvest laboratory at ARC-TSC in Nelspruit. At the laboratory, fruits were dipped in a Sporekill® solution, re-packed into small crates (30 fruits per crate) and subjected to three waxing plus dehydration treatments (no wax + dehydration, wax + dehydration and wax + no dehydration) with three replicates per treatment. Thereafter, fruits were subjected to cold storage (-0.6 and 4.5°C) for 28 days. After 28 days of cold storage, fruits were evaluated for rind pitting, weight loss, firmness, total soluble solids, titratable acidity, Brix° and total electrolyte leakage and kept at room temperature for 7 days to allow for physiological disorders to manifest.

Results and Discussion

Rind pitting was more severe on Groblersdal wax + dehydration fruits when compared with Musina, Pongola and Tzaneen fruits stored at -0.6°C . Slight rind pitting was also observed on Musina no wax + dehydration fruits when compared with other production sites under -0.6°C conditions, no pitting oberseved on. A significant increase in weight loss percentage and firmness loss was observed on no wax + dehydration fruits when compared with wax + dehydration and wax + no dehydration at -0.6°C, for all production sites. Total electrolyte leakage was highly significant on Pongola no wax + dehydrated fruits, stored at -0.6°C,with no significant changes in internal quality parameters. Storage temperature 4.5°C had no effect in all treatments.

Conclusions

In conclusion, storage temperature (-0.6°C) had a significant effect on external quality in most cultivars. However, the internal quality variables were not affected by -0.6°C storage temperature, regardless of production site. The no wax + dehydration treatment also affected fruit weight, total electrolyte leakage and rind pitting.

References

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Keywords

rind pitting, production site, storage temperature, sweet orange

Phenology of Honeybush (Cyclopia genistoides and C. subternata) genotypes

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Introduction

Cyclopia, also known as “honeybush”, is a largely unstudied leguminous genus of South African herbal teas restricted to the megadiverse Cape Floristic Region. Presently, intra- and interspecies information on the phenology of Cyclopia is scarce, yet this is important in providing information on the timing of plant development and growth, species co-existence and growth dynamics of the genus. This study determined the monthly genotypic variation, the start time and duration of phenological phases in genotypes of *C. subternata* and *C. genistoides*.

Materials and Methods

Five randomly selected plants of 15 and 22 genotypes grown from rooted cuttings of *C. genistoides* and *C. subternata* respectively in 2011, were sampled. Data comprised weekly observation of plants using visual estimates of phenophases. Observations were scored on a 0 – 100 scale with 10 increments per individual plant. Data were collected in July to December of 2013 and 2014. Four phenophases were observed; budding, flowering, fruiting (pod formation) and seed dispersal (harvesting).

Results and Discussion

Budding significantly peaked in July for *C. subternata*, whilst extending to August in *C. genistoides*. However, the majority of both species genotypes significantly flowered in September; with pod initiation and development peaking in October, and seed dispersal in late November extending to early December in *C. genistoides*. Compared to *C. genistoides*, *C. subte*rnata genotypes had a shorter time (days) to start of flowering (25.9 versus 51.2), fruiting (46.1 versus 61.5) and harvesting (96.3 versus 110.0). However, the duration (days) of flowering (13.2 versus 24.3), fruiting (45.6 versus 52.2) and seed dispersal (4.3 versus 8.9) was shorter in C. genistoides. Phenology in C. subternata was 2-3 weeks earlier compared to C. genistoides.

Conclusions

These findings are insightful in reproductive, morphological and physiological studies in the Cyclopia genus, and will assist farmers and researches for timing of crop requirements and management practices, that have practical implications in the cultivation of the species (uniform flowering, pollination trials, time for seed harvesting dates and strategies to avoid seed loss).

References

Keywords

Cyclopia, phenology, budding, flowering, fruiting, seed dispersal

Essential oil yield and composition of African wormwood (Artemisia afra) found in different agro-climatic zones of the Eastern Cape, South Africa.

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Introduction

The genus Artemisia is characterised by a wide range of morphological and phytochemical variabilities, which are associated with the different geographical origins of the plant samples. The main components of the volatile secondary metabolites in the populations of *Artemisia afra* vary from one geographical region to another (Abad et al., 2012). Cultivation methods, fertilization, irrigation and harvesting date can also affect the composition of essential oils (Nurzynska-Wierdak, 2013).

Materials and Methods

A study was conducted to characterise essential oil yield and composition of *A. afra* collected from 6 agro-climatic zones of Eastern Cape (Bizana, Indwe, Kolomana, Mt Fletcher, Ngqeleni, and Adelaide). Soil and shoots of *A. afra* were collected from the six agro-climatic zone. Soil and plant mineral content analyses were conducted at the Dohne Agricultural Development Institute laboratory to determine macro- and micro-nutrients. Essential oils were extracted from fresh *A. afra* plant shoots, using steam distillation to determine oil content. Gas chromatography (GC), with mass spectrometry was used for the identification of essential oil chemical components. For quantification of components, a flame ionization detector (FID) was used. The GC temperature program had an initial temperature of 60 ºC and a temperature ramp of 3 ºC/minute to 245 ºC. Oil component identification was done using the NIST mass spectra library, and confirmation was based on retention index, using the extensive essential oil identification dictionary of Adams (2007).

Results and Discussion

Soil samples from all the localities surveyed were found to be acidic, with pH ranging from 4.83 to 6.43. Soil from Bizana had higher rates of potassium, and magnesium compared to the other localities, while calcium was highest in the soil sampled from Adelaide. Nitrogen, magnesium and potassium were found to be higher in plant samples from Mount Fletcher. Essential oil content (in fresh mass basis) ranged from 0.01% in Mount Fletcher to 0.448 % in Ngqeleni. cis-Thujone was found to be a major component in all locations except in Adelaide where artemisia ketone was found to be high (47.75%). cis-Chrysanthenly acetate with the concentration of 12.17% was found in Mt Fletcher as compared to concentrations less than 1% in all other areas.

Conclusions

The study showed wide variations in both oil yield and composition of plants from different localities in the Eastern Cape. cis-Chrysanthenyl acetate was recorded for the first time in South Africa in one location where soils were found to be acidic and containing lower calcium rates.

References

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Keywords

Artemisa afra, essential oil yield, essential oil composition

IMPROVED GROWTH OF HYDROPONICALLY GROWN ROUGH LEMON (CITRUS JAMBHIRI LUSH) SEEDLINGS TREATED WITH KELP AND ORGANIC EXTRACTS

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Introduction

A significant number of South African citrus trees are rooted on rough lemon rootstocks. In order to ensure the successful establishment of a high percentage of young citrus trees, it is necessary to ensure that farmers are provided with young nursery trees that have a large, healthy root system. Ecklonia maxima (EM) and extracts from unique organic products (OE) have been used on various crops over the past decades to promote plant growth and development. It is widely reported that plant growth and seedling vigour increased and the water use efficiency and nutrient-uptake of these crops improves with EM and OE treatments, thereby reducing excessive fertiliser applications. The benefits from applications of EM and OE have been attributed to the presence of plant growth regulators.

Materials and Methods

A hydroponic experiment was conducted in a glasshouse at the University of Pretoria. Liquefied Ecklonia maxima from different manufactures (EM1 & EM2) and extracts from unique organic products (OE) were applied separately to rough lemon seedlings as a drench (0%, 0.5%, 1% and 2%), at 14 day intervals. Root volume, root length, stem diameter, plant height and chlorophyll content, were measured weekly for 12 weeks. At the end of the trial, the average root dry mass and shoot dry mass for each treatment was determined.

Results and Discussion

Rough lemon seedlings treated with EM and OE had a significantly greater root volume and root dry mass than the control, with the 2% OE resulting in the highest increase in root volume , root dry mass and shoot dry mass compared to the other treatments. EM applied at lower concentrations (0.5% and 1%) stimulated more root growth (root length, root volume and root dry mass), whilst the higher concentration (2%) negatively affected root development. Although the control had the highest significant root length, this was at the expense of dry mass accumulation as it had the lowest root dry mass. For the above-ground growth parameters, 1% EM1 induced the highest increase in stem diameter. 0.5% EM1 induced the highest increase in chlorophyll content whilst 1% EM2 significantly had the highest plant height, followed by EM1 and OE applied at the same concentration.

Conclusions

Results indicate that the different kelp and OE treatments resulted in an increase in root length, root dry mass, root volume, above ground dry matter and nutrient uptake. OE resulted in the largest increase in the root parameters measured while differences between the EM treatments were found.

References

Keywords

EFFICACY OF GLUFOSINATE AMMONIUM ON RYE-GRASS AS INFLUENCED BY DIFFERENT TEMPERATURES AND PLANT GROWTH STAGES

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Introduction

Herbicide resistance in ryegrass (*Lolium* spp) has resulted in severe yield reductions of field crops in the **W**estern Cape. ~~It has also~~ The control of ryegrass **has been** complicated, **because** ~~with most~~ of the commonly used herbicides that include paraquat and glyphosate. Use of glufosinate ammonium as a post-emergen**ce** herbicide has great potential in controlling ryegrass in crops where it can be **safely** applied. However, efficacy of the herbicide is highly dependent on environmental and plant factors. Inconsistencies in the response of different weed species to glufosinate ammonium under different temperatures have been reported. Glasshouse experiments were conducted to evaluate the influence of temperature and ryegrass growth stage on the efficacy of glufosinate ammonium.

Materials and Methods

Glasshouse experiments were conducted at Welgevallen experimental farm. The experiment was done on mature and **immature** ~~young~~ commercial ryegrass. ~~in which~~ **M**ature ryegrass was treated **six** ~~sprayed 6~~ weeks after planting while **immature** ~~young~~ ryegrass was treated at three ~~sprayed~~ ~~3~~ weeks after planting. Glufosinate ammonium **application** rates were 0, 1.5, 3, 4.5, 6 and 7.5 L ha-1. Glasshouses were set at 10/15 °C, 15/20 °C, 20/25 °C and 25/30 °C night/day temperatures. Evaluation was done **six** ~~6~~ weeks after **treatment** ~~spraying.~~

Results and Discussion

Contrary to previous studies, ~~this study observed that,~~ **results** generally **showed that** a lower temperature of 10/15 °C resulted in higher control of ryegrass for both mature and **immature** ~~young~~ plants as compared to 15/20, 20/25 and 25/30 °C night/day temperatures. The most efficient dosage rate in controlling **immature** ~~young~~ ryegrass **was** ~~is~~ 4.5 L ha-1 while 6 L ha-1 dosage rate **was** ~~is~~ efficient for mature ryegrass. However, **respective** glufosinate ammonium dosage rates of 3 L ha-1 and 4.5 L ha-1 effectively controlled **immature** ~~young~~ and mature ryegrass~~ respectively~~ at 10/15°C. Poor control at high temperatures can be **ascribed** ~~accounted~~ to ~~ryegrass~~ moisture stress, accumulation of calcium in cytoplasm and thickening of plant cuticle. There was a significant effect of ryegrass growth stage on efficacy of glufosinate ammonium. When sprayed at the same rate and ~~under the same~~ temperature, control of **immature** ~~young~~ ryegrass was 30% greater than that of mature ryegrass.

Conclusions

The study concluded that glufosinate ammonium controls ryegrass **more effectively** ~~better~~ at lower temperatures than at higher temperature. ~~The ease of control of ryegrass was much more difficult with mature ryegrass than with young ryegrass.~~ **Immature ryegrass was much more susceptible to glufosinate ammonium than mature ryegrass.**

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Keywords

Dosage rate, efficacy, glufosinate ammonium, growth stage, ryegrass, temperature.

QUANTIFYING SWEET POTATO (IPOMOEA BATATAS) EVAPOTRANSPIRATION USING THE EDDY COVARIANCE TECHNIQUE

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Introduction

Sweet potato (Ipomoea batatas) is commonly grown for its edible storage roots which contain high levels of β-carotene. Little is, however, known regarding the water use of this crop for South Africa conditions. A field trial was therefore conducted to estimate ET of sweet potato under optimum management practices using the eddy covariance (EC) technique, and to extrapolate this information for use under varying growing conditions by determining crop coefficient (Kc) that can be used with FAO-56 methodology.

Materials and Methods

An EC system containing surface energy balance (EB) sensors was installed on a 1.3 ha field at the Agricultural Research Council - Vegetable and Ornamental Plants (ARC-VOP), (lat. 25°35’N, long. 28°21’E and alt. 1164 m above sea level) in Gauteng Province, located 30 km north east of Pretoria, South Africa. The region experiences summer rainfall, with an average of about 650 mm per annum (Jovanovic et al. 1999). The study area has a humid subtropical climate and average daily temperatures range from 8-34°C in summer and 4-23°C in winter (Beletse et al. 2013), during the 2014/2015 and 2015/2016 growing season. Measurements of ET were subsequently used to determine daily Kc values of sweet potato (cv. Bophelo) using the FAO-56 single Kc approach and to estimate the water use efficiency of this crop.

Results and Discussion

Daily ET of sweet potato during the measurement period varied between 0.5 to 5.54 mm (linked closely to canopy cover and weather conditions), with total seasonal ET measured 347 and 361 mm for the 2014/2016 and 2015/2016 seasons, respectively. Averaged values of Kc were 0.25, 1.15 and 0.35 at the initial, middle and late growth stages. Final storage root yields were 32.2 (2014/2015) and 29.7 t ha-1 (2015/2016), with water use efficiencies of 89 and 85 kg ha-1 mm-1, respectively.

Conclusions

The ET of sweet potato was successfully measured for two growing seasons using the EC technique. This enabled the development of accurate Kc values, which can be used to improve irrigation water management for a wide range of irrigated sweet potato cropping systems in South Africa using the FAO-56 approach. Currently work is looking at the performance of sweet potato under deficit irrigation, including both orange and white-flesh cultivars

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Keywords

Crop coefficients, Crop modelling, FAO-56, Surface energy balance ACKNOWLEDGEMENTS We would like to acknowledge the Agricultural Research Council Professional Development Programme and National Research Foundation for funding this study.

Protein expression in maize leaves exposed to combined drought and heat stress

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Introduction

Combined drought and heat stress has a significant effect on protein expression. Such effects include protein degradation, inhibition of protein accumulation and production of stress-induced proteins. These changes have negative and positive ramifications on growth and development of crops under stressed conditions. This necessitates development of tolerant varieties especially for semi-arid environments where both stresses are prominent. Proteomics analyses compares protein expression profiles and links the identified proteins to causal effects Proteomics can be applied in novel gene identification, genome editing and biomarker selection. The objective of the current study was to identify proteins that confer tolerance to combined drought and heat stress at the seedling stage.

Materials and Methods

In the current study, one tolerant and one susceptible quality protein maize (Zea mays L.) inbred lines were exposed to combined drought and heat stress by withholding water for 7 days and increasing the ambient temperature by 5°C from 25°C to 40°C. Protein extraction was done using a combined sample of 3 plants /genotype/ treatment. Leaf samples were bulked for each sample genotype. Proteins were extracted from the leaves using a Readyprep protein extraction kit. Two dimensional electrophoresis analyses compared the protein expression profiles between the tolerant and susceptible inbred lines.

Results and Discussion

Comparative analysis revealed that the susceptible inbred line (QS21) produced proteins that were significantly ($P<0.05$) different from the tolerant inbred line, CIM18. One hundred and fourteen out of a total of 505 proteins showed a significant quantitative variation (increase or decrease). Of these, 62 proteins had a twofold up-regulation in the tolerant inbred line (CIM18), while 52 were down-regulated. Of the up-regulated proteins 20 were selected for amino acid micro sequencing. Of these, 11 proteins were expressed only in the tolerant inbred line but were undetected in the susceptible inbred line. The other nine selected proteins had at least a twofold up-regulation in CIM18 compared to QS21. The functions of the identified proteins included defence, metabolism, photosynthesis and structure. The observations from this study implied that CIM18 responded to combined drought and heat stress by modulating the expression of stress-responsive proteins. The up regulation of anti-oxidant enzymes enhanced the stress defence response of CIM18 in addition to accelerated biosynthesis of proteins such as HSPs, and carbohydrate metabolism, all of which conferred tolerance.

Conclusions

The proteins identified in the tolerant line are potential biomarkers to use when screening germplasm for combined drought and heat stress tolerance.

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Keywords

drought tolerance, MALDITOF, proteomics, QPM

Population structure and genome-wide marker-trait association of key agronomic traits in wheat

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Introduction

Genome-wide association study (GWAS) facilitates understanding of the genetic bases and dissection of complex genes controlling economic traits such as drought tolerance. The objective of this study was to determine the population structure and genome-wide marker-trait association of key agronomic traits of wheat for drought-tolerance breeding.

Materials and Methods

A population of 93 diverse bread wheat genotypes was genotyped using the Diversity Arrays Technology sequencing (DArTseq) protocol. Also, the following agronomic traits assessed under drought-stressed and non-stressed conditions were considered for the study: the number of days- to-heading (DTH), number of days-to-maturity (DTM), plant height (PHT), spike length (SPL), number of kernels per spike (KPS), thousand kernel weight (TKW) and grain yield (GYLD) (Mwadzingeni et al., 2016). Population structure analysis and genome-wide association mapping were undertaken based on 16,383 silico DArTs loci with < 10% missing data.

Results and Discussion

The population evaluated was grouped into nine distinct genetic structures. Inter-chromosomal linkage disequilibrium showed the existence of linkage decay as physical distance increased. A total of 62 significant ($P < 0.001$) marker-trait associations (MTAs) were detected explaining more than 20% of the phenotypic variation observed under both drought-stressed and non-stressed conditions. Significant ($P < 0.001$) MTA event(s) were observed for DTH, PHT, SPL, SPS, and KPS; under both stressed and non-stressed conditions, while additional significant ($P < 0.05$) associations were observed for TKW, DTM and GYLD under non-stressed condition. These MTAs were identified on chromosomes that have previously been associated with the respective traits (Mathews et al., 2008; Pinto et al., 2010; Alexander et al., 2012).

Conclusions

The markers identified in this study are useful genomic resources to initiate marker-assisted selection and trait introgression of wheat for drought tolerance breeding and for fine mapping and cloning of the underlying genes and QTL. Further studies are required to validate the significant markers identified in the present study.

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Keywords

Diversity Arrays Technology, drought tolerance, genome wide association study, linkage disequilibrium, population structure, wheat

EFFECTS OF LAND USE CHANGE ON SOIL AND WATER QUALITY AND PLANT SPECIES COMPOSITION OF CEDARA WETLANDS

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Introduction

Wetlands are vital in the provision of ecosystem services and land use change could affect their functioning and health. Disposal of organic waste slurries on wetlands could result in high nutrient loads, whereas drainage for agriculture, could adversely affect their characteristics, particularly soil properties. The purpose of this study was to assess the effects of land use changes on soil chemical properties, water quality and plant species composition of three wetlands at Cedara.

Materials and Methods

One wetland was used for discharge of sewage effluent and dairy slurry; another was drained using ridge/furrow system and used for pasture production, while the third, undisturbed wetland, was used as the control. A soil survey was carried out to identify soil forms and soil sampling was done on transects at 0–20, 20–40, 40–60 and 60– 100 cm depths, and the samples were analysed for pH, clay content, total C and N, CEC, exchangeable K, Ca, Na, Mg, available Mn, Zn, Cu and P. Water samples, taken during different seasons from upstream, midstream and downstream positions, were analysed for quality parameters. Grass species were identified for species composition.

Results and Discussion

The dominant soil form in all wetlands was Katspruit, with Pinedene, Clovelly, Griffin and Hutton on the edges. Soils in all wetlands were acidic, with the drained wetland having higher pH, Ca and Mg concentrations. The dairy/sewage wetland had significantly higher P, Zn and Cu than the ridge/furrow drained wetland while the undisturbed wetland had the least. The undisturbed wetland had higher total C, N and available Mn concentrations than the other two. In the water samples pH, Ca, Mg and P was higher in the ridge/furrow drained wetland than the others. The undisturbed wetland had higher species composition and had more wetland plant species than the other wetlands which mostly had pasture grasses.

Conclusions

The findings suggested that land use change will reduce soil C and N and available Mn, and modify the concentrations of available P and micronutrients and bases in the soil, impair water quality and ultimately result in loss of wetland plant species diversity.

References

The National Research Foundation and the KZN Department of Agriculture are acknowledged for funding the study

Keywords

Drainage, dairy slurry, sewage waste, total carbon, phosphorus, micronutrients

Postharvest Treatments to Enhance the Colour Development and Fruit Quality of Cherry Tomato (Solanum lycopersicum L. var. cerasiforme)

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Introduction

Tomato (*Solanum lycopersicum*) is the most-consumed horticultural commodity worldwide due to its attractiveness and significant contribution to the health and nutrition of humans (Soto-Zamora et al., 2005). While substantial investigations have dealt with colour development in standard tomato, cherry tomatoes (*S. lycopersicun* cv. cerasiforme Alef) that need to be red-ripe when reaching the consumer have been little investigated. As hot water and/or light treatment induce colour change and alter fruit quality characteristics (Itoh, 2003, Farkas et al., 2014) the effect of these treatments on fruit colour change and other quality parameters were examined.

Materials and Methods

Cherry tomatoes at green mature stage were randomly divided into six lots consisting of control (C), light treatment with an LED light for 24h, hot water treatment at 48 °C for 30s, LED light plus hot water treatment (HWT) at 48 °C but at 30s, 1min or 2min. Immediately after treatment, the tomatoes were packed into perforated modified atmospheric packaging and transferred to storage at 25 °C. Colour, firmness, % TSS, antioxidants and severity of heat injury were evaluated.

Results and Discussion

Twenty-five days after treatment, a significant difference was found between the treated and untreated tomatos in terms of colour. Hot water treatment at 48 °C for 1 min and LED light increased tolerance of cherry tomato fruit to heat stress, indicated as low outbreak of skin injuries, and a high redness (a*) value. It also resulted in insignificant heat injury and / or losses in antioxidants. No disease incidences were recorded in treated tomatoes.

Conclusions

The combination of HWT and LED light could be a promising method for extending the shelf life and controlling postharvest diseases of cherry tomato fruit.

References

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Keywords

light treatment, hot water treatments

The effect of white shade net on post-harvets fruit quality and storage potential of 'Nadorcott' mandarine (Citrus reticulate Blanco)

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Introduction

White shade-nets were shown to have a direct effect on tree physiology of ‘Nadorcott’ mandarins, therefore, highly likely that cold storage potential and postharvest fruit quality can also be affected by shade nets. A literature study revealed that little research has been carried out on the effect of shade nets on postharvest fruit quality and storage potential of ‘Nadorcott’ mandarin fruit. The aim of the current study was therefore to investigate the effect of white shade nets on postharvest fruit quality and storage potential of ‘Nadorcott’ mandarin fruit.

Materials and Methods

Fruit for the current study were obtained from a commercial pack-house. Upon receipt, fruit were already washed, waxed, graded, separated (shaded and non-shaded) and treated with the imazilin fungicide . Two types of packaging materials were used, namely; open top and supervent packaging. Fruit for each treatment (shaded and non-shaded) and packaging type were cold-stored at three different storage temperature regimes, namely -0.6, 2.0 and 4.5° C for 28 days. The experimental design was a randomized block design, consisting of three replicates per treatment. Fruit quality (rind thickness, fruit firmness, weight loss, TSS/TA and fruit colour), decay and physiological disorders (rind pitting, zebra skin and stem end rot) were evaluated prior to cold storage, on day 7, 14 and 28 during cold storage and five days after cold-storage.

Results and Discussion

The trial is currently still in progress and complete results will be presented. General trends observed thus far include increased fruit firmness with storage period, which could be attributed to skin hardening due to moisture loss recorded. Only packaging appeared to have an effect on firmness and moisture loss. During storage, TSS, TA and fruit colour was not affected. The incidences of physiological disorders were also not affected.

Conclusions

The results of this study showed that shade net does not affect the post-harvest storage potential and fruit quality. The type of packaging used however, has an effect on fruit moisture loss and firmness.

References

Keywords

Packaging material, physiological disorders, storage temperatures, cooling, market

Comparing three herbicide resistance screening methods

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Introduction

Herbicide resistance was first reported in 1986 in Avena fatua (wild oat) by Cairns and Hugo. Since then various other weed species have been reported as being resistant to herbicides from different mode of action groups. One such weed is Lolium spp. Ryegrass is a genetically highly variable, cross-pollinated species (Owen, et al. 2007), which can develop herbicide resistance quickly. The problem with ryegrass is, that the time-frame that producers have are very short to control the ryegrass after they have germinated. Therefore, producers need to know the resistance status of their ryegrass populations, as to make quick and timely decisions on spraying. The aim of this study was to compare three different screening methods, to determine which method takes the least amount of time and still show reliable results.

Materials and Methods

Petri-dish assay: Samples were germinated in petri-dishes in a growth chamber, by breaking the dormancy at 5 degrees in the dark and then adjusting the temperature to a day/night temperature of 20/15 degrees Celsius. Ryegrass samples were removed after 14 days and four replicates, containing 20 seedlings each, were prepared per sample. A control was also included. The petri-dishes were then left in the germination chamber for another 10 days, after which evaluation was done. Glass bottle method: Ryegrass seeds were planted in seedling trays and put into a seedling room to allow germination (14 days). After germination, four plants per sample were put in glass bottles with only the roots touching the herbicide solutions. The seedlings were placed in a germination chamber for 14 days, after which evaluation was done. Glasshouse method: Ryegrass seeds were planted in 1.5 liter pots, containing potting soil. Four replicates were used per sample. Seeds were allowed to germinate and grow until the 3-4 leaf stage (28 days). Different herbicides were then applied to the plants with a cabinet sprayer. After spraying, the plants were returned to the glasshouse and evaluated 10-14 days later.

Results and Discussion

All screening methods yielded reliable results. The only difference between the screening methods was the duration of the experiment. The petri-dish assay yielded quicker results than the other two methods. It is therefore concluded that the petri-dish assay proofed to be the most efficient and time-saving method for testing herbicide resistance.

Conclusions

From the three screening methods tested, it was concluded that the petri-dish assay method was the best method to use to screen for herbicide resistance in ryegrass.

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Keywords

glasshouse screening, herbicide resistance, petri-dish assay

OPTIMISATION OF NITROGEN AND POTASSIUM FERTILISATION FOR SELECTED NEW POTATO CULTIVARS

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Introduction

South Africa is the best potato producing country in Africa in terms of yield per hectare and newer cultivars are continuously added to improve yield and quality. Little local research on potato nutrition has been conducted in the past decade, hence there is a need to optimize fertilizer guidelines for newer cultivars.

Materials and Methods

A pot trial was conducted during the 2015/2016 growing season to evaluate two newer potato cultivars, namely Lanorma and Innovator at four progressive levels of N and K and to determine appropriate N:K ratios that would give optimal yield and quality. N levels were 180, 230, 280 and 330 kg ha-1 and K levels were 160, 230 300 and 370 kg ha-1. Mid-season harvest was done at 30 days after emergence (DAE). Plant height and shoot mass were measured at that stage. At final harvest (110 DAE), yield, tuber number per treatment as well as specific gravity (SG) were measured and subjected to ANOVA.

Results and Discussion

At 30 DAE, all plants which received lowest K level were exhibiting K deficiency symptoms. Both cultivars had initiated tubers at 30 DAE, except Lanorma at highest K level across the 3 higher levels of N. Lanorma plants were significantly taller ($P < 0.05$) than Innovator across fertilizer treatments. Shoot mass between cultivars varied significantly ($P < 0.05$), with Lanorma having higher shoot mass than Innovator. At final harvest (110 DAE), lowest yield of around 200 g pot-1 was associated with lowest K level. Significantly higher yield (460 g pot-1) was observed for the treatment combination of 230 kg ha-1 N and 230 kg ha-1 K. Across most treatments, except treatments with lowest K level, significantly higher yields (400 – 473 g pot-1) were obtained at N:K ratios ranging from 0.77 to 1.22. Incrementing K across all four levels of N increased tuber number for both cultivars, although for Innovator a K level of above 230 kg ha-1 resulted in no further increase. On the other hand, tuber number for Lanorma increased until highest K level. Specific gravity (SG) was not significantly influenced by fertilizer treatment, but Innovator had significantly ($P<0.05$) higher SG values than Lanorma.

Conclusions

Our preliminary conclusion from this study is that for optimal yield, the N:K ratio should be kept around one, provided that both nutrients are sufficient. For this particular soil, it is recommended that N and K levels should be kept at 230 kg ha-1.

References

Keywords

N:K ratio, Yield

Nematode resistance in sweet potato cultivar ‘Mafutha’ to Meloidogyne species in South Africa

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Introduction

The root-knot (*Meloidogyne* species) nematodes are a threat to the biofortification programme of sweet potato (*Ipomoea batatas* L.). Most sweet potato cultivars with biofortification attributes are highly susceptible to *Meloidogyne* species. Nematode-resistance in biofortified sweet potato cultivars is introduced using molecular breeding approaches, which requires information on the degree of nematode resistance and type of nematode resistance (Laurie *et al*., 2015). The objective of this study was to assess the degree of resistance to *M. incognita* 2 and 4 and *M. javanica* in sweet potato cv. ‘Mafutha’, which has attributes for use in biofortification programmes.

Materials and Methods

Experiments were conducted under greenhouse conditions, arranged in a randomised complete block design with ten replicates. Treatments comprised inoculation with 0, 25, 50, 125, 250, 625, 1250, 3125 or 5250 eggs and juveniles (J2). Uniform sweet potato cuttings were propagated into 25 cm diameter plastic pots filled with steam pasteurised (300˚C for 1 hour) loam soil and hygromix mixed at a 3:1 (v/v) ratio. Cuttings were fertilised using 2 g 2:3:2 (22) NPK and 2 g 2:3:2 (43) Multifeed fertiliser a week after planting and plants were irrigated with 250 ml water every other day.

Results and Discussion

At 56 days after inoculation, all levels of inoculation had no significant ($P \leq 0.05$) effect on plant variables such as vine length, stem diameter, dry shoot mass and fresh shoot mass in all the experiments. The reproductive factors of *M. incognita* race 2 and 4 and *M. javanica* on sweet potato cv. ‘Mafutha’ were equivalent to zero. The Zero RF values suggest that the plant is a non-host to the *Meloidogyne* species. The results of the study suggested that sweet potato cv. ‘Mafutha’ was resistant to *M. incognita* race 2 and 4 and *M. javanica*.

Conclusions

This cultivar is suitable for use in biofortification breeding programmes for nematode resistance.

References

Laurie, S.M., Faber, M. and Adebola P. And A Belete. 2015. Biofortification of sweet potato for food and nutrition security in South Africa. Food Research International 76: 962-970.

Keywords

host-status, host-sensitivity, *Meloidogyne* species, nematode resistance

INFLUENCE OF MARGINAL SOILS ON GROWTH OF MORINGA OLEIFERA SEEDLINGS

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Introduction

Historically, most smallholder farmers in South Africa were settled on marginal soils, characterised by heavy clay, high calcium content (calcareous) and/or high sand. The introduction of *Moringa oleifera* in rural communities of Limpopo Province as a developmental project might be limited by the widespread distribution of marginal soils. Moringa is a fast-growing, drought-resistant versatile tree that can be used as a vegetable, for water purification and herbal medicine. The objective of this study was to determine the effects of growing *M. oleifera* seedlings on marginal soils under greenhouse conditions.

Materials and Methods

The steam-pasteurised growing media, namely, sandy soil, clay soil, red loam soil and calcareous soils, were placed in 5 L black polythene bags and arranged in a randomised complete block design, with 15 replications. Seedlings were transplanted from the seedling tray after two weeks hardening. Sixty days after initiating the treatments, plant variables including chlorophyll content, plant height, fresh shoots and roots, dry shoots and roots, stem diameter and tuber weight were collected and subjected to analysis of variance.

Results and Discussion

The treatments had significant effects on dry shoot mass, dry root mass, root length, leaf number and chlorophyll content, but had no effect on plant height. Relative to loam soil, growth of moringa seedlings increased in clay and sandy soils, but decreased in calcareous soil. *Moringa oleifera* seedlings performed better in clay soil. Generally, clay soil has high organic matter and mineral elements, along with high capacity to retain water when compared to loam, sandy and calcareous soils. Soil texture is an important factor where clays generally comprise the majority of cation exchange sites in the soils. This is because clay soils by virtue of their small particle sizes have the most surface area and therefore, the most exchange sites. Also, clay soils have the greatest risk for excess sodium binding and dispersion (Leal et al., 2009).

Conclusions

Marginal clay soils such as clay and sand are suitable for the introduction of moringa as a developmental project in South Africa, whereas calcareous soil is not. Therefore, clay soil could be recommended for cultivation of *Moringa oleifera* in marginal communities of South Africa.

References

Leal, R.M., Herpin, U.W.E., Fonseca, D.A., Firme, A.F., Montes, C.R. and A.J. Melfi. 2009. Solidity and salinity in a Brazilian Orison cultivated with sugarcane irrigated with waste water. Agricultural Water Management 96:307-316.

Keywords

Calcareous soil, marginal soils, moringa, nutrient elements

PERFORMANCE OF COWPEA VARIETIES UNDER STRIP INTERCROPPING AND PHOSPHORUS FERTILISATION IN LIMPOPO PROVINCE

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Introduction

Limpopo Province is in the semi-arid region that is prone to drought. Crop yields continue to decline due to low soil fertility and bad cropping systems. Cowpea is a nutritionally rich crop in proteins which are important for both human consumption and livestock feeding. Phosphorus is one of the macro- nutrient elements required by crops to produce satisfactory yields. However, the interactions between different rates of P fertilisation have not been intensively studied under rain-fed strip intercropping in Limpopo Province. The objectives of the study were to determine the performance of cowpea varieties in cowpea-maize strip intercropping and P application.

Materials and Methods

The experiment was conducted at Syferkuil in Limpopo Province during 2015/16 growing season. It was laid in a split-split plot design with two maize varieties (WE3127 and ZM1423) and three cowpea varieties (PAN 311, TVu13464, and IT82D-889). Four levels of P-fertiliser (0, 15, 30, 45 kg P/ha) were added to a P deficient soil. Data were collected on flowering, maturity, canopy height, root weight, number of pods per plant and grain yield. Data was analyzed using SAS 9.3 version. Means were separated with DMRT.

Results and Discussion

Phosphorus application levels significantly influenced flowering, maturity, root weight, number of pods and grain yield of cowpea varieties. PAN311 flowered earlier than other varieties across P levels. The P level of 30 and 45 kg P/ha reduced the number of days to maturity as compared to 0 and 15 kg P/ha. IT82D-889 and TVu13464 did not show significant differences in number of days to flowering under monocropping and intercropping with 95 and 102 days to maturity, respectively. Height of IT82D-889 was significantly ($P<0.05$) taller than PAN311 and TVu13464 across all P levels and cropping system. Increasing P resulted an increase in root weight of all varieties. Similarly, significant ($P< 0.05$) higher number of pods per plant were recorded under 30 and 45 kg P/ha than 0 and 15 kg P/ha. TVu13464 variety produced more pods (31) per plant than IT82D-889 (23) and PAN311 (29). PAN311 yielded more grains with an average of 1062.52 kg/ha than other varieties. Yield of PAN311 increased with increasing P level but yield of IT82D-889 increased only from 0 - 30 kg P/ha. Under intercropping, PAN311 was superior to other varieties with the yield of 2241.67 kg/ha.

Conclusions

The study showed the importance of P application in improving cowpea yield in cowpea-maize strip intercropping. Furthermore, the optimum levels of P for most varieties was at 30 and 45 kg P/ha.

References

Keywords

Cropping system, Cowpea, grain yield, V*igna unguiculata*

POST-HARVEST FACTORS AFFECTING THE INCIDENCE OF BLOSSOM-END CLEARING IN GRAPEFRUIT

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Introduction

Blossom end clearing (BEC) is a post-harvest physiological disorder that typically appears as a wet translucent area at the blossom-end of grapefruit (Echeverria *et al*., 1998). The formation of the wet area on the fruit's surface is the result of internal bruising and juice leakage out of the vesicles into the peel (Goell *et al*., 1988). The disorder leads to significant financial losses as fruit appearance is blemished, off flavours develop and the area becomes susceptible to pathogens (Echeverria and Burns, 1994).

Materials and Methods

'Star Ruby' grapefruit from Jassie in Letsitele (Limpopo) were used for experiments in the 2015 and 2016 harvest season. The aim of experiments was to identify possible pre- and post-harvest stresses that may lead to the development of the disorder and the cumulative effects thereof. In all treatments fruit were dropped from 1.5m onto a hard steel surface to induce the disorder. The following potentially aggravating factors were evaluated additionally; effect of over-irrigation (1800L/tree/week vs 300L/tree/week), time of harvest during the day, fruit size, fruit position in the canopy, orchard age and effect of multiple impacts coupled with sun exposure.

Results and Discussion

A higher incidence of BEC was seen in the 2016 season compared to the 2015 season. Cumulative impacts increased the incidence. Furthermore, smaller fruit and inside fruit were found to be more susceptible. Picking fruit later in the day (2pm onwards) decreased fruit sensitivity. However, over-irrigation and turgidity did not have an effect on the incidence as thought.

Conclusions

Results suggest that post-harvest handling may be the starting point of BEC, but its development may only be brought to the fore when coupled with other post-harvest stresses.

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Keywords

Star Ruby, *Citrus paradisi*

Interactive effects of biomuti, mycorrhizae and phytonematicides on growth of tomato seedlings and nematodes

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Introduction

Biomuti (B) and Mycorrhizae (M) and phytonematicide (P), are sustainable products being developed in South Africa to manage the root-knot (*Meloidogyne* species) nematodes. The two phytonematicides used in the tests were Nemarioc-AL and Nemafric-BL. The interactive effects of these products on nematode suppression and plant growth have not been investigated. The objective of this study was to determine whether B, M and P would have interactive effects on growth of tomato plants and population densities of *M. javanica* under microplot conditions.

Materials and Methods

A 2 × 2 × 2 factorial experiment was established for Nemarioc-AL with B, M and P being the first, second and third factors, respectively. Uniform six-week old tomato (*Solanum lycopersicum*) cv. 'HTX 14' seedlings were transplanted into 5 L plastic bags containing steam-pasteurised river sand and Hygromix-T at 3:1 (v/v) ratio. Each seedling was inoculated with 5000 eggs and second-stage juveniles of *M. javanica*. Seedlings were irrigated with 300 ml water every other day using a drip irrigation system, and this was substituted with appropriate treatment application every 17 days. Plants were fertilised at transplanting using 5 g 2:3:2 (26) NPK, repeated as a top dressing at flowering. Diseases were managed using a commercial tomato-spraying programme for diseases. The corresponding Nemafric-BL phytonematicide trial was the same as above but Nemarioc-AL was substituted with Nemafric-BL. At 56 days after initiating the treatments, plant and nematode data were collected, processed and analysed using SAS software.

Results and Discussion

In the Nemarioc-AL trial Biomuti, Mycorrhizae and phytonematicide second order interactions and Mycorrhizae and phytonematicide first order interactions were highly significant for gall rating and plant height respectively, explaining 34% and 43% of total treatment variation. In contrast, for the Nemafric-BL trial, Mycorrhizae and phytonematicide first order interaction was significant for fruit mass, contributing 62% of total treatment variation. The second and first order interactions were further assessed using three- and two-way matrices, with evidence that these interactions were not desirable since they reduced plant growth and were less effective in nematode suppression (Mashela et al., 2015).

Conclusions

The observations in the study suggested that it was not advisable to combine the sustainable products in suppression of *M. javanica* in tomato production.

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Keywords

Cucumis africanus, Cucumis myriocarpus, plant parasitic nematodes.

TEMPERATURE AND GROWTH STAGE INFLUENCE GLYPHOSATE RESISTANCE IN CONYZA BONARIENSIS (L.) CRONQ. FROM SOUTH AFRICA

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Introduction

Glyphosate is a potent inhibitor of 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS), a shikimate pathway, chloroplast-localized enzyme, responsible for the biosynthesis of aromatic amino acids, hormones and other essential plant metabolites. Inhibition of EPSPS enzyme by glyphosate results in an accumulation of shikimic acid in treated plants. As glyphosate is the only reported herbicide to inhibit EPSPS, endogenous accumulation of shikimic acid has been used as a biomarker for the herbicide’s activity, and for determining plant resistance to glyphosate. Glyphosate-resistant Conyza bonariensis has been confirmed in South Africa. The weed germinates in flushes and its growth is staggered throughout the year under conducive temperature regimes. Consequent variability in growth stage poses a challenge in chemical control. Temperature reportedly has a profound effect on glyphosate's efficacy . The objective of this study was to use a shikimate assay to evaluate the influence of temperature and growth stage on glyphosate resistance in Conyza bonariensis.

Materials and Methods

Two resistant biotypes (Swellendam and Piketberg localities) and two susceptible biotypes (George and Fauresmith localities) were established in the glasshouse at the University of Pretoria’s experimental farm. For the experiment on the effect of temperature on glyphosate resistance, plants were moved to respective phytotrons set at 27 0C for high and 15 0C for low temperature regimes, prior to herbicide treatment. For the growth stage experiment, two growth stages, 4 to 6- and 40 to 50-leaf stages were assessed. All plants were sprayed with 900 g ae/ha glyphosate and shoot tissue sampled for analysis at varying time intervals. Frozen tissue was ground in liquid nitrogen and 100 mg weighed out into Eppendorf tubes. Extraction was done in 0.25 N HCl, followed by vortexing and centrifuging. The supernatant was directly used for HPLC analysis. Shikimic acid levels were analyzed with SAS statistical package and means separated using a Tukey test.

Results and Discussion

Shikimic acid accumulated in all biotypes but declined from 4 DAT in resistant biotypes. Shikimic acid was significantly higher under cold than warm temperature regimes, which indicated more sensitivity to glyphosate under cold temperature conditions. The levels were higher in plants treated at the 4 to 6-leaf stage as compared to the later growth stage.

Conclusions

Results indicate a temperature and growth stage dependence of glyphosate in C. bonariensis. Possible outcomes of spraying glyphosate under warm temperature conditions and at the bolting stage is poor control, which in practical terms constitute unintended under-dosing, which is known to promote the evolvement of herbicide resistance.

References

Keywords

Conyza bonariensis, glyphosate, shikimic acid, temperature, growth stage

Chloroplast phylogenomics in cactus pear (Opuntia ficus-indica)

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Introduction

Cactus pear (*Opuntia ficus-indica*) belongs to the family Cactaceae. Nowadays, the use of limited water resources has become ever more important. The water use of cactus pear plants is three times more efficient than C4 and five times more so than C3 plants (Guevara et al., 2011). This unique metabolism (CAM) causes plants to be drought resistant and guarantees a stable biomass production in variable rainfall regimes (Fouche & Coetzer, 2015). Cactus pear can propagate sexually or asexually and is also able to produce interspecific hybrids. They are polyploid organisms, with genomes ranging from triploids (2n = 3x = 33) to octoploids (2n = 8x = 88) being common, while diploids (2n = 2x = 22) tend to be quite rare. The purported genetic variability infers some concomitant phenotypic diversity, especially regarding plant structure, tissue pigmentation and fruit size. More than 70 cactus pear cultivars are now farmed in South Africa (Potgieter & Smith, 2006). The growing interest in commercial cactus pear production and the broad morphological diversity, along with varying reproduction strategies, means that identification of breeding or propagation material must be done at the DNA level. The aim of this study was to identify and characterize genetic markers that can be used to distinguish between different cactus pear cultivars in South Africa.

Materials and Methods

Nine *O. ficus-indica* cultivars of the Burbank type were selected for finding putative genetic markers. Cladodes were sampled from a cactus pear orchard harbouring 42 cultivars, located at the University of the Free State. Genomic DNA was extracted from each sample based on the NucleoSpin Plant II kit (Macherey-Nagel GmbH & Co. KG, Düren, Germany), followed by quality and quantity analyses of isolates through electrophoresis in 1% (w/v) agarose gels and spectrophotometry (NanoDrop Products, Delaware, USA), respectively. Upon validation, DNA samples were subjected to the Illumina HiSeq2500 next-generation sequencing based on the paired-end method.

Results and Discussion

Agarose gel electrophoresis of DNA samples from the nine *O. ficus-indica* cultivars showed single, intact bands of high molecular weight. Concentrations of the samples ranged from 11 – 120 ng uL-1, with average A260/280 and A260/230 ratios of 1.87 and 1.94, respectively. Currently, DNA sequencing and analyses are still in progress.

Conclusions

The current study will be the first to report on chloroplast phylogenomics in cactus pear, a tactic that should simplify cultivar identification in this minor food crop of agricultural eminence.

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Keywords

Predicting macadamia kernel shelf-life

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Introduction

To ensure the continued viability of the South African macadamia industry, it is vital that only kernel of the highest quality reaches the consumer. Industry sets standards for quality at time of packaging but currently has no test available which allows a sell-by or best-by date to be predicted. Rancimat induction time indicates the formation of secondary oxidation products and is an indicator of sample quality in oil containing products. This study aimed to determine whether a rancimat test at time of packaging could be used to predict shelf life in macadamia.

Materials and Methods

Kernel samples representative of 17 commercial farms were sourced from five processors. For each farm, both style 1 and style 5 kernel were obtained. For each sample, peroxide value and rancimat induction time were determined at receipt using cold pressed oil from a sub-sample. The remaining kernel was divided into subsamples, vacuum packed and stored at 15 °C. After one year of storage, six replicates per combination of style and source were used for peroxide determination. Relationships between initial quality indicators and final quality were examined.

Results and Discussion

It was found that there was a good correlation between initial peroxide value and induction time for both style 1 and 5 kernel. For both styles, approximately 30% of all samples exceeded the industry norm for peroxide value, indicating that not all commercial kernel meets standards for export. After a year of storage, peroxide values were again plotted against the initial induction time as well as the initial peroxide values. For style 1 kernel there was a reasonable correlation between final peroxide value and induction time ($R2 = 0.65$), while for style 5 kernel the correlation was extremely good ($R2 = 0.9232$). For style 5 there was also an excellent correlation between starting and final peroxide values ($R2 = 0.9201$). It appears that rancimat induction time may serve as a reasonable predictor for shelf life in style 1 kernel, while both induction time and initial peroxide value are good predictors for shelf life of style 5 kernel.

Conclusions

This work indicated the potential of both rancimat induction time as well as peroxide values for predicting shelf life, although a larger sample size would be needed for accurate predictions. It also showed that some commercial batches exceed the peroxide value limit set for export kernel. This is an issue industry can eliminate by implementing peroxide tests for every batch.

References

Keywords

Macadamia, shelf life, sell-by date, Rancimat, predict

VERTICAL DISTRIBUTION OF ESSENTIAL ELEMENTS AND TRACE METALS ON A CONTINUOUSLY CULTIVATED AND FERTILIZED FIELD.

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Introduction

Due to a large area of marginal land in Limpopo province and increasing population, farmers tend to continuously cultivate their fields and at the same time constantly applying fertilizers to improve their yields and meet food security. However, these practices might have an impact on the distribution of trace and essential elements. Therefore, the objective of this investigation was to assess the vertical distribution of essential elements and trace metals in a field that is continuously cultivated and fertilized.

Materials and Methods

The study was conducted at the University of Limpopo Experimental farm. A continuously cultivated field was divided into equal grids of 50 m x 50 m. A soil profile was opened in each grid where soil samples were collected from three depths of 0-20; 20-40 and 40-60 cm for analysis. Samples were analyzed for soil texture, pH, organic matter content, selected essential elements (calcium, sodium, phosphorus, potassium and magnesium) and trace elements (copper, iron, nickel, and zinc).

Results and Discussion

Results showed that most of the variables were significantly different vertically, showing high amounts of all the studied essential elements except for magnesium. There was no distinctive trend of vertical decrease and increase of the elements but magnesium, sodium and potassium displayed a decline in concentration at depths of 40 – 60 cm per soil profile while showing a high concentration at upper depth 20 cm. The amounts of iron, copper, zinc and nickel were generally low, which might be due to their indirect relationship with soil pH (Balgobind et al., 2013).

Conclusions

Continuous cultivation and fertilization at the field altered the properties of the soil and further implication might degrade its quality. Because of the high pH of the soil, low organic matter content and loamy sand texture of soil the amount of the essential elements is high and mobile but this resulted in low amounts of trace elements.

References

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Keywords

vertical distribution, continuous cultivation, essential elements, trace metals.

The effect of plant density and nitrogen application on yield and quality of baby red cabbage

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Introduction

Cabbage *(Brassica oleracea L. var capitata*) is an excellent source of calcium, potassium and rich in certain source of antioxidants (ascorbic acid and polyphenols). Baby vegetables have a short growing period and are planted at high plant densities compared to the other traditional vegetables, therefore, fertilizer requirements will differ. Increasing plant density has the potential to increase yield and profit in cabbage as well as reducing head size. Therefore, the study was carried out to evaluate the effect of plant density and nitrogen (N) application on yield and quality of red baby cabbage.

Materials and Methods

The study was conducted at the Agricultural Research Council- Vegetable and Ornamental Plants (VOP) in a sandy loam soil during May to August 2015. Five-week old baby cabbage (cultivar 'Red Jewel') seedlings were planted in a plot size of 3 m^2. Plants were subjected to three plant densities (33.3, 25 and 20 plants.m^{-2}) combined with five different levels of N [0, 40, 80, 120 (control), 160 and 200 kg.ha^{-1}]. Eighteen treatment combinations were arranged in a 3 x 6 factorial experiment, laid out ina randomized complete block design with four replicates. At harvest, fresh head mass, dry head mass, fresh wrapper leaves mass and dry wrapper leavesmass were weighed. Dry wrapper leaves and dry head mass were determined by drying leaves in an oven at 70˚C for 48 hours. Ascorbic acid was determined spectrophotometrically.

Results and Discussion

Nitrogenapplication did not have a significant effect on fresh and dry head, and fresh and dry wrapper leaves mass per plantor per plot. There was no significant interaction between N and plant density onfresh and dry head mass, fresh and dry wrapper leave mass per plant or per plot. However, plantdensity had a significant effect ($p>0.05$) on fresh and dry head mass, fresh and dry wrapper leaves mass per plot. The highest fresh head mass, dry head mass, and fresh and dry wrapper leaves mass were obtained froma plant densityof 33.3 plants.m^{-2}.Plants grown at a plant density of 33.3 plants.m^{-2} with N application of 80 kg.ha^{-1} had the highest ascorbic acid content compared to other treatments.

Conclusions

Results demonstrate that yield and ascorbic acid content of red baby cabbage can be manipulated by plant density and N application. Plant density of 33.3 plants/m^2 improved yield andascorbic acid content of baby red cabbage while 80 kg.ha^{-1} N application resulted in a decrease in ascorbic acid.

References

Keywords

ascorbic acid, head fresh mass, plant spacing, wrapper leaves

Influence of management practices on soil organic matter indicators under kikuyu, ryegrass and clover pasture mixtures on dairy farms in the Tsitsikamma region, South Africa

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Introduction

South African soils have long been classified as being severely degraded by the international soil reference and information centre (ISRIC, 1997). The state of the soils is even more pronounced in sandy soils that are managed for pasture production in the Tsitsikamma region. This is mainly due to the fact that these soils have poor soil organic matter (SOM) content and are therefore prone to nutrient leaching, erosion and water loss through runoff and deep percolation (Bruand et al., 2005). Better soil quality measures need to be introduced in order to help mitigate the situation. SOM is one of the soil quality indicators that have been identified as a suitable measure that can be used to assess soil productivity. The study aimed to assess whether SOM indicators differed within depth and between farms as well as whether pasture management practices had any influence on the status of SOM indicators.

Materials and Methods

An average of 5675 samples was taken for analysis across 10 irrigated farms situated in the upper (UT) and lower Tsitsikamma (LT) region. SOM indicators that were measured included total carbon (C), total nitrogen (N), C/N ratio, active C, PMN rate and inorganic N. Soil samples were taken in four soil layers namely, 0-15; 15-30; 30-45 and 45-60 cm respectively. The analysis of variance was measured at 99% confidence interval.

Results and Discussion

For all indicators measured, with the exception of active C and inorganic N, there were significant differences when comparing the UT and LT regions. There were also significant differences for all indicators between all measured soil layers. It was also observed that the most significant differences occurred at approximately 30 cm soil layer for all measured indicators except for C/N ratio and Inorganic N.

Conclusions

It is evident that soil management that encourages SOM build-up is a prerequisite for sustainable and improved soil quality. The burden falls on land managers to try and better understand the principles behind soil quality and continuously implement strategies that build SOM.

References

Keywords

soil quality, soil organic matter, total carbon, total nitrogen, active carbon, nitrogen mineralization

FIELD PERFORMANCE OF SUGARCANE CULTIVARS DURING DROUGHT: INSIGHTS INTO DROUGHT TOLERANCE STRATEGIES

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Introduction

Multi-environment cultivar trials exposed to drought present opportunities to evaluate drought tolerance of commercial cultivars. The 2015 season was categorised as one of the most severely drought affected years in the South African sugar industry's history. The objectives of this study were to identify potential drought tolerant/sensitive cultivars, and to gain insights into possible drought tolerance strategies for sugarcane in coastal growing conditions.

Materials and Methods

Sugarcane crops from long-term cultivar evaluation trials along the coastal belt of KwaZulu-Natal were characterised for drought using seasonal rainfall from weather stations in the proximity of trials and estimated soil water deficits. The relative cultivar rankings for cane yield (t/ha) in drought-affected and normal crop years for the same trial were evaluated to identify significant cultivar rank changes. The Canesim crop growth model was used to simulate growth during drought years and to identify growth stages most severely affected by the drought. In-season measurements of stalk elongation rates and biomass accumulation in some trials helped identify cultivars that maintained or ceased growth during periods of severe drought.

Results and Discussion

Crops categorized as "drought-affected" showed significantly ($P<0.05$) lower mean cane yields in the 2015 season compared with previous ratoon crops of the same trial. Cultivar N52 consistently showed significant improvements in rankings relative to other cultivars in drought-affected crops, while the ranking in normal years (and in irrigated trials during the drought year) was moderate to low. In contrast, cultivars N39 and N51 exhibited sharp rank declines associated with the drought year in some trials. Crop simulation and measurements of biomass accumulation rates in one trial revealed that N52 continued growing during the period of peak water stress while other cultivars effectively ceased growth. The vigorous, sustained growth of N52 during periods of water stress is proposed as a feasible drought tolerance strategy for coastal growing conditions. The benefits and drawbacks of sustained growth during drought are discussed and compared with water conserving strategies known to be beneficial in the midlands region.

Conclusions

Multi-environment cultivar trials are useful tools to help identify drought tolerant/susceptible cultivars. When combined with in-season growth measurements and integrated use of crop models and weather data, multi-environment trials can provide insights into possible drought tolerance strategies and how these differ for varying target environments. The cultivars identified in this analysis may be used as indicator cultivars in more detailed physiological research on drought tolerance mechanisms in sugarcane.

References

Keywords

cultivar trials, drought tolerance, multi-environment trials, sugarcane

The effect of 1-methylcyclopropene (1-MCP) and prochloraz on the storage potential and quality of 'Hass' avocado fruit

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Introduction

Almost 50% of South African avocados are destined for the European export market. To prevent ripening in transit and maintain fruit quality, fruit are cold-stored and in some instances treated with the ethylene-inhibitor, 1-methylcyclopropene (1-MCP). To prevent fungal decay, fruit are treated with the fungicide, prochloraz. Currently, the interactions between 1-MCP, fruit maturity and storage temperature are not fully understood. Nor are the effects of season, 1-MCP treatment and prochloarz on the phytochemical composition of fruit. The aim of this study was to investigate the effect of 1-MCP and prochloraz at two different temperature regimes on storage potential, quality and phytochemical composition of ‘Hass’ avocado fruit harvested at three different maturities.

Materials and Methods

Fruit at three different maturities were obtained from a commercial packhouse for this study. Half of the fruit were treated with the fungicide prochloraz, while the other half was untreated. Again, half each of the prochloraz treated and untreated fruit were treated with 300 ng.L-1 1-MCP. Thereafter, fruit were stored at 2.0 or 5.5 °C for 28 days. After the cold storage period, fruit were ripened and evaluated for the number of days to ripen (DTR), fungal decay incidences (anthracnose, stem-end-rot and vascular browning) and physiological disorders (diffuse mesocarp discolouration, anthocyanin staining and seed cavity browning). Fruit samples for each treatment were also stored for phytochemical analysis.

Results and Discussion

1-MCP and the colder storage regime (2°C) significantly delayed ripening during all the harvesting periods. Unfortunately, the colder storage regime increased the incidence of black cold damage on the exocarp of the fruit. Quality-wise, it appeared as if the mid-season fruit were of much lower quality, as they had higher incidences of fungal decay and physiological disorders. In general 1-MCP reduced the incidences of physiological disorders, but delayed ripening caused by 1-MCP increased fungal decay. Decay caused by the stem-end-rot fungal complex was further increased by the colder storage regime. The fungicide reduced the incidences of anthracnose but unfortunately had no effect on stem-end-rot. The changes in phytochemical composition will be discussed as analyses are still in progress.

Conclusions

1-MCP, as previously shown, was effective in delaying ripening and reducing physiological disorders, but has the disadvantage of increasing fungal decay. The fungicide, prochloraz, was found not to be effective in controlling the stem-end-rot complex. This will be further investigated, but points to a need to investigate alternative control measures.

References

Keywords

Phytochemicals, cold-storage, maturity, fungal decay

GEOMORPHOLOGY AND SOILS OF THE LETABA TERRACES

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Introduction

A simplified geomorphology hillslope model used in the Land Types (LT) data set does not always adequately describe the soil-landscape relationship, particularly at higher than LT (1:250 000) scales. Here we show that geomorphological analysis may explain the soil spatial distribution in the Lowveld geomorphic province better than the common catena model. The analysis of soil clay mineralogy emphasizes the contribution of local fluvial transport to formation of sediments and soils of the palaeoterraces.

Materials and Methods

A sequence of cross-sections was derived from the 20m SUDEM of the Letaba river catchment. The channel elevation was normalized to 0 along the whole section of the Great letaba catchment. The DEM analysis was conducted in the middle reaches of the river, where its profile is nearly linear. In cross sections the true elevation was substituted with vertical distance above the channel (VDC). Maximum VDC values were extracted from the combined range of 50 sections to create continuous integrated cross-sectional profiles. The latter were used to define the palaeoterraces, their extent and slope. The 38 soil profiles located on the main surfaces identified by the DEM analysis were described, sampled and analysed for PSD and clay mineralogical composition.

Results and Discussion

The Letaba river catchment in its linear section is defined by the distinct geomorphic features: the main planation surface cut from the Precambrian basement (pierced by the younger granite copies and mafic ridges) and a sequence of palaeoterraces. Terracing was identified at the relative elevations approximately following 7, 20, 35, 45, 60 and 100 m above the present channel, where the 100m level represents the main planation surface (presumably the Tertiary African Surface). PSD and clay mineralogy show distinct link between the occurrence of mafic koppies and ridges with significant increases in smectite clay content within the associated soil profiles located on fluvial terraces of various ages. Dramatic changes of clay mineralogy were observed as the river moves from granitic to Precambrian surfaces, where micas and talc mark the transition.

Conclusions

We conclude that the main geomorphic features may be successfully mapped using multi-scale object-oriented terrain (DEM) analysis. This approach may significantly facilitate the delineation of soil types or their groups and further advance the methods of spatial soil analysis.

References

Keywords

Landscape evolution, Palaeoterraces, Soil geography

Acknowledgements

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A REVIEW ON THE POTENTIAL OF ECOLOGICAL INTENSIFICATION TO IMPROVE FOOD PRODUCTION SYSTEMS IN SMALLHOLDER AGRICULTURE IN SOUTHERN AFRICA

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Introduction

Global food production will need to more than double to meet the growing demand by 2050. Population growth occurring more rapidly in Sub Saharan Africa (SSA) than anywhere in the world. This therefore means food demand is expected to increase resulting in more chronic food shortages and food in secure livelihoods. With an estimated 70 % of Africans are dependent on rain-fed agriculture as a source of food production. Climate change and variability, steadily degrading resource base and poor agricultural markets are adversely affecting countries in southern Africa, particularly as they affect the ability of smallholder farmers to raise enough food to feed themselves.

Materials and Methods

Results and Discussion

Globally there is focus on increasing agricultural investments in Africa to achieve food security and alleviate poverty. Competing demands for land to produce food, fuel, fibre, and other resources to support livelihoods places a critical challenge on nature conservation which is a pressing issue which needs to be addressed due to the irreversible damage already done to biodiversity by agriculture. Given that agricultural yields are well below attainable levels in smallholder farming systems in Africa. There is a need to understand the suitability of various food production systems in achieving food security in Africa. This paper provides an insight on the social, economic and environmental impact and sustainability of conventional and sustainable intensification production systems in an African smallholder agriculture context. The paper also looks at the potential and suitability of ecological intensification in achieving United Nations Sustainable Development Goals (SDGs) on zero hunger and biodiversity conservation.

Conclusions

We therefore suggest that knowledge gaps on the potential of biodiversity and associated ecological process and services and their yield benefits to smallholder farmers in sub Saharan Africa be addressed as this could be a way to improve food security now and in the future in SSA.

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Keywords

food security, conventional intensification, sustainable intensification, ecological intensification

AN EVALUATION OF THE NUTRITIONAL AND HEALTH PROMOTING PROPERTIES OF TWO RUMEX SPECIES CONSUMED AS WILD LEAFY VEGETABLES

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Introduction

Rumex crispus and *R. lanceolatus* are considered as invasive species in many parts of the world; however, the plants are still grown especially in the Eastern Cape Province of South Africa for their medicinal properties and as vegetables. The leaves of these plants are consumed as vegetables and are added to salads in moderate amounts. The objective of this study was to assess the nutritional and health-promoting properties of these two Rumex species as part of strategies towards broadening the food base.

Materials and Methods

The nutritional contents of cooked and uncooked *R. crispus* and *R. lanceolatus* leaves were evaluated in terms of their beta-carotene, vitamins E and C content using HPLC-DAD. The antioxidant activity and phytochemical composition of their dried leaves were also determined.

Results and Discussion

Both cooked and uncooked *R. lanceolatus* leaves had high beta-carotene content when compared to cooked and uncooked leaves of *R. crispus*. Similarly, the vitamins C and E content of both cooked and uncooked leaves of *R. lanceolatus* was high compared to similar preparations of *R. crispus* leaves. *Rumex lanceolatus* dried leaves had a high amount of total phenolic (94.3 mg GAE/g dry weight) and flavonoid (56.1 mg CE/g dry weight) content compared to *R. crispus* dried leaves. The antioxidant activity of *R. lanceolatus* expressed as EC50 was 5.6 and 24.1 µg/ml with 50% methanol and water extracts, respectively. The antioxidant activity observed was significantly higher than those recorded with similar extracts obtained from *R. crispus* leaves.

Conclusions

Overall, *R. crispus* appeared to have less nutritional and medicinal values compared to *R. lanceolatus*. Nevertheless, the consumption of these wild vegetables as a dietary component especially among the rural dwellers in sub-Saharan Africa is relatively inexpensive and beneficial for broadening the food base while promoting food and nutritional security.

References

Keywords

Rumex crispus, R. lanceolatus, nutrition, wild leafy vegetables

COMPARING EFFICACY OF NEMACUR, BIOCULT MYCORRHIZAE AMD NEMARIOC-AL PHYTONEMATICIDE ON MELOIDOGYNE JAVANICA POPULATION DENSITIES AND GROWTH OF POTATO

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Introduction

The potato industry had been highly reliant of synthetic chemical nematicides to the extent that alternatives such as nematode resistance were ignored for a long period at international scale. Internationally, with the cut-off date of the withdrawal of methyl bromide in 2005, much research work had been focusing on managing nematode population densities using environment-friendly sustainable products. Nemarioc-AL phytonematicide is a potent phytonematicide, which consistently reduced population densities in various crops (Mashela et al., 2015). Biocult Mycorrhizae, which contains Glomus species and Trichoderma species, can also suppress plant-parasitic nematodes. The objective of this study was to compare the efficacy of Nemarioc-AL phytonematicide (P), Biocult Mycorrhizae (B) and Nemacur (N) on population densities of Meloidogyne javanica and growth of potato under field conditions.

Materials and Methods

The study was conducted under field conditions, with soil being predominantly Hutton sandy loam (65% sand, 30% clay, 5% silt). Seeds were sown in 25-cm deep furrows at industry-recommended inter-row and intra-row spacings. At 50% clone emergence, each clone was inoculated with 5000 eggs and second-stage juveniles (J2) prepared by extracting eggs and J2 of M. javanica from roots of kenaf (Hibiscus cannabinus) in 1% NaOCl solution. Agronomic cultural practices such as irrigation, fertilisation and pest management were as applied in commercial potato production systems. Nemacur was applied once at a recommended rate of 24 L/ha at 7 days before planting, with Biocult Mycorrhizae applied at 50% seedling emergence. At 56 days after inoculation, plant and nematode variables were collected and analysed.

Results and Discussion

Treatment effects were highly significant on population densities of eggs, J2 in roots, total nematodes and gall rating. Relative to control, Nemarioc-AL phytonematicide reduced eggs and J2 in roots, total nematodes and gall rating. More or less similar trends were observed in the Biocult Mycorrhizae treatment. The relatively high impacts of the treatments were comparable with those of Nemacur. In granular formulation, the efficacy of Nemarioc-AG phytonematicide on nematode suppression was similar to that of Nemacur and Aldicarb (Mashela et al., 2008).

Conclusions

The efficacies of Nemarioc-AL phytonematicide and Biocult Mycorrhizae on nematode suppression were comparable to those of Nemacur, which is currently being withdrawn from the agrochemical markets.

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Mashela, P.W., Dube, Z.P. and Pofu K.M. 2015. Managing the Phytotoxicity and Inconsistent Nematode Suppression in Soil Amended with Phytonematicides. In: Meghvansi, M.K. and A. Vorma (eds.). Organic Amendments and Soil Suppressiveness in Plant Disease Management, Soil Biology, vol.46. Springer International Publishers Switzerland, Heidelburg.

Keywords

sustainable nematodes management, Meloidogyne species, plant extracts, synthetic nematicides, Cucumis myriocarpus

EFFICACY OF POST-HARVEST SILICON DIPS ON THE MANAGEMENT OF CHILLING SUSCEPTIBILITY OF “M37” MANDARIN SELECTION

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Introduction

Citrus fruit exported from South Africa to the USA and China require cold treatment of -0.6°C for 22-24 days during shipment to sterilise any insect eggs and larvae in the fruit. However, this treatment often causes chilling injury (Hordjik, 2013). Furthermore, sufficient empirical results showed that silicon induces resistance to both abiotic and biotic stress. Therefore, silicon could be applied to reduce chilling injury (Mditshwa, 2012). “M37”, a new selection developed by the ARC-TSC, has shown good internal qualities and has potential to become an export cultivar. However, it is highly susceptible to cold sterilization temperatures. Thus, the aim of this study was to evaluate the potential of post-harvest silicon dips to mitigate chilling injury on the “M37” selection.

Materials and Methods

Harvested fruit were dipped into different silicon concentrations (0, 50, 100 and 150 ml/L) for 30 minutes, air dried and then waxed with Citrishine®. Afterwards, fruit were packed into smaller boxes which contained 15 fruit per box with three replicates and stored at -0.6 and 4.5ºC for 28 days. Fruit were evaluated immediately after experiment initiation just after treatment application, at 21, 28 plus 7 days shelf-life. Fruit were evaluated for chilling injury, firmness, weight, electrolyte leakage, total soluble solids (TSS) and titratable (TA) acidity.

Results and Discussion

Treatment with 50 and 100 ml/L potassium silicate concentrations reduced chilling injury on fruit stored at -0.6 and 4.5ºC when compared with water-treated and the highest potassium silicate concentration (150 ml/L). There was no significant difference in fruit weight loss or firmness amongst water and potassium silicate treated “M37” fruit. However, fruit weight loss and firmness reduction appeared to have increased with the increase in potassium silicate concentration, storage temperature and storage duration. Furthermore, water-treated fruit stored at -0.6 and 4.5ºC exhibited higher electrolyte leakage compared with the potassium silicate treatment of 50 ml/L. As expected, TSS increased and TA decreased with storage duration at -0.6 and 4.5 ºC, irrespective of potassium silicate concentration.

Conclusions

In conclusion, cold storage temperature and storage duration are the most important factors affecting fruit quality of “M37” fruit during postharvest. Therefore, potassium silicate concentrations of 50 and 100 ml/L may be used to reduce chilling susceptibility of “M37” as an alternative to other commercially-used mitigation strategies.

References

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Keywords

electrolyte leakage, fruit weight loss, fruit firmness, total soluble solids, cold sterilization

EFFECT OF HARVEST TIME, POST-HARVEST STORAGE AND RIPENING TEMPERATURE ON QUALITY OF ‘REED’ AVOCADO CULTIVAR

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Introduction

‘Reed’ avocado is a late season cultivar introduced to South Africa from California, USA. Its pre-harvest adaptation and production aspects have been researched and documented (Nevett *et al*., 2002). However, effect of harvest time, post-harvest storage and ripening temperature have not been studied for this newly-introduced avocado cultivar. Thus, the objective of this study was to investigate the effect of these three factors on fruit of ‘Reed’ avocado cultivar.

Materials and Methods

The experiment was carried out in a factorial, arranged in a completely randomised design, with three replicates. Treatment factors were: 2 harvest times (mid-and late), 2 post-harvest storage temperatures , 3 ripening temperatures and 5 ripening day intervals (0, 2, 4, 6 and 8). Fruit were stored at 2.0 and 5.5°C for 28 days, thereafter, ripened at 16, 21 and 25°C until fully ripe. Data collected included weight loss, firmness and respiration rate, ripening percentage and skin colour.

Results and Discussion

The three treatment factors significantly influenced fruit weight loss, firmness and respiration rate but not ripening percentage. Ripening at higher temperatures (25 and 21°C) resulted in higher fruit weight loss when compared with lower ripening temperatures (16°C) throughout the ripening time, irrespective of storage temperature and harvest time. Fruit firmness decreased faster at higher temperatures (25 and 21°C) with fruit ripening within 4 and 6 days, respectively. In addition, ripening at lower temperature (16°C) was slower with fruit fully ripened within 8 days after withdrawal from cold storage at all harvest times. ‘Reed’ avocado fruit respiration rate followed a climacteric pattern, however, significantly higher at higher temperatures (25°C) when compared with the lower ripening temperature (16°C) after withdrawal from cold storage during both harvest times. Treatment factors had a significant effect ($P < 0.05$) on lightness (L *) and hue angle (h) but no significant effect ($P > 0.05$) on chroma (C *) and eye colour of 'Reed' avocado fruit during ripening. Overall results showed a visual change on ‘Reed’ avocado skin colour, with eye colour changing from green to bright yellow.

Conclusions

The study showed that harvest time, post-harvest storage and ripening temperatures had profound influence on quality of ‘Reed’ avocado fruit. In South Africa, ‘Reed’ avocado fruit can be harvested during mid-or late season and stored at the recommended low temperature (2.0°C); and thereafter, ripened at either 16 or 21°C.

References

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Keywords

‘Reed’ avocado fruit; firmness; respiration rate; fruit skin colour; fruit weight loss

Concentration of Nemafric-BL phytonematicide to stimulate growth of Pelargonium sidoides

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Introduction

The Curve-fitting Allelochemical Response Dosage (CARD) model was adapted to generate the Mean Concentration Stimulation Point (MCSP) (Mashela et al., 2015), which is a crop-specific phytonematicide concentration that would safeguard phytotoxicity. Therefore, the objective of this study was to investigate the MCSP of Nemafric-BL phytonematicide on nematode-infested African geranium (*Pelargonium sidoides*).

Materials and Methods

A microplot trial was conducted at the Green Technologies Research Center (GTRC), University of Limpopo, South Africa (23°53'10"S, 29°44'15"E) in autumn (March-May) 2015. Established clones were raised in 30-cm-diameter plastic pots containing 10-L steam-pasteurised sand and Hygromix at 3:1 (v/v) ratio. Each clone was inoculated with 5000 eggs + second-stage juveniles (J2) of *M. javanica*. Six treatments, namely, 0, 2, 4, 6, 8 and 10% Nemafric-BL phytonematicide concentrations, were arranged in a randomised complete block design, with seven replications. Treatments were applied weekly using 250 ml diluted solutions. At 56 days after inoculation, plant and nematode variables were subjected to analysis of variance, with significant plant data further subjected to the CARD model to generate the MCSP.

Results and Discussion

The CARD model suggested that the MCSP of Nemafric-BL phytonematicide on *P. sidoi*des was at 2.87%, with the overall sensitivity (∑k) of 3 units. Treatments exhibited quadratic relations on plant height and root galls, with the model explained the relationship by 87 and 97%, respectively. In this study, all levels of Nemafric-BL phytonematicide were highly effective in suppression of Meloidogyne population densities, which confirmed observations in other crops (Pelinganga et al., 2012).

Conclusions

Nemafric-BL phytonematicide should be used at the concentration of 2.87% to manage populations of *M. javanica* on *P. sidoides*. The established MCSP would allow for the determination of the application interval, which would provide information for the generation of the dosage model on this plant species.

References

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Keywords

African geranium, allelopathy, cucurbitacin, crude extracts

EFFECT OF ORGANIC AND INORGANIC MULCH APPLICATION ON THE YIELD AND WATER USE EFFICIENCY OF SWISS CHARD

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Introduction

Improvements in water use efficiency (WUE) in agriculture are needed due to the scarcity of fresh water, increasing input costs and increasing population growth. Mulching is a potential solution to small holder and commercial farmers, depending on the material used, to improve yield and reduce the cost involved in the cultivation of vegetables. The objectives of this study was to investigate the effect of organic and inorganic mulch on the performance of Swiss chard in terms of water use, weed control, yield and quality.

Materials and Methods

Seedlings were planted in 3 m x 0.9 m plots, at a plant spacing of 15 cm x 30 cm with six mulching treatments, i.e.**,** control (bare-soil), white plastic sheet, black plastic sheet, maize-meal bag, grass and double layers of newspaper in a plot to cover 2.7 m2. The experiment was laid out as a randomized complete block design with four replicates. Soil water content in the root zone was monitored twice a week using a CPN 503 DR Hydroprobe. Readings were taken at intervals of 0.20 m to a soil depth of 1 m by lowering the radioactive source through an access tube. At 30 days after transplanting, leaf area, leaf number, and leaf fresh and dry mass were measured on the harvested yield of 10 data plants per treatment and replicate.

Results and Discussion

Black plastic, newspaper and grass mulches suppressed weeds significantly, while weed growth were encouraged under bare-soil, white plastic and maize-meal bag mulch conditions. White plastic and grass mulch improved WUE significantly, and excelled above other treatments at 259.9 and 242.0 kg ha-1 mm-1, respectively, followed by black plastic mulch at 207 kg ha-1 mm-1. Mulching did not have a significant effect on the number of leaves and leaf fresh mass of Swiss chard; however, all mulch treatments produced higher leaf fresh mass, leaf area and leaf dry mass, as compared with the bare-soil, with white plastic mulch performing the best with regard to the number of leaves and leaf fresh mass produced.

Conclusions

This study showed that mulching (grass/hay and white plastic) can improve WUE, combined with yield improvement in Swiss chard production. Grass/hay mulch could be an option for both, commercial and small scale farmers, in improving WUE and weed control. Mulching resulted in water savings of up to 65% and could play a major role in successful production of the crop in a water-scarce country like South Africa.

References

Keywords

Beta vulgaris, grass mulch, leaf fresh mass, plastic mulch, weeds

INVESTIGATING AVAILABLE SOIL NUTRIENT LEVELS IN IRRIGATED WHEAT FIELDS IN SOUTH AFRICA

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Introduction

Increases in genetic yield potential of irrigated wheat (*Triticum aestivum* L.) in South Africa have increased nutrient demand and nutrient removal. Availability of plant nutrients may thus be a major factor influencing wheat yield potential. The objectives of this study were to 1) to determine the availability of essential plant nutrients in soils obtained from irrigated wheat fields in relation to wheat requirements and 2) to determine the variability of nutrient availability across geographical regions, tillage systems and crop rotation practices.

Materials and Methods

Soils (n=130) were randomly sampled from the 0–20 cm and 20–40 cm depths of representative and purposely selected fields in KwaZulu-Natal (KZN), the Cooler Central (CC), the Eastern Highveld (EH) and the Warmer Northern (WN) wheat production regions of South Africa, during the 2015/16 wheat planting season. The samples were analysed for electrical conductivity (EC), pH (KCl), exchangeable acidity, extractable phosphorus (P), sulphur (S), zinc (Zn) and exchangeable cations. Cation exchange capacity (cmolc /kg), acid saturation (AS), exchangeable sodium percentage (ESP) and Ca: Mg ratio were calculated. Visual assessments of wheat crops were done at the flag leaf stage for nitrogen adequacy. Statistical analysis was done using residual maximum likelihood (REML) on Genstat® 17th statistical software.

Results and Discussion

Soil pH, ESP, AS, EC, CEC, Ca:Mg and plant available P, K, Mg, Zn and Ca varied considerably across geographical regions. Soils in KZN were the most acidic (pH 4.51 ± 0.05), followed by EH (pH 4.97 ± 0.08), CC (pH 5.75 ± 0.09) and WN (pH 6.32 ± 0.12). There were positive Pearson’s correlations between pH and available nutrients such as P, Ca and Mg. Soil pH in the Eastern Highveld and Warmer Northern regions was slightly lower where wheat was rotated with legumes than with non-legumes. Extractable P was below the minimum threshold for optimum wheat growth in KZN (27.49 ± 2.04 mg/kg) and WN (36.35 ± 3.65 mg/kg). Conservation tillage and rotations of wheat with legumes resulted in higher soil acidity and P deficiency than either conventional tillage, or wheat-non legume rotations. Plant available Zn, Mg, K and S, together with EC and ESP were generally acceptable across all geographical regions.

Conclusions

The findings suggested that soil pH and P varied considerably in irrigation wheat fields and are possibly limiting factors of wheat yield potential. Plant available Zn, Ca, Mg, K and S were generally adequate. Tillage practices and crop rotation systems could be refined to improve soil pH and P.

References

Keywords

crop rotation; geographical regions; soil fertility; tillage; wheat yield

Chemical fruit thinning strategies for late mandarins (Citrus reticulata)

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Introduction

Obtaining positive results from chemical thinning agents is challenging due to sensitive interaction of concentration and timing of application with fruit load, as well as the difference in their methods of action. Efficacy of available chemical thinning agents 2,4-dichlorophenoxy propionic acid [2,4-DP (Corasil®P)] and trichlo-2-pyridinyloxyacetic acid [3,5,6-TPA (Maxim®)] have not yet been determined in late mandarin citrus cultivars. The objective of this study was to evaluate the efficacy of Corasil®P and Maxim® in a late mandarin model cultivar, 'Nadorcott' mandarin, as well as that of a novel active ingredient, Metamitron.

Materials and Methods

The experiment was conducted on 'Nadorcott' mandarin trees, in Stellenbosch (33°93'S, 18°82'E). The following treatments were replicated eight times (n=8), in a randomized complete block design, in which an individual tree equals a replicate: 1) Control: no thinning; 2) 150 ml/100L Corasil®P at 8 mm fruitlet diameter (30 dafb); 3) 300 ppm Metamitron at 8 mm fruitlet diameter (30 dafb); 4) 10g/100L Maxim® at 15 mm fruitlet diameter (60 dafb); and 5) 300 ppm Metamitron at 15 mm fruitlet diameter (60 dafb). Leaf samples were collected from each replicate tree over a 90-d period, starting on day of treatment to determine treatment effects on leaf carbohydrate contents. At time of commercial harvest, the total number of fruit removed per tree was recorded, together with their fresh weight in kilogram (kg) and the fruit size distribution per tree. Analysis of variance (ANOVA) was performed using STATISTICA software (version 13; Dell Inc.). Mean separations were carried out using the LSD test, where applicable ($P \leq 0.05$).

Results and Discussion

Corasil®P and Maxim® reduced the number of fruit per tree, but not tree total fruit yield (kg per tree). The Maxim® treatment caused severe fruit thinning (±25% reduction in fruit numbers), increased fruit growth rate and shifted fruit size distribution by up to 2 commercial fruit size calibres. Corasil®P treatment increased fruit growth rate and reduced only the number of fruit in the smallest fruit size calibre (SC <5). Both Metamitron treatments resulted in a ±25% reduction in fruit numbers and significantly reduced total fruit yield.

Conclusions

Treatments of 150 ml/100L Corasil®P and 10g/100L Maxim® had no negative impacts on tree total fruit yield or fruit quality of 'Nadorcott' mandarin, but increased fruit size and fruit size distribution per tree. Treatments of 300 ppm Metamitron at a fruitlet diameter of 8 or 15 mm did not significantly influence fruit quality, but reduced total fruit yield.

References

Keywords

Fruit load, leaf carbohydrates, plant growth regulators (PGR's), synthetic auxins

ANNUAL RYEGRASS DYNAMICS – ARE WE WINNING THE BATTLE OR LOSING THE WAR?

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Introduction

Annual ryegrass (Lolium rigidum) is the major weed problem in the Swartland production area, due to the ease in which the weed becomes resistant to herbicides and the competitiveness to the main cereal crop (wheat). One of the reported advantages of crop rotations, as part of a conservation agriculture production system, that include both cereal and broad leaf crops, is that broad-leaf and grass weeds are more easily controlled depending on the phase on the rotation. It is particularly important to have this additional weed management options to limit the potential for the development of herbicide resistance in the weed population. We monitored weed seed banks in eight crop rotation systems, comprising of four cash crop and 4 cash crop/annual pasture systems over a 16 year period from 2001 to 2016, at the Langgewens Research farm.

Materials and Methods

All phases of each rotation treatment were represented in each season and each treatment was replicate twice. Composite soil samples (50mm depth) were collected from representative areas of each camp during late February/early March from 2001 to 2016. Each sample was placed in a 20mm layer in a germination tray that had been pre-filled with weed-free building sand. The germination trays were kept moist in a shade cloth facility and all emerging seedlings were identified and counted after which they were removed from the germination tray.

Results and Discussion

Cash crop systems showed higher counts than in the crop/pasture systems. Ryegrass were generally well controlled during the pasture phase but tended to show an increase in the soil seed bank after the wheat phase. Counts increased with every consecutive year of planting the same crop.

Conclusions

Crop rotation has a positive effect on annual ryegrass seedbank management and the inclusion of annual legume pasture shows better results than pure cash crop production. From the data it would appear that we are currently winning the battle against this specific weed, but not winning the war of elimination. We have to look at alternative methods of combatting annual ryegrass in our systems.

References

Keywords

conservation agriculture, crop sequence, herbicide resistance, medic, seedbank studies

Baseline susceptibility of Busseola fusca to Bt maize in South Africa

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Introduction

Genetically modified maize expressing Bt protein have been commercialized in South Africa for the control of Busseola fusca. Busseola fusca has been reported to be resistant to Cry1Ab protein at several localities in South Africa. Reports of pest infestation in Bt maize (Cry1Ab) are regularly made in several regions, however resistance has only been confirmed in Vaalharts with few controlled laboratory experiments. There is an urgent need to evaluate B. fusca populations in South Africa for susceptibility to Bt maize. The study aimed to screen different populations of B. fusca for resistance to Bt maize and to generate baseline data regarding pest susceptibility for South Africa.

Materials and Methods

Stem borer larvae were collected from 11 field sites. Laboratory feeding studies with maize events expressing Cry1Ab (Bt1) and Cry1A.105+Cry2Ab2 (Bt2), were conducted to compare B. fusca fitness to the non-Bt iso-hybrid. The following life-history parameters were monitored: larval survival and mass, LT50, mortality, larval duration, pupation percentage, pupal mass, pupal duration, sex ratio and moth longevity.

Results and Discussion

Larval survival of up to 54.8% on Bt1 were observed in two populations and no survival was recorded on Bt2 event. Larval mass for some populations was significantly higher on the non-Bt iso-hybrid compared to Bt1 event. The LT50 for larvae feeding on the non-Bt maize ranged between 16-33 days compared to those on Bt1 with 6-25 days, and Bt2 with 4-8 days. The corrected percentage mortality for the Venda population was 94.16% compared to the known resistant population from Vaalharts at 0%. Larval development period on non-Bt maize was shorter compared to that on Bt1. No significant difference was observed between the non-Bt and Bt1 in terms of the pupal mass, sex ratio or moth longevity.

Conclusions

Results have provided an indication of the resistance status of B. fusca populations across South Africa. This study also provided base-line data for Bt2, which have been cultivated in South Africa from 2013. Studies such as these may be used as an early-warning if resistance do develop in South Africa to improve insect resistance management per region.

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Keywords

Busseola fusca, resistance, Bt maize, susceptibility.

SHOULD SLUDGE PRODUCED BY ACID MINE WATER NEUTRALISATION BE CLASSIFIED AS HAZARDOUS MATERIAL?

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Introduction

The neutralisation of acid mine drainage (AMD) facilitates the precipitation of various solids from solution. The process used is called High Density Sludge process and the solids are referred to as High Density Sludge (HDS). HDS is classified as hazardous waste. The potential environmental threat of HDS is a function of the solubility of its constituents. Currently, an understanding of solubility and weathering is lacking. Fresh and aged (43-year-old) HDS were subjected to chemical, physical and mineralogical analyses to understand its solubility.

Materials and Methods

Elemental content and mineralogical difference were assessed with XRF and XRD respectively. The water solubility, ligand- (EDTA, ammonium acetate), redox- (acid ammonium oxalate, dithionite citrate) and proton- (successive 0.1 mM HCl extractions) promoted dissolution were also assessed.

Results and Discussion

XRF showed Ca (4565 mmol/kg), SO4 (4147 mmol/kg), Fe (2229 mmol/kg), Al (1087 mmol/kg), Si (458 mmol/kg), Mg (268 mmol/kg), Mn (14 mmol/kg) and K (2 mmol/kg) to be the most abundant in the fresh HDS. For aged HDS Mg (4962 mmol/kg), Ca (2069 mmol/kg), SO4 (1973 mmol/kg) Fe (1603 mmol/kg), Al (1275 mmol/kg), Si (1128 mmol/kg), Mn (99.0 mmol/kg) and K (13 mmol/kg) were dominant. XRD showed 95.8 – 98.4 % of the crystalline phase was gypsum for both HDS, fresh HDS contained 4.2% of ankerite while aged HDS also contained quartz (5.5%). Ferric oxides remained poorly crystalline in the HDS after four decades. The relative solubility was high for SO4 (41%), Mg (39%) and Ca (22%) for the fresh HDS. Half (49%) of the total Mn was soluble suggesting to be largely in the manganous form. The relative solubility of Mn was 0.8 % for aged HD sludge, suggesting oxidation and precipitation of Mn(IV) oxides. The storing of HD sludge increased the alkalinity (0.2 mmol/kg for fresh HDS versus 1.1 mmol/kg of aged HDS) and salinity (EC increase: 364 to 730 mS/m) of HDS. The relative solubility increased for SO4 (84%) and Ca (31%). Mg content was higher in aged but the solubility was lower (14%). Solubility of Co, Cu, Zn, Cr, and Na was low; ranging between 2-9% for both fresh and aged HDS.

Conclusions

Aged sludge had lower concentration of SO4, Ca and Fe than fresh HDS, while Mg, Mn, K, Al and Si were higher. The data suggests that Fe and Al in HDS are of low environmental availability. Gypsum dominated in both HDS while ankerite and quartz were minor components in fresh and aged HDS respectively.

References

Keywords

Keywords: Classification, Weathering, High Density Sludge, Mineralogy, Solubility

Quantifying soil organic matter loss due to cultivation in southern Africa

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Introduction

Soil organic matter (SOM) is tightly linked to soil quality, but cultivation generally causes a decline in SOM, thereby reducing soil quality and releasing carbon dioxide into the atmosphere. Internationally, countries are expected to reduce their greenhouse gas (GHG) emissions, and to compile and update GHG inventories (Otter et al. 2010). However, many developing countries, such as those in southern Africa, do not have reliable information regarding SOM levels in cultivated soils, changes over time and best management practices to maintain or even restore SOM. A review was therefore conducted to collate published research on SOM [or its indicator elements, carbon (C) and nitrogen] in cultivated fields in southern Africa.

Materials and Methods

We used a systematic review process to collect all peer-reviewed publications in southern Africa about SOM in agriculture (Swanepoel et al. 2016). A total of 84 publications were assessed, and information such as date, location, SOM/soil organic carbon (SOC) content, clay and key findings were recorded. SOM dynamics from long-term trials conducted in South Africa were also simulated using the APSIM model to investigate the impact of different management practices.

Results and Discussion

Research on SOM in agricultural soils is unequally distributed, and focused on the central maize producing areas of South Africa. Analysis of the data shows an average SOC of 0.7% in low rainfall areas, and up to 2.5% in higher rainfall areas. A decline of 46% in SOC due to cultivation was representative for all cultivated fields in southern Africa ($R^2 = 0.84$). Research gaps identified include understanding C sequestration under various management systems and for different climatic regions, and ways that modelling can be applied to improve our understanding are discussed.

Conclusions

The loss of almost half the SOC in cultivated fields is a huge concern, as this results in both elevated levels of GHGs in the atmosphere and, perhaps more importantly, the loss of soil quality which influences the production potential of soils in a region that is already food insecure. Ongoing work aims to identify practices that can be used effectively to restore SOM in degraded soils.

References

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Keywords

TARGETED HAPLOTYPE COMPARSIONS BETWEEN SA WHEAT CULTIVARS APPEAR PREDICITVE OF PHS TOLERANCE

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Introduction

Pre-harvest sprouting (PHS) has been a serious production restraint for over two decades, especially in the summer rainfall wheat production regions. However, the PHS tolerance levels in South African wheat cultivars has steadily improved directly/indirectly through wheat breeding. PHS is a complex genetic trait controlled by multiple genes which are significantly influenced by environmental conditions. This complicates accurate prediction of a genotypes' stability in terms of PHS tolerance. Recently a number of reports have documented the presence of major QTL on chromosomes 3A and 4A of modern bread wheat which confer PHS tolerance. In this study, the SSR marker haplotypes of chromosomes 3A and 4A of former and current South African cultivars were compared with the aim to select for improved PHS tolerance levels in cultivars in future.

Materials and Methods

A total of 98 wheat cultivars, six resistant checks from around the world and one susceptible check were evaluated for their PHS tolerance in a rain simulator and scored on a scale from 1 to 8. Five seeds of each entry were planted out into seedling trays. Seven days' post germination leaf material was harvested for DNA isolation. A modified CTAB method was used before progressing to downstream PCR applications. In total six SSR markers were used to conduct the haplotype analysis. These markers were targeted from the well characterized 3A and 4A QTL regions (three SSR markers per QTL). The haplotype marker data was compared across all genotypes and different production regions. A relative change in observed phenotypic variation percentage was obtained per marker allele and across marker haplotypes when compared to the susceptible check Tugela.

Results and Discussion

The PHS resistance of the cultivars in the study varied from excellent (<2.9 - 29.6% of entries) to moderately tolerant (<3.7 - 22.4% of entries), to moderately susceptible (<4.6 - 24.5% of entries) and to highly susceptible (>4.6 - 23,5% of entries). Clear favorable alleles/haplotypes, contributing 40-60% of the variation for better PHS tolerance were identified. Based on the haplotype data, germplasm under development can now be selected positively or negatively to improve PHS tolerance.

Conclusions

The haplotype data presented in this study is the first of its kind for PHS genotyping in South Africa. Initial analysis shows haplotype data appears to be predictive of PHS tolerance status. In future, we hope to use this molecular data as a tool to predict the possible PHS tolerance range of a new genotype.

References

Keywords

Haplotype, pre-harvest sprouting, QTL, SSRs, wheat

ESTIMATING WATER USE OF MATURE PECAN ORCHARDS: A SIX STAGE CROP GROWTH CURVE APPROACH

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Introduction

Mature pecans use large quantities of water and therefore the accurate estimation of water use or evapotranspiration (ET) of pecan orchards is critical for judicious irrigation water management and planning. Measuring ET under all possible combinations of climate and management practices is not possible, and as a result, models are used to estimate ET. Empirical modelling approaches are more widely adopted than the more complex mechanistic models, as they are more easily parameterized, but they are not always easily transferred across a wide range of growing conditions, making local evaluation and validation essential. This study evaluated existing crop coefficient models in a mature pecan orchard for three seasons in a semi-arid subtropical climate.

Materials and Methods

Transpiration of mature pecans was monitored for three consecutive growing seasons (from 2009 to 2012) at Cullinan using the Heat Ratio Method. Soil evaporation was estimated with a successfully calibrated and validated FAO-56 soil evaporation model. Evapotranspiration estimates were obtained as the sum of evaporation and transpiration estimates. These measured estimates were compared with estimates from simple empirical modelling approaches, including the generic FAO-56 approach and a pecan-specific approach.

Results and Discussion

Whilst the generic FAO-56 approach, using parameters provided for stone fruit performed reasonably well on a seasonal basis, accurate monthly estimates of ET were not achieved throughout the season. A closer analysis of data from the current study and a previous study in New Mexico, revealed that a six stage crop coefficient curve should be considered for pecans, together with higher mid-season crop coefficient (Kc) values for mature orchards. More accurate estimates of monthly ET for mature pecan orchards were obtained when reference Kc (Kc-ref) values for a well-managed mature pecan orchard in New Mexico were adjusted for local conditions of climate, using a growing degree day – Kc relationship and canopy cover.

Conclusions

The adjustment for climate should, however, be used with caution. A comparison between seasons at Cullinan and with New Mexico suggests that whilst thermal time is likely to predict the start of leaf fall, it is unlikely to accurately predict canopy development at the start of the season. As a result it is suggested that in future a crop growth curve based on visual observations of phenological stages is developed.

References

Keywords

crop coefficient, evapotranspiration, growing degree days, fractional canopy cover

The effect of sludge treatment methods and post treatment dewatering techniques on the nitrogen fertilizer value of sludge

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Introduction

To promote beneficial agricultural use of sludge and minimize risks associated with nutrient oversupply, it is crucial to explore the effect of wastewater treatment and post treatment drying techniques on the Nnitrogen fertilizer value of sludge. The aim of this study was to investigate the N fertilizer value of sludge from selected sludge treatment and post treatment drying techniques and to identify organic compounds responsible for carbon and nitrogen release during the decomposition process.

Materials and Methods

A sludge-soil mixture incubation study (100 days) was conducted using thermally-hydrolysed-sludge (THS), Aactivated-sludge (Activated), and anaerobically-digested-sludges (ADS1, ADS2, ADS3). The thermally-hydrolysed-sludge was belt pressed and had a moisture content of 50%, ADS3 and Activated were dried in drying beds in thin layers of ≤100 mm deep and, ADS1 and ADS2 in thick layers of 250 mm.

Results and Discussion

Results show that net N mineralization in 100 days per kg organic N and C applied was highest for activated sludge (474 g kg-1 N and 77 g kg-1 C) and lowest for ADS2 (205 g kg-1 N and 23 g kg-1 C). The N fertiliser value (kg N released per ton of sludge applied) was highest for activated sludge dried in thin layers of less than 100 mm (24 kg) because of its high N content and lowest for ADS2 (6 kg) because of its low N content, high lignin content, high C:N and Llignin:N ratios.

Conclusions

It can be concluded that wastewater treatment methods, post treatment drying depth in beds and duration have significant implications on the fertilizer value of sludge. It was also apparent from this study that the soluble fraction, as determined by the Van Soest method, was responsible for about 90% of the organic matter decomposition. Further investigation is needed on the effect of dewatering techniques on the N fertilizer of sludge.

References

Keywords

nitrogen mineralization, carbon decomposition, lignin, C:N ratio, cellulose, hemicellulose, soluble compounds

Effect of sampling depth on determination of soil potassium and carbon stocks

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Introduction

Globally, soil sampling for fertility purposes has predominantly been at depths ranging from 10 to 50 cm, with the most frequent intervals being 15 to 20 cm. Recent work has shown that more useful information is obtained using shallower sampling depths. The first objective of this report was to investigate the effect of sampling depth on the determination of levels of potassium (K). The second objective was to determine organic carbon (C) distribution in the soil profile using two C assessment methods.

Materials and Methods

Soil samples were collected from several sites at depth intervals of 0 – 2 cm, 0 – 10 cm and 0 – 20 cm. Common treatments at all the sampling sites were burnt and unburnt cane before harvest. Samples of the third leaf were also collected and analysed. All soil and leaf samples were routinely analysed by the FAS lab at SASRI. Only C and K data are included in this report.

Results and Discussion

Data revealed that the K concentration from the 0 – 2 cm depth was about double that obtained from the 0 – 10 cm and 0 – 20 cm depths. However, K was significantly lower in all depths of the unburnt treatment compared with the burnt. The concentration of total C was found to be very similar between depths. The three day incubation method revealed that for the bare surface and mulched surface treatments SMC was three times higher in the 0 – 2 cm depth interval compared with the 0 – 10 cm depth. Using total C as an indicator of the impact of surface residue management revealed no significant effects in the 0 – 10 cm depth interval. However, SMC levels in the 0 – 10 cm depth interval of residue-covered soil were up to double those from the bare surface treatment.

Conclusions

The much higher K load in the 0 – 2 cm depth interval compared to the deeper depths, regardless of the surface residue management, is an indication of K immobility in soils, and possibly of limited root activity at the immediate soil surface. Future work should explore options to improve uptake from this relatively thin soil layer. In terms of carbon dynamics, data highlight the insensitivity of measurements of total C to varying management practices. The carbon pool represented by SMC is sufficiently sensitive to show the impact of surface residue management on C stocks, particularly at shallower sampling depths.

References

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Keywords

Depth intervals, potassium, soil carbon, active carbon, sugarcane, surface cover

AN EVALUATION OF LIME REQUIREMENT METHODS FOR SOUTH AFRICAN SOILS

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Introduction

Liming of acidic soils is an essential practice to maintain both soil fertility and optimal crop production. Local agricultural consultants report that lime requirement methods are occasionally found to be inaccurate, resulting in under or over liming of soils. Therefore, an incubation study was conducted with the aim to evaluate the accuracy of the most commonly used lime requirement methods which include the Eksteen, Cedara, ARC- Small Grain Institute, SMP single buffer, and Adams and Evans single buffer methods on 20 South African soils.

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 K_2SO_4), exchangeable base cations (NH_4AOc) were determined. Lime recommendations were calculated as specified by procedures related to each lime requirement method. Laboratory grade $CaCO_3$ was applied to soils, which were incubated for 3 months at FWC.

Results and Discussion

The Eksteen method was found to prescribe 30.8% more lime on average than was required to achieve a pH(KCl) of 5.5 on the population of soils. Over-liming by the Eksteen method was especially prevalent on weakly buffered soils. The Cedara method was found to prescribe 12.7% less lime on average than was required for the population of soils. Interestingly, under liming was found to mostly occur on weakly buffered soils. The ARC – Small Grain Institute method prescribed 160.3% more lime on average than was required. The SMP single buffer method prescribed 61.0% less lime on average than was required. Under-liming using this method was especially prevalent on weakly buffered soils, most notably on soils with CECpH7 values below 6 cmolc/kg. The Adams and Evans single buffer method prescribed on average 17.2% more lime than was required.

Conclusions

The Eksteen, Cedara and Adams and Evans methods were found to be suitable for use on a wide range of soils in South Africa. However, caution should be exercised on weakly buffered soils, especially soils that contain less than 1% total C in order to avoid over-liming. The ARC – Small Grain Institute method should be replaced with a more suitable method, as it shows little accuracy in practice, especially on weakly buffered soils. The SMP single buffer may be considered on strongly buffered soils with more than 2% total C.

References

Keywords

buffer capacity, CEC, lime requirement, soil carbon, soil pH

TOWARDS ECOLOGICALLY SUSTAINABLE CROP PRODUCTION IN SOUTH AFRICA

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RJ	Stirzaker	CSIRO Land and Water, PO Box 1666, ACT 2601, AustraliaFood production comes at an ecological cost, and the lack of sustainability of our crop production systems is becoming increasingly worrisome. South Africa is characterised by environmental fragility and water scarcity. We analyse the impact of South African commercial crop production on the environment and what can be done about it.

Introduction

Food production comes at an ecological cost, and the lack of sustainability of our crop production systems in South Africa, which is characterised by high levels of food insecurity, environmental fragility and water scarcity, is a major concern. We analyse the impact of South African commercial crop production on the environment and what can be done about it.

Materials and Methods

Impact categories considered were divided into what we consider ‘better-researched’ problems: fresh water depletion, salinisation, soil degradation, eutrophication and land use change; and into what we consider ‘emerging’ problems for agriculture: greenhouse gas emissions, soil profile acidification, ecotoxicity and non-renewable resource consumption.

Results and Discussion

Results indicate that many of our agroecosystems are degrading, with both immediate impacts on- and off-site and those playing out over longer time frames. Achieving ecologically sustainable crop production is a ‘wicked’ problem – containing dynamic social, economic and biophysical complexities. Increased stakeholder engagement to better understand these problems, the tradeoffs linked to finding solutions and to involve those with the resources to turn knowledge into action is required. Collecting key data, turning it into information within local contexts (involving the ecology, agronomy, sociology, psychology, economics and other disciplines simultaneously) and communicating it effectively to allow learning and adaptive management is essential. An example is the display of river flows on a website in real-time to help farmers manage and adapt irrigation practices better, and to improve understanding of the responsibilities of managing water at catchment scales.

Conclusions

Farming continually degrading systems when an increase in yields is required to meet population growth is worrisome. Scientists need monitoring data and guided modelling to figure out the ‘how’, but as importantly this data needs to be interpreted and communicated in a way that can guide adaptive management, policy formulation and monetary investment. Addressing both immediate food security and long term environmental sustainability simultaneoulsy is a comlex issue requiring greater engagement and action by all stakeholders. South Africa, as with many other countries faces a skills shortage, and leaders who are able to incorporate and integrate the knowledge, skills, resources and perspectives from many actors is needed. Mitigating impacts will sometimes come at the cost of short-term farm profitability, so do we pay more for our food so farmers look after the environment better, or will we pay higher taxes so government can pay farmers for their stewardship of landscapes on behalf of society?

References

Keywords

sustainable crop production, soil and water degradation, land use change, greenhouse gas emissions, salinization, resource depletion

Optimization of a Method for Flavonoid Quantification in Grapefruit

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Introduction

Grapefruit are naturally rich in health beneficial flavonoids with a total flavanone content of 27mg aglycones/100g edible fruit or fruit juice. Naringin is the major flavonoid of grapefruit and is best known for its distinct bitterness (Peterson et al., 2005). The standardisation of a fast, reliable and cost-effective analytical method to screen grapefruit cultivars for their flavonoid content could potentially provide important information for the Agricultural Research Council's citrus breeding programmes in terms of screening for these beneficial nutrients.

Materials and Methods

In this study the optimization of a high-performance liquid chromatography technique coupled with a UV/Vis detector (HPLC-UV/Vis) was carried out using an Accucore C18 column, I.D. 3mm and a gradient elution of acetonitrile and deionized water. Detection was carried out at 284nm, with a spectral screen carried out between 210nm and 450nm. Flavonoids were quantified using external standards prepared in methanol. Calibration curves of acceptable linearity were determined for each analyte. The repeatability, precision, LOD, and LOQ were also evaluated for each analyte as part of the method validation. Grapefruit juice samples were analysed and flavonoids were identified and quantified using this method.

Results and Discussion

Preliminary data indicated that the HPLC-UV/Vis method was suitable for the quantification of grapefruit flavonoids. The method was applied for the analysis of a large number of grapefruit juice samples (n=960), representative of different grapefruit varieties. Furthermore, differences between trees of the same variety, differences between quadrants within a tree and individual fruit were also investigated. Preliminary data indicated that there was a difference between the tree quadrants in terms of naringin content.

Conclusions

While extensive progress was made towards optimisation of the flavonoid quantification method, further optimisation is in progress in order to increase the resolution of peaks. The preliminary data indicated, however, that the method is suitable for the determination of the flavonoid composition of grapefruit juice.

References

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Keywords

A PRELIMINARY STUDY: IMPACT OF BIO-STIMULANTS ON WHEAT UNDER HERBICIDE STRESS

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Introduction

Grain crops are very important worldwide; however the successful production thereof is influenced by various factors, one of the most important being efficient weed control. Annual losses in wheat production for example due to weed infestation are estimated at about 10-80 % due to competition, and various factors, ultimately reducing yield (Saladin et al., 2003). Bio stimulants can supply a solution via increased growth, induced resistance against both biotic and abiotic stress conditions, and stimulation of various metabolic processes, increasing quality and production of crops to mention only a few positive effects (Parrado et al., 2008).

Materials and Methods

A wheat trial laid out in a complete randomized block design was conducted in glasshouses of the Department of Soil, Crop and Climate Science from the University of the Free State in South Africa during the 2014/2015 growing season. A standard fertilizer program was applied based on soil analysis under irrigation. All the treatments were applied according to the specifications of the distributors and replicated 7 times. Certain physiological and morphological parameters were measured as well as soil microbial activity.

Results and Discussion

In wheat the root and top growth as well as ear weight were increased compared to the treated control. The bio stimulant significantly increased the photosynthetic rate as well as yield by 22% compared to the herbicide control.

Conclusions

Bio stimulants can lighten stress related to possible herbicide damage and competition on crops.

References

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Keywords

Herbicide stress, bio stimulant, wheat

Hydropedology: Linking groundwater and surface water

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Introduction

Implementation of the National Water Act of 1998 and management of water resources require the understanding, characterisation and quantification of groundwater/surface water interactions. Accurate characterisation of the groundwater contribution to surface resources are complicated by the heterogeneity of South African aquifers and the fact that flow through fractured rock are often the dominant pathway in many catchments. Characterisation of groundwater/surface water interactions typically involves the geomorphic description of the catchment, hydrograph separation and geochemistry. Soils, a first order control in partitioning of hydrological flowpaths, are often ignored in these studies. In this paper it is argued that hydropedological interpretation of soil information can contribute to the characterization of groundwater/surface water interactions.

Materials and Methods

Long term streamflow records were used to determine the contribution of groundwater to streamflow in 21 catchments by Ebrahim et al (2016). The catchments are diverse in terms of area (22 – 696 km2), climate (rainfall between 640 – 1048 mm.y-1) and spatial distribution. The Baseflow Index (BFI) and Coefficient of Variation in Baseflow (CBV) were selected as hydrological variables in this study. Soils and soil distribution patterns within the catchments were obtained from the Land Type database (Land Type Survey Staff, 1972 – 2004). The soil types were related to their dominant hydropedological response and re-grouped into four hydropedological classes: recharge (freely drained – vertical flow dominant); interflow (lateral flow dominant); wet responsive (overland flow due to saturation excess dominant) and shallow responsive (overland flow due to infiltration excess dominant). A total of 188 land type inventories were interpreted. The dominant hydropedological soil distribution pattern for each catchment were determined by average weighing.

Results and Discussion

Significant ($p < 0.05$) positive correlations exists between the coverage of recharge soils, average soil depth and average clay content, implying that recharge soils do indeed recharge groundwater stores and thereby contribute to baseflow. These variables were negatively correlated with CVB. Significant negative correlations exists between the coverage of interflow soils as well as shallow responsive soils and BFI. These variables significantly increased the CVB as well. Subsurface lateral flow is therefore associated with stormflow in these catchments and not baseflow. Interestingly there were no significant correlations between rainfall or catchment area and BFI or CVB.

Conclusions

The hydropedological interpretation of soils and their spatial distribution can contribute to the understanding and characterization of groundwater/surface water interactions.

References

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Keywords

Baseflow Soil types National Water Act, 1998

Digital soil mapping applications for agriculture

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Introduction

The importance of soil management in crop production is illustrated by the fact that 95% of our food is produced from the soil (FAOSTAT, 2003). In order to successfully manage the soil, the spatial extent of soil properties must be known, usually in the form of a soil map. Unfortunately, the conventional methods of soil mapping are cumbersome and expensive. During the past two decades the advances in information technology and remote sensing have opened a whole range of possibilities on how soil surveys can be improved. Collectively these methods are known as digital soil mapping (DSM). However, for DSM to be conducted with success, local research is needed to fine tune the methodology to the needs of the local situation. In South Africa DSM has reached the point where crop production can benefit from the new technology.

Materials and Methods

Several DSM case studies, conducted as commercial soil surveys in Southern Africa, have provided the platform from which this work is presented. These case studies were done for a range of situations, including variations in size, geology, data availability and use of the soil map.

Results and Discussion

DSM shows tremendous promise in supporting the crop production industry in Africa by making soil information readily available at reduced cost. Within DSM there are tools to map soils at varying levels of intensity, with corresponding costs. The mapping products range from small scale soil associations to large scale soil property maps. The case studies show that there is an exponential cost decrease with increasing mapping area. This is due to the optimal extraction of information from soil observations. DSM produced maps have the added advantage that they come standard with an accuracy assessment, which allows for more informed decisions to be made by the farmer/manager. DSM should be utilized when developing large areas (> 1000 ha) for crop production, a phenomenon which is increasingly occurring in Africa. It will cut the costs of the soil survey, and allow for temporal monitoring of soil properties.

Conclusions

DSM is an advanced soil survey technique, which harnesses the technological advances made in the fields of information technology, remote sensing and geostatistics. Currently local DSM research has reached a stage where it can advance crop production by enabling soil surveys at reduced costs on large (>1000 ha) areas. This enables the mapping of larger areas and the temporal monitoring of soil properties.

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Keywords

Africa, Crop production, Soil monitoring, Soil survey

Indigenous Knowledge Systems (IKS) used by farming communities to conserve soil and water, and improve crop yields in the face of an erratic rainfall supply

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Introduction

Climate variability has a negative impact on rain-fed agriculture production practised by communal farmers. Most of Southern Africa is semi- arid, experiencing erratic rainfall and extreme events such as droughts, floods and thunderstorms. For decades, farmers have used IKS in predicting weather and planning crop choices, timing of planting and method of cultivation. Some of the IKS is site-specific, hence there is need to interface it with western knowledge. The aim of the study was to identify the indigenous strategies employed by the farmers to conserve soil and water under a variable climate.

Materials and Methods

This was done in Bergville and uMsinga in KwaZulu Natal, where IKS data was gathered through a baseline survey, in eight villages from each area through 5 key-informant interviews, 8 focus group discussions and 200 household questionnaires with farmers. This was done in villages where both conventional and conservation tillage were being practiced. Soil samples were also collected where conservation and convectional tillage methods were being practiced for physico-chemical characterization in the laboratory.

Results and Discussion

Results from the survey showed that farmers believe the climate has been changing over the years. They use indigenous indicators such as wind and cloud patterns, bird or animal behavior and shape of the moon to predict weather. In both uMsinga and Bergville farmers use both indigenous strategies (rain water harvest, manure addition, contour farming and mulching) and scientific conservation strategies (terraces using stones, raised beds, zero tillage and furrow/ridge planting) that would increase crop yields.

Conclusions

In villages where conservation tillage was practiced they were higher CEC, total P, organic C, total C and N; however there was less exchangeable acidity and bulk density compared to conventional tillage. Integrating IKS with scientific technologies would be integral to adapting to climate variability.

References

Keywords

IKS-Indigenous Knowledge System

Tuta absoluta (Lepidoptera: Gelechiidae), a new devastating tomato pest in South Africa

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Introduction

The tomato leaf miner (Tuta absoluta Meyrick), originally from South America, is an invasive pest, now reported for the first time in South Africa. It is a destructive pest that has the potential to destroy untreated tomato plantings (Tumuhaise et al. 2016). Tomato plants may be attacked at any developmental stage; leaves, stems and fruit are all mined by the larvae. The main host plant of Tuta absoluta is tomato, but other crops such as potato, eggplant, and pepper, are known alternative hosts (Brevault et al. 2014).

Materials and Methods

In anticipation of the arrival of Tuta absoluta, the north-eastern borders of South Africa were monitored with pheromone traps by Crop Watch Africa®, over a two-year period. The first incidence of moths in traps were reported in late July, and conclusive identifications were received in August 2016. Surveillance is currently overseen by the Department of Agriculture, Forestry and Fisheries (DAFF), to monitoring the spread of the moth and to advise farmers to the best control strategies.

Results and Discussion

The presence of Tuta absoluta is now confirmed in South Africa. Research on aspects of its ecology, biological control, damage potential on different tomato cultivars and its potential as a pest of potato will now be initiated. Although seven insecticides already hold emergency registrations from the Registrar of Act 36(1947), insecticidal efficacy trials will now be initiated by agro-chemical companies, for full registration against the pest in South Africa.

Conclusions

Tuta absoluta has reached South Africa, and farmers who cannot afford to implement effective control strategies, may be severely affected. This may be relevant for especially the small scale farmers and backyard gardeners who cannot afford the new expensive insecticides. Future research on natural control and alternative control strategies may play an important part to help these farmers to continue producing tomatoes in South Africa.

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Keywords

Tomato leafminer, first record, potato, eggplant, pepper

Using an agro–ecology based approach for underutilised crops in southern Africa

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Introduction

Southern Africa is divided into agroecological zones (AEZs) in geographic areas classified using climate (tropical or sub-tropical), elevation (warmer lowland or cooler upland), and water availability (arid zones (water for <70 growing days/year) to humid zones (water for 9 months/year)) (Sebastian, 2014.). This paper discusses the use of AEZs as a basis to plan support for underutilised crops. SADC smallholders grow a large variety of crops described as underutilised or orphan or indigenous or neglected or traditional crops. Padulosi and Hoeschle-Zeledon (2004) define them as “non-commodity crops, part of a larger biodiversity portfolio, once more popular and today neglected by users’ groups for a variety of agronomic, genetic, economic, social and cultural factors”. These crops are used at home and are not part of formal markets due to limited volumes.

Materials and Methods

Young agricultural scientist interns from 14 SADC member states worked in-country to collect information about distribution and use of underutilised crops. They were guided in weekly tasks by CFF scientists over about 4 months and send reports via email and ‘dropbox’. A workshop was held to discuss and collate findings. A second round (lead by Mabhaudhi) collected more detailed information to fill gaps. Crop lists included botanical names, local names, agronomic practices, uses and storage methods for each country. Information was integrated into a report describing this agro-biodiversity across SADC landscapes and identifying gaps (CFF & CCARDESA, 2015).

Results and Discussion

Underutilised crops are suitable for local landscapes, providing an alternative to help achieve nutritional food security and alleviate poverty (Mabhaudhi et al., 2016). However, their potential is hindered by a lack of comparable and reliable information describing aspects of their agronomy, utilisation and marketing. About 75 underutilised crops commonly occur across SADC, without including a vast number of trees and shrubs. The exploitation of underutilised crops, as their name suggests, has been on the decline in recent decades. Various reasons associated with their decline include lack of policy, lack of inadequate information on their husbandry, and lack of insufficient proper marketing practices to support them. Another gap identified is the confusion over the definition of underutilised crops in the region.

Conclusions

SADC is rich in agro–biodiversity especially underutilised crops, which are adapted to semi–arid AEZs where vulnerable people live. Policies concerning research and development are needed to unlocking the potential of underutilised crops. A coordinated regional approach based on AEZs could promote underutilised crops within SADC.

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Keywords

agroecological zones, indigenous crops, traditional crops, SADC

USE OF CONTINUOUS STEM AND FRUIT GROWTH MEASUREMENTS FOR DETECTING WATER STRESS IN APPLE ORCHARDS

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Introduction

High yielding apple orchards (100+ t/ha) are likely to have high water requirements to cater for the increased crop load. It is therefore imperative to have a continuous and reliable method of monitoring possible water stress in such orchards to optimize water productivity and ensure that fruit quality is not adversely affected.

Materials and Methods

Water relations were continuously measured in four apple orchards in the Western Cape Province during the 2015/16 growing season. They were: full-bearing ‘Golden Delicious’ (FBGD), full-bearing ‘Cripps’ Pink’ (FBCP), non-bearing ‘Golden Delicious’ (NBGD) and non-bearing ‘Cripps’ Red’ (NBCR). All orchards were irrigated using micro jets according to standard farm practice. DEX 70 Dynamax dendrometers were used to measure hourly trunk and fruit diameter. Potential water stress was identified using daily growth (DG) and maximum daily shrinkage (MDS) of the tree trunk and fruit. Volumetric soil water content and microclimatic parameters were measured on an hourly basis. Irrigation volumes were measured using in-line flow meters. Measurements of midday stem water potential were made on a monthly basis to assess the water status of the trees.

Results and Discussion

Although the orchards were generally not water stressed, some periods of stress were identified. Irrigation frequency was identified as the main cause of water stress during such periods. Water stress of various degrees was noted (negative DG values) when there was no irrigation for two or more consecutive days. The MDS trends in all the orchards were influenced by the microclimate (air temperature, solar radiation, vapour pressure deficit) prevalent in the orchards. The MDS and DG values in all orchards were found to be strongly reliant on the volumetric soil water content. Inverse relationships were identified between MDS and midday stem water potential in full-bearing orchards ($R^2 = 0.86$ and 0.69) for the FBGD and FBCP orchards, respectively.

Conclusions

Monitoring the daily tree trunk and fruit growth increment can be used as a continuous measure of apple tree water status and stress detection. Further work is required to interpret short and longer periods of water stress in the context of whole tree and orchard production and fruit quality.

References

Keywords

Apple, daily growth increment, irrigation, stem water potential, water stress

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