Powdery mildew on Swiss chard in South Africa

Compiled by Dr Elsie Cruywagen and Dr Mariette Truter, Crop Protection Division, ARC-VOP

Swiss chard (Beta vulgaris L. subsp. cicla (L.) Koch), also known as Perpetual Spinach, is a popular leafy vegetable in South Africa. During the spring of 2017 to 2019, outbreaks of powdery mildew were observed on Swiss chard in the Gauteng and North West Provinces of South Africa. Infection of up to 90% of the fields were observed on four farms in the Winter-veld region during 2017. However, in subsequent years, lower levels of infection were reported in Gauteng. Ad hoc infections were observed in other areas, including home gardens in Pretoria and at the ARC-VOP, Roodeplaat, Pretoria. Initial symptoms of the disease presented as small white patches on both sides of the leaves and eventual colonisation of the whole leaf (Fig. 1a). This resulted in the crop becoming unmarketable and leading to a substantial loss of income for small-scale farmers.

DNA was extracted directly from conidia (Figs. 1c and d), and the internal transcribed spacer (ITS) region of the rDNA was amplified and sequenced with primers ITS5 and ITS4 (White et al. 1990). The powdery mildew samples from Gauteng showed a 100% sequence identity with the reference Erysiphe betae specimens. Symptomatic Swiss chard leaves collected in Pretoria were used as a source of inoculum to infect healthy plants of Swiss chard cultivars Greenwave and Bright lights in a greenhouse. Similar symptoms developed on the leaves of both cultivars (Fig. 1b) and morphological identification of the pathogen confirmed the presence of E. betae. The pathogen E. betae has been reported worldwide from Beta atropilicifolia, B. corolliflora, B. diffusa, B. intermedia, B. lomatogona, B. macrorhiza, B. patellaris, B. patula, B. trigyna, B. vulgaris, B. vulgaris subsp. maritima (Braun & Cook 2012), B. vulgaris subsp. amaranthaceae (Joa et al. 2017) and B. vulgaris subsp. cicla (Vakalounakis & Kavroulakis 2017). To our knowledge, this is the first report of powdery mildew on Swiss chard in South Africa. This has not been reported as a problem on Swiss chard from commercial farms, but small-scale farmers have reported huge losses. Further monitoring is needed to determine the best control strategies for small-scale farmers.

References


At least 44 species in the insect order Lepidoptera (moths and butterflies) attack vegetables in South Africa. Some occur as polyphagous species complexes, while others occur as single species that feed on specific crops or on crops in only one family. Nearly all lepidopteran pests are moths (only two butterfly species occur as minor pests), and all are indigenous or have been naturalised over the decades. However, two species, the lesser armyworm (Spodoptera exigua) and the tomato moth (Spodoptera littoralis), are very serious. Damage: When young plants are attacked, larvae may chew irregular holes right through the leaf. The window dermis intact. This results in window feeding. Control: There are no effective sprays for such pests. The caterpillars hide in the soil near harvest time, removing of cull piles (to eliminate pest hotspots) and in stores. Infestations of tubers under field conditions are usually due to the very small first instar larvae that are actively searching for feeding sites when the foliage is dying down naturally near the end of the season. Small cracks in the soil that appear at this time, due to tuber bulking and the drying out of soils, contribute significantly to the ability of the small larvae to reach and infest tubers in soils. Damage to the foliage is insignificant compared to the high yield losses experienced when tubers are attacked at the end of the season. Control: Control is mainly with insecticides. Other integrated options include ridging, preventing or closing of cracks in the soil near harvest time, removing of cull piles (to eliminate breeding areas), and monitoring the occurrence in fields with pheromone traps.

Sweet potato hawk moth
The sweet potato hawkmoth, Agrius convolvuli, is a large and robust moth, occurring in most countries, but is absent in the Americas. Crops attacked: Only sweet potato. Alternative hosts include morning glory and a few species of bindweed. Damage: The caterpillars, especially the later instars, destroy considerable amounts of foliage. The larger caterpillars move down to the lower canopy where they rest during daytime, and are therefore not often seen. Control: Insecticides are available for control. In small plots, the caterpillars can be removed by hand when searching in the lower canopy.

Tuta absoluta
In South Africa, the tomato leafminer is better known by its scientific name, Tuta absoluta. It was first reported in 2016 in the eastern parts of the Mpumalanga Province, but is today widespread across the country. Crops attacked: Mainly tomato, but to a lesser extent, also other crops in the Solanaceae family, e.g. potato. Damage: Similar to the potato tuber moth, the larvae are blotch leafminers. However, they occur in much higher numbers, and may destroy entire tomato fields when insecticides are not used. Later instars also bore into tomato fruit. Although they also commonly occur in potato fields, they do not move down cracks to infest tubers, and therefore do not destroy the foliage, as is often the case in tomato fields. Control: Many insecticides are available for control. Because the moth disperses quickly, and because they occur in huge numbers, other control options are less effective.

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Common Lepidoptera Pests of Vegetables in South Africa

- Potato tuber moth
- Tuta absoluta
- Diamond-back moth
- Lesser armyworm adult
- Common cutworm adult
- African bollworm adult
- Lesser armyworm larva
- Common cutworm larva
- African bollworm larva
- Plusia semi-looper adult
- Sweet potato hawkmoth
- Fall armyworm female
- Plusia semi-looper larva
- Tomato semi-looper adult
- Fall armyworm male
- Tomato semi-looper larva
- Tomato moth adult
- Tomato moth larva
- Fall armyworm larvae
- Sweet potato hawkmoth larvae

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Note: Many more lepidopteran pests occur on vegetables in South Africa, these are just selected common ones.
Fissure scab on potatoes in South Africa

Compiled by Dr Elsie Cruywagen and Dr Michele Cloete, Crop Protection Division, ARC-VOP

In South Africa, common scab is caused mainly by Streptomyces scabiei and to a lesser extent by S. europascabiei, S. stelliscabiei and S. caviscabiei. Since early 2010, distinct atypical scab symptoms have been observed on potato tubers in some production regions in South Africa. Symptoms were characterised by longitudinal cracks 3 to 12 mm deep containing scab-like lesions (Fig. 1a). The symptoms differed from growth cracks in that the surface inside growth cracks are smooth (Fig. 1b), whereas the surface of atypical cracks is covered by corky tissue. Streptomyces species were isolated from affected tubers, but were found to be distinct from those causing common scab on potato (Gouws & McLeod 2012). The disease was named ‘fissure scab’ and DNA sequencing revealed that the isolates obtained from affected tubers were related to S. werraensis, S. pseudogriseolus and S. gancidicus. Further studies were needed to identify the Streptomyces isolates involved in fissure scab to species level and to determine the role of Rhizoctonia solani in fissure scab. This fungus has been associated with similar symptoms on potato tubers, where the disease is referred to as corky cracks of potatoes.

Isolation and identification of causal organisms

A total of 142 Streptomyces isolates were retrieved from potato tubers displaying fissure scab symptoms that were collected from the KwaZulu-Natal, Mpumalanga, East Free State, Western Free State, Northern Cape and Gauteng Provinces, from 2010 to 2018. The isolates were characterized morphologically and phylogenetically. PCR amplification of the 16S rDNA, and five housekeeping genes were conducted, followed by sequencing and phylogenetic analyses. Three main phylogenetic groupings were obtained and named ‘species 1’, ‘species 2’ and ‘species 3’. A total of 85 of the isolates obtained from fissure scab lesions belong to three main Streptomyces species. Research was therefore focused on Streptomyces species 1, 2 and 3. A glasshouse trial was carried out to determine whether isolates from the three main Streptomyces species were able to cause the same symptoms as was observed initially. Potato cultivars Mondial and Innovator, which are susceptible to fissure scab, were infected with three isolates from each species. All the isolates from the three species caused similar symptoms as what was originally observed. The other 57 Streptomyces isolates comprise of 37 other Streptomyces species that need to be investigated further to determine if they are pathogenic and able to cause fissure scab symptoms.

Isolations for both bacteria (Streptomyces species) and fungi (Rhizoctonia solani) were done from 199 symptomatic tubers. Streptomyces was only isolated from 174 tubers and R. solani was only isolated from 20 tubers. The fungal pathogen R. solani was isolated along with Streptomyces from only five tubers, indicating coinfection. It thus seems that co-infection of the two pathogens rarely occurs and that both Streptomyces and R. solani can cause similar symptoms on potato tubers. There is a lot of overlap in the symptoms observed on the tubers from which Streptomyces and R. solani were isolated from (Fig. 2). It is therefore not possible to predict which pathogen is responsible for the observed symptoms before isolations and identifications are done.

Control of fissure scab

Control of soil-borne diseases can be achieved with the use of tolerant cultivars, as is the case with common scab. To determine whether fissure scab can be managed in the same way, field trials were conducted over three seasons. Various cultivars were planted in a field that was previously inoculated with fissure scab isolates. The most susceptible cultivars identified during the trial were Mondial, Innovator and Eos. The most tolerant cultivars identified were Arizona, Sifra and Up-to-Date.

Figure 1. Potato tubers with fissure scab symptoms (a), and a growth crack (b).

Management of a disease can be improved when rapid, cost effective diagnostic tests are available. A diagnostic test was developed by qPCR amplification, followed by High Resolution Melting Point (HRM) analyses of the products. The qPCR-HRM test was able to distinguish between the three Streptomyces species associated with fissure scab, as well as between the three species in the Streptomyces scabiei complex that are associated with common scab in South Africa. Fig. 3 shows the results of the diagnostic test.

Conclusions

The symptoms of fissure scab on potatoes are caused by a complex of microorganisms that include both various Streptomyces species, as well as R. solani. Initial results show that Up-to-Date, Arizona and Sifra are cultivars that may provide good tolerance to infection by Streptomyces species associated with fissure scab. Further field trials are needed to confirm these findings. Mondial, Innovator and Eos should not be planted in fields with a history of fissure scab, as they tested susceptible in trials at Roodeplaat. It is unfortunate that Mondial, that has good tolerance to common scab, is very susceptible to fissure scab. Currently, none of the cultivars evaluated have shown tolerance to both common scab and fissure scab. Thus, newly developed potato cultivars should be evaluated for tolerance to both of these pathogens in order to provide farmers with the best possible options to obtain maximum disease-free yields.

Reference


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Mr. Lawrence N Malinga attended the 2019 Research Associate Programme held in Washington DC, the United States of America (USA) from the 20th of September to the 04th of October 2019. The programme was hosted by the International Cotton Advisory Committee (ICAC) and participation was open to individuals from ICAC member countries, including persons from government agencies, universities and the private sector. Ten participants from nine countries, namely, Argentina, Bangladesh, India, Mozambique, Poland, South Africa, Switzerland, Turkey, and Zimbabwe, attended the programme. The ICAC Secretariat conducts the programme in the USA, alternately each year in production research and in economics/marketing of cotton. The theme for the 2019 Programme was “Risk Management in the Cotton Industry”. The programme enabled the participants from different continents to share their information on the cotton industry in their respective countries. It also created a platform to engage on how to improve cotton production, and enabled opportunities for networking. The initial part of the programme was conducted at the premises of the ICAC Secretariat in Washington DC, where sessions covered the following topics:

**Introduction and ICAC activities** – the role and strategy of the ICAC, challenges being faced by the ICAC, as well as the mission of the ICAC to serve the cotton and textile communities through promotion, knowledge sharing, innovation, partnerships and providing a forum for the discussion of cotton issues of international significance.

**World cotton situation** - projections of world supply and demand, as well as international cotton prices.

**Cotton pricing and world textile demand** - comprehensive presentation on the analysis and projections of the worldwide end-use of textile fibres, mill use, production and trade of cotton yarn and fabric, and production of chemical yarn, for more than 100 countries.

**Cotton research in the 21st Century** - uptake, distribution, and redistribution of nutrients in the various cotton-growing stages. The key messages for the obtaining of high yields were: i) Increase of the harvest index; ii) High density and canopy management; iii) Reduction of nutrient wastage and improvement of efficient nutrient harvesting.

**Major developments in world cotton trade** - trade developments in raw cotton, with an analysis of world trade by region, import/export projections by country, and matrices of trade flows.

**Price risk management in cotton production and trade** - training on price risks, market analysis and volatilities, as
well as differences between current farm prices and future prices.

A visit to the United States Department of Agriculture headquarters was undertaken where an overview of cotton production in the USA was presented. The programme also included a visit to some cotton-producing areas in North Carolina and a session on the role of Cotton Incorporated. The session included presentations on:

- **Gene editing** - next generation of crop improvement that targets a specific section of DNA to make a gene non-functional.
- **New insect and disease control systems** - a new system for pest and disease management by Cotton Incorporated to develop glandless cotton with reduced gossypol.
- **Cottonseed oil** - promotion of diet rich cottonseed oil with a unique component that contributes to heart health.
- **Crop production risk management** - tools to help growers minimize climate risks, and the use of irrigation sensors for soil and plant water, and short season and high residue cotton production systems.

Mr. Malinga presented a country report on cotton production in South Africa and later published an article titled “Situation overview and outlook for South Africa’s cotton sector”, in Cotton: Review of the World Situation.

The following opportunities are available for cotton research in South Africa in collaboration with the ICAC:

- Research on conventional cotton yield improvement.
- Exploring opportunities on gene editing through a cotton breeding programme.
- Collaborations on cotton pest control with the institutes in the region.
- As per the discussion with the ICAC, seeking funding opportunities for collaborative cotton research.

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Presentation by Mr Malinga of the South African country report.

Participants visiting a cotton field in North Carolina, USA.

International Cotton Advisory Committee (ICAC) 2019 Research Associate Programme participants.
Technology Transfer July 2019 to March 2020

Scientific publications


Scientific publications


Technology Transfer cont.

Conference proceedings


Chapters in books


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