Mondstuk van die Suid-Afrikaanse aartappelbedryf • Mouthpiece of the South African potato industry

CHIPS

VOL 35 NO 05 • NOVEMBER / DECEMBER 2021

CERES/KOUE BOKKEVELD-KULTIVARPROEF ONDER BESPROEIING: DONKERBOS 2020/2021

EMPANGENI INFORMATION DAY A SPUD-TACULAR LEARNING EXPERIENCE

Die GeoFarmer-platform maak monitering maklik

Stuit Alfalfa-mosaïekvirus in sy spore

Potato product exports: A twelve-month snapshot

Evaluation of various treatments for the management of diseases caused by *Spongospora subterranea* f. sp. *subterranea* in potato fields in South Africa

By Carmen Rensburg and Jacquie van der Waals,
Department of Plant and Soil Sciences, University of Pretoria

Powdery scab is caused by a plasmodiophorid plant pathogen, *Spongospora subterranea* f. sp. *subterranea* (*Sss*). Powdery scab disease is cosmetically unappealing due to the lesions on the tuber surface. The presence of these lesions reduces tuber quality and marketability.

The pathogen is also responsible for causing two other diseases, namely root infection and root gall formation. These two diseases disrupt water and nutrient uptake, which reduces plant growth and tuber yields.

Economically significant

Sss has become an economically important pathogen in the South African potato industry due to the increase in powdery scab disease outbreaks reported over the last decade in many potato production regions of the country. The recent escalation in the importance of powdery scab disease has been attributed to the increased use of irrigation, intensified potato production, use of susceptible potato cultivars and discontinuation of various seed tuber pesticide treatments exhibiting broad-spectrum activity.

Sss produces resistant resting spores, contributing to soil inoculum levels and long-term survival. The persistent nature of the pathogen makes it difficult to manage and an integrated approach must therefore be adopted. Methods such as avoidance of fields known to be heavily infested with *Sss*, planting resistant or tolerant potato cultivars, application of chemicals to seed tubers and/or soil treatments, post-planting crop management practices, harvesting when dry to reduce transmission of the pathogen to other fields, and post-harvest hygiene, should be combined to manage diseases caused by *Sss*.

The main objective of this study was to evaluate various treatments (applied to the soil, seed tubers or foliage) for their efficacy in suppressing diseases caused by *Sss* on potatoes (root gall formation and powdery scab) in three different potato growing regions in South

Table 1: Details of the field trials conducted in 2018 and 2019 in three potato-growing regions in South Africa.

Potato growing region and trial number	Planting date	Number of treatments	Number of replicates per treatment	Plot sizes	Total area of the field trial
Limpopo 1	11 June 2018	8	4	15 x 6 m	± 3 429 m^2
Limpopo 2	16 April 2019	19	4	15 x 6 m	± 8 181 m^2
Sandveld 1	25 June 2018	9	3	24 x 3 m	± 1 944 m^2
Sandveld 2	25 June 2019	20	3	15 x 3 m	± 3 450 m^2
KwaZulu-Natal 1	27 September 2018	5	4	10 x 4 m	± 800 m^2
KwaZulu-Natal 2	16 July 2019	15	4	10 x 4 m	± 2 400 m^2

Galls caused by *Sss* on sampled potato roots. (Photograph by C Rensburg)

Africa. This was done to determine which product/s could be incorporated in an integrated *Sss* management programme for potato growers.

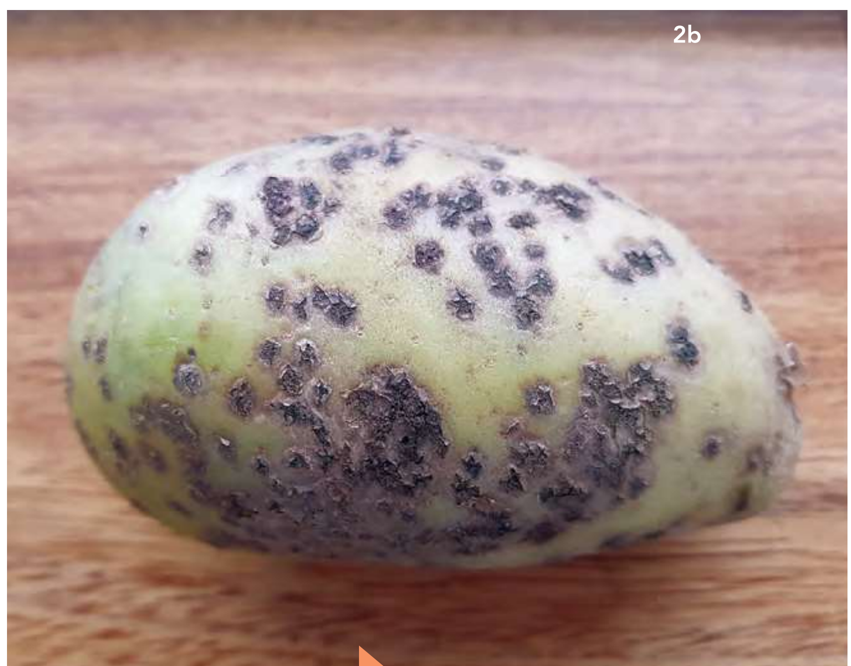
Field trials

Six field trials were conducted over two consecutive years (2018 and 2019) during the potato growing seasons. The fields that were selected and used for the field trials were known to be infested with *Sss*. Various companies supplied chemicals, biological control agents (BCAs) or fertilisers for use as in-furrow, foliar or seed treatments, to determine the efficacy thereof in suppressing diseases caused by *Sss* on potatoes.

The field trials took place in three different potato production regions, namely KwaZulu-Natal, Limpopo and the Sandveld. Each trial consisted of between five and 20 treatments, including a chemical standard (Mancozeb 800 WP), an untreated control, and three to four replicates of each treatment (*Table 1*). All field trials were laid out in a randomised complete block design (RCBD).

Disease assessment

Root gall assessment was conducted by the careful removal (ensuring roots remain intact) of three to five plants per plot from the soil, at approximately six weeks post-emergence. The roots were washed with tap water and visually assessed for root galling (*Photo 1*). Both the incidence and severity of gall formation were determined.



Potato harvest (a) and powdery scab disease (b) on tubers. (Photographs: C Rensburg)

Table 2: Products that significantly reduced or increased root gall or powdery scab disease expression in field trials conducted in three different potato growing regions in South Africa during 2018 and 2019.

Limpopo field trial 1 (2018)		
Effect on disease	**Root gall index**	**Powdery scab index**
Reduced	• Calcium cyanamide (pre-plant fertiliser)	• Calcium cyanamide (pre-plant fertiliser) • *Bacillus amyloliquefaciens* subsp. *plantarum* and *B. subtilis* (seed treatment)
Increased	• *Trichoderma harzianum* (seed treatment)	• *Bacillus amyloliquefaciens* subsp. *plantarum* and *B. subtilis* (foliar treatment)
Limpopo field trial 2 (2019)		
Effect on disease	**Root gall index**	**Powdery scab index**
Reduced	• *Bacillus amyloliquefaciens* subsp. *plantarum* and *B. subtilis* (seed treatment) • Fluazinam (500 g/L) (in-furrow treatment) • Dichlorophen (200 g/L) (in-furrow, drench treatment) • *Trichoderma* isolates (0.5x) (in-furrow, drench treatment)	• Calcium cyanamide (pre-plant fertiliser) • *Trichoderma harzianum* (in-furrow, drench treatment)
Increased	• *Bacillus amyloliquefaciens* subsp. *plantarum* and *B. subtilis* (seed treatment) • *Trichoderma asperellum* (2x) (in-furrow, drench treatment)	• *Trichoderma asperellum* (0.5x) (in-furrow, drench treatment)
Sandveld field trial 1(2018)		
Effect on disease	**Root gall index**	**Powdery scab index**
Reduced	• No disease expressed	• Azoxystrobin (250 g/L) (in-furrow treatment)
Increased	• No disease expressed	• Dichlorophen (200 g/L) (in-furrow, drench treatment)
Sandveld field trial 2 (2019)		
Effect on disease	**Root gall index**	**Powdery scab index**
Reduced	• Fluazinam (500 g/L) (in-furrow treatment) • Dichlorophen (200 g/L) (in-furrow, drench treatment)	• Potato pack (seed tuber treatment) • Mancozeb (800 g/kg) (seed tuber treatment) • *Trichoderma asperellum* (1x) (in furrow, drench treatment) • *Mycorrhiza* spp. (in furrow, drench treatment)
Increased	• *Trichoderma* spp. 500 g/ha (in-furrow treatment) • *Trichoderma* spp. 1 kg/ha (in-furrow treatment) • *Trichoderma asperellum* (2x) (in-furrow, drench treatment)	• *Trichoderma asperellum* (0.5x) (in-furrow, drench treatment) • *Trichoderma harzianum* (in-furrow, drench treatment)
KwaZulu-Natal field trial 1 (2018)		
Effect on disease	**Root gall index**	**Powdery scab index**
Reduced	• *Bacillus amyloliquefaciens* subsp. *plantarum* and *B. subtilis* (foliar treatment) • Calcium nitrate (soil drench treatment)	• Calcium nitrate (soil-drench treatment)
Increased	• *Trichoderma harzianum* (seed tuber treatment)	• *Bacillus amyloliquefaciens* subsp. plantarum and *B. subtilis* (seed tuber and foliar treatment) • *Trichoderma harzianum* (seed tuber treatment)
KwaZulu-Natal field trial 2 (2019)		
Effect on disease	**Root gall index**	**Powdery scab index**
Reduced	• *Bacillus amyloliquefaciens* subsp. *plantarum* and *B. subtilis* (seed tuber treatment)	• Fluazinam (500 g/L) (in-furrow treatment) • *Trichoderma asperellum* (2x) (in-furrow, drench treatment)
Increased	• Mycorrhiza spp. (1x & 2x) (in-furrow, drench treatment)	• *Trichoderma asperellum* (1x) (in-furrow, drench treatment)

Severity was assessed using a published root gall scoring scale (*www.spongospora.ethz.ch/LaFretaz/scoringtablegalls.htm*), where 0 = no galls, 1 = 1 to 2 galls, 2 = 3 to 10 galls, 3 = > 10 galls mostly in clusters, and 4 = many galls regularly distributed. A root gall disease index was calculated for each treatment by multiplying mean disease severity by mean disease incidence.

Powdery scab incidence and severity were determined by assessing progeny tubers at harvest (*Photo 2a* and *2b*). Twenty tubers were randomly sampled from each plot, washed in tap water and air dried. Severity was assessed using a modification of the rating scale developed by Falloon *et al*. (1995) where 0 = absence of powdery scab lesions; 1 = 1 to 5 %; 2 = 6 to 25 %; 3 = 26 to 75 %; and 4 = 76 to 100 % of the total surface covered with lesions. The powdery scab disease index was calculated for each treatment by multiplying mean disease severity by mean disease incidence.

Results

Analyses of the results showed that none of the tested products completely controlled root galling or powdery scab in any of the field trials; however, certain products reduced or increased these diseases. Products that significantly reduced or increased either of these diseases compared to the untreated control are listed in *Table 2*.

Calcium cyanimide (pre-plant fertiliser), calcium nitrite (soil-drench treatment) and fluazinam (in-furrow treatment) slightly reduced both root galling and powdery scab. The performance of various biological control agents containing *Bacillus* and *Trichoderma* spp. was inconsistent. Dichlorophen (in-furrow drench treatment) reduced root galling, while azoxystrobin reduced powdery scab in the Sandveld field trials.

Discussion and conclusion

Over the past decade, there has been an increase in the number of powdery scab disease outbreaks in South African potato growing regions. Since then, efforts have gone into assessing various management strategies. Until recently, no chemicals were registered against *Sss* on potatoes in South Africa. Fluazinam and flusulfamide are fungicides currently registered against powdery scab disease in South Africa. This study showed that certain products have the potential to reduce root galling and/or powdery scab disease incidence and severity.

Products containing calcium cyanamide, calcium nitrate, fluazinam and certain formulations of *Bacillus* and *Trichoderma* spp. as active ingredients caused slight reductions in root gall and powdery scab disease. Although some products reduced root gall and powdery scab disease, no single control strategy is completely effective against *Sss*. Further studies to specifically evaluate the modes of action, dosage and application of BCAs for management of *Sss* are required.

PSA bids farewell to a stalwart

Prof Jacquie van der Waals has been well-known in potato circles since her potato research career started in 1998. Jacquie also completed her PhD in potatoes. Her work on potato diseases gained momentum soon after, and her work on powdery scab has been challenging, but highly satisfying, she says.

Her work on the *Rhizoctonia* project also yielded satisfying results when the research team was able to confirm symptoms not usually associated with the pathogen. A smaller project was the research into brown spot, in which Jacquie and her team were tasked with looking into this new disease in the early 2000s and were able to identify *Alternaria alternata* as the disease-causing organism.

Prof Jacquie van der Waals

"Our ability to assist producers in improving their crops by identifying diseases, is certainly a satisfying endeavour and I will miss working with all the role-players in the potato industry – from Potatoes SA to the producers." Jacquie will be leaving the industry soon, and will join Citrus Research International in January 2022.

"I am sad to leave my potato family, but I am very excited about the new opportunity offered to me. I truly hope that my contribution to the potato industry has assisted producers in improving their production management practices, and that my students will continue to hone their skills and contribute to the industry."

Potatoes SA would like to congratulate Jacquie on her new appointment and wish her well with her new endeavours. We will remember her for her dedication and huge contribution to our industry.

For more information or references, send an email to Prof Jacquie van der Waals at jacquie.vdwaals@up.ac.za.