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Excellence in Research and Development

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Inside this issue:

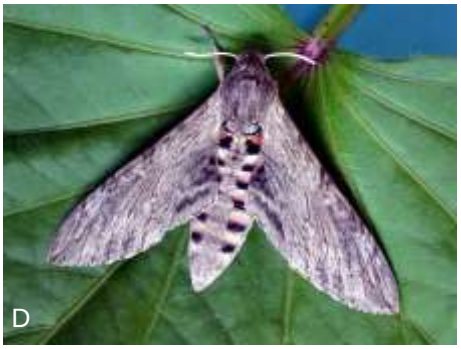
ARC-Vegetable and Ornamental Plants Newsletter

Newsletter of Vegetable and Ornamental Plants, a campus in the Crop Sciences Programme of the Agricultural Research Council (ARC)

Key sweet potato pests in South Africa

Compiled by Diedrich Visser, Crop Protection Division

Sweet potato, *Ipomoea batatas*, is a warm climate adapted perennial plant, cultivated as an annual crop over an area of about 3 000 ha in South Africa. Approximately 41 insect pests are known to attack sweet potato in South Africa. The four key pests include the African bollworm, sweet potato hawk moth, sweet potato weevils, and white grubs.



Sweet potato hawk moth caterpillar

Description and background: The sweet potato hawk moth, *Agrius convolvuli*, occurs in the tropical and warm subtropical regions of Africa and Asia. Young larvae are usually pale green in colour, but older larvae may be green (Fig. A), yellow or brown to blackish (Figs B and C). All instars have a short, sharp tail, with longitudinal or slanting lines on the sides. Larvae can reach lengths of up to 100 mm. Pupae are formed in a soil cell and can be identified by its "jug-handle" or elephant trunk-like proboscis. The adult is a medium-large moth (up to 60 mm in length), typically with a streamlined appearance (long narrow pointed wings) (Fig. D).

Damage: Larvae mainly feed on plants in the Convolvulaceae family, including sweet potato and morning glory. Young larvae feed during the day and night, but older larvae mainly feed during the evenings. The caterpillars typically rest on a leaf stem while feeding, making it difficult to spot them. During the day they usually hide lower down between the foliage or in the undergrowth.

Control: One pyrethroid insecticide is registered against sweet potato hawk moth. Other control actions include the removal of larvae by hand in small plots and reworking of the soil by ploughing. The latter may expose and kill overwintering pupae.

African bollworm

Description and background: The African bollworm, *Helicoverpa armigera*, is a native African pest. It is the most polyphagous agricultural pest in southern Africa, attacking nearly all crops. The young larvae are usually yellowish to blackish, but the later stages vary considerably, from yellow to green to brown. A longitudinal white or beige stripe is usually visible on older larvae (Fig. E). Lengths of older larvae vary between 30 and 40 mm. The moth is usually brownish in colour and is mostly active at night.

Damage: Larvae of the African bollworm feed on any plant part above ground level. The small larvae feed superficially on leaves, but older larvae may eat large holes in leaves, and may also consume

stems, flowers, and fruit.

Control: One insecticide is available to control African bollworm on sweet potato. Refer to www.croplife.co.za for the complete list of insecticides registered on sweet potato in South Africa.

Sweet potato weevils

Description and background: The sweet potato weevils can be divided into two groups, i.e. the rough sweet potato weevils and the slender sweet potato weevils. They comprise of several species in the genera *Blosyrus* and *Cylas*. The larvae are whitish legless grubs, 8-10 mm in length, with dark brown heads. The rough sweet potato weevils are mostly brown in colour (8-9 mm in length), while the slender sweet potato weevils are ant-like blackish beetles 5-6 mm in length (Fig. F).

Damage: The beetles themselves do very little damage; the larvae are responsible for eating shallow channels or grooves on the surface of storage roots (Fig. G) (rough sweet potato weevil), while the slender sweet potato weevil larvae tunnel inside storage roots (Fig. H). Feeding activity may result in rotting of storage roots or downgrading in quality. The slender sweet potato weevil larvae may also tunnel inside vines, causing malformation, thickening and cracking of the affected vines.

Control: One pyrethroid insecticide is registered for controlling the adult weevil. When the larvae start to mine the vines or storage roots, it becomes difficult to prevent yield loss. Alternative control measures include the use of clean propagation material, clean cultivation by removing volunteer plants after harvest, and destruction of discarded storage roots or vines. A pheromone trap is commercially available to monitor the presence of the slender sweet potato weevil in fields.

White grubs

Description and background: The sweet potato white grub, *Temnorhynchus coronatus*, occurs in sub-Saharan Africa. Larvae are typical whitish or cream coloured grubs that curl in a c-shape when handled (Fig. I). The extended body length is 30–45 mm. Pupae are formed in soil cells. Sweet potato white grub adults are shiny, dark brown to black rhinoceros beetles of moderately elongate shape. Body length is approximately 23 mm.

Damage: Currently, only sweet potato and strawberries have been reported as agricultural host plants. Damage is done by the larvae (white grubs), chewing shallow, irregular holes into the storage roots of sweet potato (Fig. J). Only shallow holes are eaten, and they always fall out with harvesting. Storage roots with white grub damage are downgraded or unmarketable, depending on the severity of damage. Storage roots above the soil are not attacked, but discarded roots may serve as refuges for other pests, e.g. the slender sweet potato weevil.

Control: No insecticides are registered against white grubs on sweet potato. Clean cultivation to remove weeds from fields for a few weeks before planting may reduce numbers in soils.

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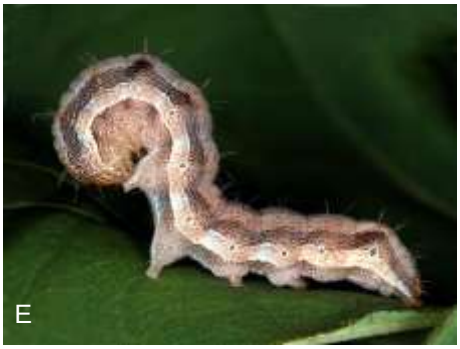
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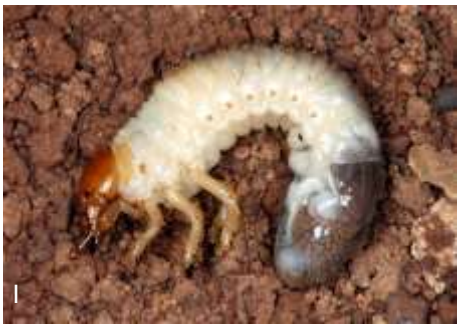
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Use of the fungus, *Beauveria bassiana,* for the control of the slender sweet potato weevils

Compiled by IN Hlerema (Crop Science Division), Dr SM Laurie (Plant Breeding Division), and Dr B Eiasu (University of Fort Hare, Department of Agronomy)

Introduction

Sweet potato weevil (*Cylas puncticollis* and *C. formicarius*) (Coleoptera: Brentidae) is a major constraint to sweet potato (*Ipomoea batatas* L.) production and causes huge losses in marketable yield. In South Africa, *C. puncticollis* is widespread, while *C. formicarius* is limited to the KwaZulu-Natal Province (Visser, 2011). C*ylas* species attack sweet potato, both in the field and during storage. Adult weevils attack leaves, while the larvae feed on roots and stems. Several methods, such as crop rotation, planting of sweet potato weevil-free cuttings, flooding of fields before planting and prompt harvesting four to five months after planting, have been used with varying degree of success for control of the pest. At present, biological control is an attractive option due to a reduction in agro-chemicals which are associated with resistance development and environmental concerns. *Beauveria bassiana* is considered a virulent pathogen against the banana weevil, *Cosmopolites sordidus* (Coleoptera: Curculionidae) (Ondiaka et al., 2008), and has also been used successfully in the control of the coffee borer (Smit et al., 2001). A study was done to determine the efficancy of using *B. bassiana* (Eco-Bb) for the control of the slender sweet potato weevil *C. puncticollis*), as indicated by the number of damaged storage roots in a field trial.

Material and methods

An experiment was conducted at the Agricultural Research Council–Vegetable and Ornamental Plants, Roodeplaat in Pretoria, Gauteng (25.6048 S, 28.3458 E), on a field that was previously affected by sweet potato weevils. Four treatments were tested, namely: 1) dipping sweet potato cuttings in a solution of 1 g/litre Eco-Bb (commercial product of *B. bassiana*) before planting, 2) spraying with the registered chemical Deltametrin at 50 ml/100 litre (recommended dosage) every 2 weeks for four months after planting, 3) spraying the leaves every 2 weeks with Eco-Bb for four months after planting at a rate of 10 g/100 litre water, and 4) control (sprayed with distilled water). The registered product, Eco-Bb, that contains *B. bassiana* at >2 x 10^9 spores/g, is produced by Plant Health Products (Pty) Ltd, registration number 2003/007987/07. The registered chemical for control of the sweet potato weevil is Decis, containing deltametrin at 25 g/litre and produced by Bayer CropScience, registration number L1741 (Act No. 36 of 1947).

Results

Spraying fortnightly with *B. bassiana* provided equally effective control as spraying with Deltametrin when applied on sweet potato cultivars Blesbok, Bophelo and Ndou. The different weevil control treatments were significantly different for the total number of roots damaged by insects, percentage damaged roots, total yield and unmarketable yield. As expected, the control had the highest number of unmarketable roots. The percentage insect damage was high for the control treatment and for dipping cuttings into *B. bassiana* before planting.

Dipping the cuttings into solution with the fungus did not significantly reduce the number of damaged roots. This might be due to the trial being conducted in a temperate region where frost occurs during winter, thereby reducing the population of the sweet potato weevil. In other climates, e.g. subtropical areas, dipping may be more feasible.

For control of the weevil, 300 g of Eco-Bb is used per hectare for the season (30 applications of 10 g/100 litre water). The cost of controlling the sweet potato weevil using Eco-Bb will be R456/ha, compared to Decis at a cost of R1 282/ha (at 2018 prices).

Conclusions

B. bassiana can be sprayed at a rate of 10 g/100 litre on sweet potato leaves every two weeks as an alternative control method for the sweet potato weevil. Biological control is less detrimental to the environment.

Field trial at Roodeplaat (top) and damage caused by the slender sweet potato weevil larvae that tunnel inside storage roots (bottom photo by D Visser).

Although *B. bassiana* is generally non-toxic to beneficial insects, applications to areas where bees are actively foraging should be avoided.

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Smit, N.E.J.M., et al., 2001. Mass trapping male *Cylas* spp. with sex pheromones: A potential IPM component in Sweet potato production in Uganda. Crop Prot. 20: 643-651.

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Swiss chard or Spinach …. Who is who?

Compiled by Dr WS Jansen van Rensburg and Ms LN Khoza (Plant Breeding Division)

Spinach is part of the daily diet of many South Africans. We all know that spinach is good for you and that it is full of vitamins and other micro-nutrients. However, the name "spinach" in South Africa is very ambiguous. What most South Africans call 'spinach' is actually Swiss chard, and the 'real' spinach is referred to as 'baby spinach'.

'Real' spinach is botanically known as *Spinacia oleracea* (L) and is in the Amaranthaceae family. Spinach originates in central and western Asia but is grown worldwide now. Spinach is an annual crop, and rarely biennial when it overwinters in temperate regions. Spinach can grow as tall as 30 cm but is normally smaller, hence the name 'baby spinach'. The leaves are variable in size, between 2 and 30 cm long and up to 15 cm broad. The leaves are various shades of green, simple, ovate to triangular. The leaves are alternate, but it looks like it is arranged in a rosette around the short stem. The flowers are inconspicuous, yellow-green and mature into a small, hard, dry, lumpy fruit cluster containing several seeds (Figure 1). Popular spinach cultivars are Bloomsdale Longstanding, Monstrous Virofly and Giant Noble spinach.

Swiss chard (*Beta vulgaris* subsp. *vulgaris*) is also in the Amaranthaceae family, but is very closely related to beetroot. This explains the other common name spinach beet or '*sny beet'* in Afrikaans. Swiss chard is a native of Mediterranean Europe, northern Africa, and southern Asia. 'Chard' descends from the French word *carde*, meaning artichoke thistle, however, the adjective 'Swiss' is unclear, since the Mediterranean plant is not native to Switzerland. Some attribute the name to it having been first described by Swiss botanists. Swiss chard has wrinkled leaves with prominent veins. The colour varies from a lime green to dark green. Some leaves can even have a red/purple tint. The leaves grow upright from a dense rosette of ribbed stems. The leaves are succulent and tender when young, but the leaf stalks can be fibrous and sometimes bitter and inedible. The leaf stalks are fleshy and usually white, but can be in various shades of yellow, pink and purple (Figure 2). Popular Swiss chard cultivars are Ford Hook Giant, Green Wave, Lucullus and the multi coloured cultivars Bright Lights and Kaleidoscope.

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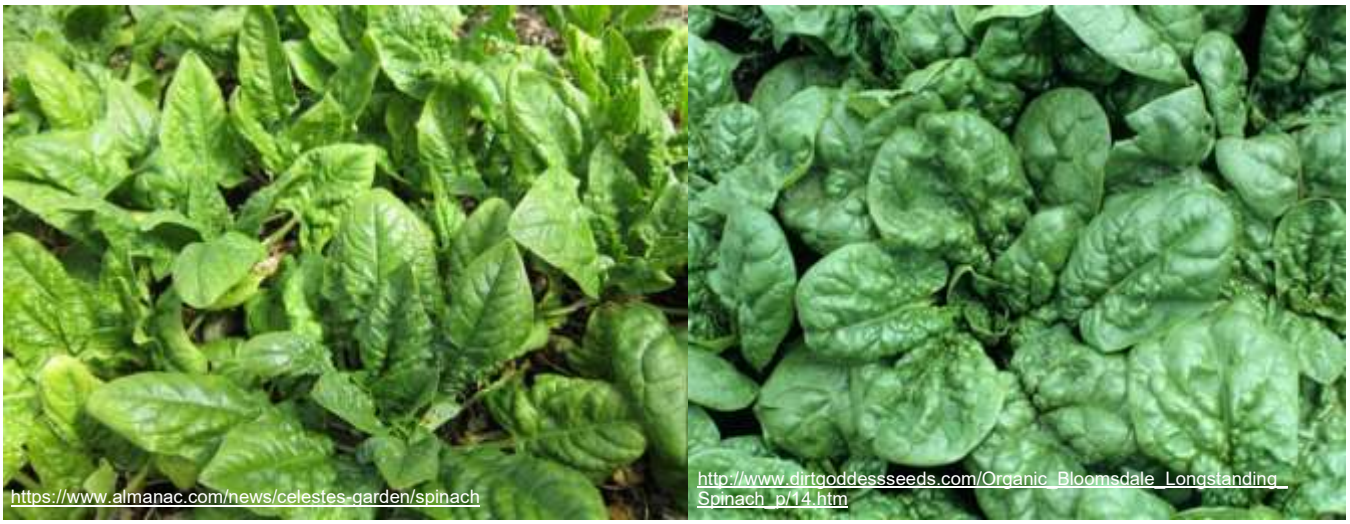

Figure 1. 'Real' spinach, *Spinacia oleracea* (L), referred to as 'baby spinach' in South Africa.

Figure 2. Swiss chard, *Beta vulgaris* subsp. *vulgaris*, referred to as 'spinach' in South Africa.

Partnership with national universities: University of Venda

Compiled by Dr Abe Gerrano, Plant breeding Division

The indigenous vegetable breeding team at the Plant Breeding Division, ARC-VOP, recently hosted three 4th year students from the University of Venda in the School of Agriculture (Department of Crop Production) for a 6-week Work Integrated Learning (WIL) programme from 15 January to 28 February 2019. The main objectives of the visit for WIL were to (i) augment the theoretical knowledge gained from lectures and practicals at the University with real-life practical experience in the work environment, (ii) provide professional mentorship to the students, and (iii) prepare the students for life post graduation. Indeed, the importance of WIL for practical-oriented professional courses (such as Plant Production) cannot be over emphasized. The request was made by Prof ET Gwata, Head of Department, Crop Production at the University of Venda to host the 4th year students to gain research experience in plant breeding. The indigenous crops, such as Bambara groundnut, cowpea and chickpea were the selected crops for the students to collect plant morphology data in the field and glasshouse. The researcher (Dr Abe Gerrano), Research Team Manager (Dr Michael Bairu), and technicians (Mr Abueng Moalafi and Ms Milcah Masemola) are directly involved in the research and shared their experience with the hosted students. The exposure involved practical demonstration/training in the glasshouse and in the field at the ARC-VOP. The learning program expanded their knowledge on indigenous vegetable breeding and production, and this will enhance the contribution of both institutions to future food and nutritional security. This will create possibilities for future collaboration and strengthens existing collaboration in student supervision, publications and collaborative proposal writing in line with the existing MOU between the University of Venda and the ARC. The work related learning of the students helps the students to interact with the researchers, research technicians and assistants in the breeding programme and they gained experience which was of value for their future careers.

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From left to right: Dr Abe Gerrano (researcher for legume crops and fruit vegetables), Tintswalo Maluleke, Zinhle Mbokane, Phumudzo Mandinda, Milcah Masemola, Abueng Moalafi and Dr Michael Bairu (Research Team Manager for Plant Breeding Division).

Students from the University of Venda visiting plant breeding research trials at Roodeplaat.

Congratulations!

Dr Mariette Truter from the Crop Protection Division, received an NRF rating of C3 (established researcher) in January 2019. The evaluation of the rating is based on her research outputs of the last eight years. Dr Truter is one of five researchers at the ARC-VOP that has received an NRF rating.

Dr Truter was appointed as Senior Researcher in the Crop Protection Division, ARC-VOP in 2016. Before then, she worked in the Biosystematics Division, ARC-Plant Health and Protection (2006-2016) and the Department of Microbiology and Plant Pathology, University of Pretoria (2001-2006). Dr Truter's research during the past eight years consists of a combination of fungal systematics (pathogen characterisation) and plant disease diagnosis and characterisation.

Research on the agricultural important pathogen, *Alternaria*, included the description of two new species from sweet potato, *Alternaria ipomoeae* and *A. neoipomoeae* (Woudenberg et al. 2014) and the first report of *A. alternata* causing leaf blight on sunflower (Kgatle et al. 2018), and leaf spot of coriander in South Africa (Mangwende et al. 2018).

Research on the soil-borne pathogens, *Rhizoctonia solani* and binucleate *Rhizoctonia* on potato, resulted in the first report of *R. solani* AG 2-IIIB and AG 4 HG-I causing stem and stolon canker, *R. solani* AG 4 HG -III causing stem canker, and binucleate *Rhizoctonia* AG A and AG R causing stem canker and black scurf on potato in South Africa (Muzhinji et al. 2014, 2015).

Her current research focus is on the fungal pathogens of indigenous vegetable crops, such as cowpea, amaranth and marama beans; medicinal plants, such as the African potato, canker bush, and moringa; essential oil crops, such as rose geranium, lavender and thyme and, the commercial crops potato, tobacco and sweet potato.

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Muzhinji, N., Truter, M., Woodhall, J.W. & Van der Waals, J.E. 2015. Anastomosis groups and pathogenicity of *Rhizoctonia solani* and binucleate *Rhizoctonia* from potatoes in South Africa. *Plant Disease* 99:1790-1802.

Woudenberg, J.H.C., Truter, M., Groenewald, J.Z. & Crous P.W. 2014. Large-spored *Alternaria* pathogens in section *Porri* disentangled. *Studies in Mycology* 79: 1-47.

Technology transfer through the ARC-VOP Training Unit

Compiled by Vitshima L., Van den Heever E., Kekana M.V., Tjale S and Mamadi N., Crop Science Division

Emerging farmers and homestead food gardeners dominate the farming sector in South Africa. Therefore, training and skills transfer forms an integral part in the advancement of South African Agriculture at grass roots level. In order to exploit available resources efficiently, the primary producers should be equipped with recent technology relevant to production requirements.

The ARC-VOP Training Unit offered accredited training services to smallholder farmers of the North West Province through Provincial Departments of Agriculture: North West Department of Rural, Environmental and Agricultural Development (NW-READ); on topics relating to production planning, seedling production, plant spacing, irrigation, fertilisation, scouting and sanitation, pest and disease management, harvesting and grading.

The community of Mamelodi in the City of Tshwane received training on cultivation of African leafy vegetables through the Water Research Commission fund. The main aim of the training was to demonstrate the correct spacing and planting times of different crops that contribute to human nutrition, how to handle planting material and basic plant health and disease management.

Non-accredited training was offered to Agricultural Advisers from Limpopo Department of Agriculture and Rural Development. Training topics covered were on mechanization, irrigation, fertilization, fertiliser analyses and recommendation, fertigation, irrigation scheduling and installation of pipes, the food based approach, seed multiplication, medicinal plants, planting in a bag, agro-processing (Moringa), important vegetable pests in Limpopo, pest management, and sweet potato schemes.

Follow-up training was organised on topics that were challenging for the agricultural advisers, i.e. irrigation scheduling and fertiliser recommendation. Specialist Researchers were invited to assist in the clarification of the identified topics. It was important to ensure that the advisers understood basic fertilisation principles and the different elements that can influence fertilisation, understanding soil analyses report from the laboratory, and how to work out the quantities of different fertiliser mixtures.

Comoros islands was visited by the ARC-VOP and the ARC-SCW to provide technical support to the farming community in this area and to finalise the crop suitability maps. In addition, there were demonstrations at farm sites on vegetable production and sweet potato plantings on the three islands, Anjuan, Moheli and Moroni. Two sweet potato cultivars were planted in small pots (Brondal and W-119). The previous visit was in August 2018, when 156 people from all three islands received theoretical training on vegetable production.

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Figure 1. Mr Fanie Vorster from the ARC-Agricultural Engineering conducting a practical irrigation session with agricultural advisers.

Figure 2. Dr Goodman Jezile from the ARC-Soil Climate and Water, explaining concepts on soil fertigation to Limpopo agricultural advisers.

Figure 3. Mr Aubrey Maluleke from the ARC-Vegetable and Ornamental Plants performing knap-sack sprayer calibration during the training of agricultural advisers.

Figure 4. North West farmers preparing seedling trays for planting.

Figure 5. Ms N. Mamadi working on seedbeds with farmers in Mamelodi.

Figure 6. Compost beds in Comoros.

Second International Symposium on Moringa (ISM2019)

10-13 November 2019

CSIR International Convention Centre, Pretoria

Registration now open

Compiled by Drs Sunette Laurie (Plant Breeding Division), Stephen Amoo and Ashwell Ndhlala (Crop Sciences Division)

The ARC-VOP is conducting research on Moringa, as well as technology transfer and enterprise development on Moringa. The research team is active in developing Moringa farmers with capacity for on-farm value-addition, in many cases funded by the Department of Science and Technology (DST). Research projects at the ARC cover the full value chain of Moringa, from production to product development. These include best practices for growing and harvesting of Moringa, pre-processing best practices, and optimising factors influencing nutritional and medicinal values, amongst others. The ARC-VOP Analytical Laboratory assists Moringa farmers to produce quality Moringa dry powder and/or products that meet international standards and can thus be exported. The institute also maintains different *Moringa oleifeira* cultivars in its genebank.

It is a great privilege for the ARC to co-host the Second International Symposium on Moringa in November 2019, together with the Moringa Development Association of South Africa (MDASA) and various universities under the aegis of the International Society for Horticultural Sciences (ISHS). The symposium will be of interest to scientists, students, farmers, entrepreneurs, processors, retailers, etc. A workshop on Marketing and Market requirements will be held on 10 November, and exhibition and sales of Moringa products (Fig. 1) will be open from 10-12 November.

To register, submit abstracts and find more information, please go to http://www.ism2019.co.za/

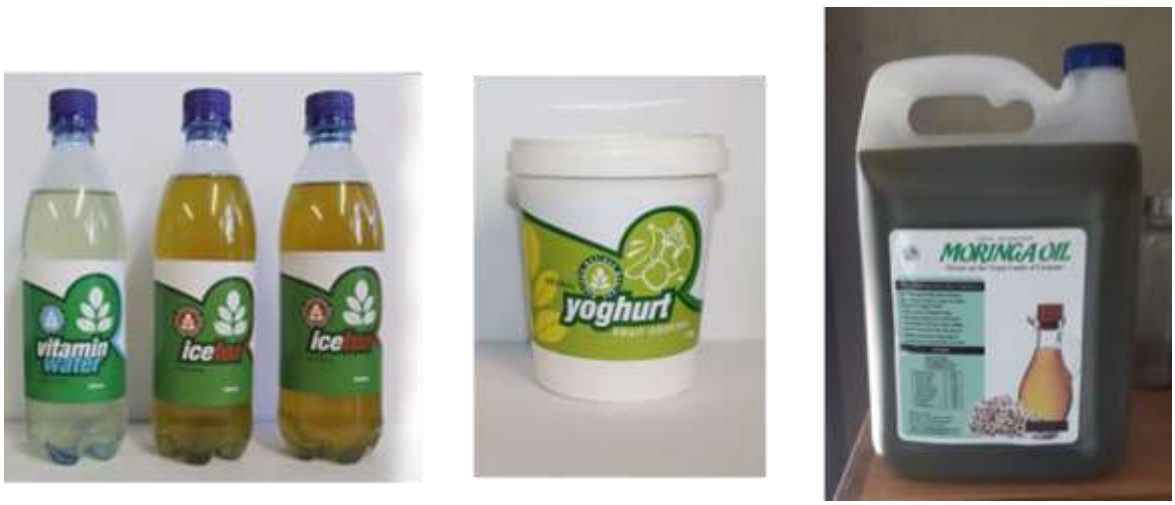

Figure 1. Products made from Moringa: ice tea, yoghurt and oil. These and many more will be on sale at the exhibitions during the symposium.

Technology Transfer

Scientific publications

Adebayo, S.A. & Amoo, S.O. 2019. South African botanical resources: A gold mine of natural pro-inflammatory enzyme inhibitors? *South African Journal of Botany* 123: 214-227.

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Aruwa, C.E., Amoo, S. & Kudanga, T. 2019. Phenolic compound profile and biological activities of Southern African *Opuntia ficus-indica* fruit pulp and peels. *LWT – Food Science and Technology* 111: 337-344.

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Gerrano, A.S., Jansen van Rensburg, W.S., Adebola, P.O., Manjeru, P., Bairu, M.W. & Venter, S.L. 2019. Evaluation and selection of taro [*Colocasia esculentra* (L.) Schott] accessions under dryland conditions in South Africa. *Acta Agriculturae Scandinavica, Section B — Soil & Plant Science* 69(3): 219-227.

Gerrano, A.S., Jansen Van Rensburg, W.S., & Kutu, F.R. 2019. Agronomic evaluation and identification of potential cowpea (*Vigna unguiculata* L. Walp) genotypes in South Africa. *Acta Agriculturae Scandinavica, Section B — Soil & Plant Science* 69(4): 295-303.

Gerrano, A.S., Jansen van Rensburg, W.S., Venter, S.L., Shargie, N.G., Amelework, B.A., Shimelis, H.A. & Labuschagne, M.T. 2019. Selection of cowpea genotypes based on grain mineral and total protein content. *Acta Agriculturae Scandinavica, Section B- Plant Soil Science* 69(2): 155-166.

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Training courses:

The Agricultural Research Council – Vegetable and Ornamental Plants, Roodeplaat is offering an accredited hydroponic vegetable production training course. For more information, contact Ms Lulama Vitshima: (012) 808 8000 or LMkula@arc.agric.za