Hort Innovation

Milestone Report

Project title:

Integrated Pest Management of Nematodes in Sweetpotatoes

Project code:

PW 17001

Milestone number:

105

Project leader:

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Delivery partner:

Department of Agriculture and Fisheries

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Milestone due date:

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27 August 2020

Confidentiality:

Is this report confidential?

☒ No

☐ Yes (whole report)

☐ Yes (sections of report are confidential)

If sections of the report are confidential, list them here:

Milestone description:

Trial monitoring including biophysical soil data and metagenomics commences.

Surveys completed, field days held.

Training workshops underway.

Milestone achievement criteria:

Latest findings communicated to industry at field days.

Monitoring of long term trials.

Surveys complete, PreDicta samples sent.

Metagenomics samples collected and biophysical soil monitoring commenced.

Soil biology training completed and field evaluation of cover crops underway.

Funding statement:

This project has been funded by Hort Innovation, using the Hort Innovation sweetpotato research and development levy, co-investment from Department of Agriculture and Fisheries, Queensland and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Abbreviations

ASPG	Australian Sweetpotato Growers Inc.
BRF	Bundaberg Research Facility
CQU	Central Queensland University
DAF	Department of Agriculture and Fisheries
DES	Queensland Department of Environment and Science
ESP	Ecosciences Precinct
GRF	Gatton Research Facility
NTF	Nematode Trapping Fungi
PRG	Project Reference Group
PT	Pathogen Tested
RKN	Root-knot Nematode
SARDI	South Australian Research and Development Institute
USQ	University of Southern Queensland

General project overview

Nematodes are an important pest of sweetpotatoes, with current estimates suggesting they cost the Australian industry $20 M per year (ASPG pers. com.). This project aims to extend existing knowledge and develop new knowledge specific to sweetpotato farming systems on soil health and nematode management. Surveys will be conducted across production areas to identify nematode species present and a range of management options such as volunteer and host weed control, suitable summer and winter cover/rotation crops, low/minimum till, long term beds and nematicide efficacy will be investigated.

Summary

This project has been consistently tracking in line with milestone requirements. The long term farming systems trial is now well established in Bundaberg. Many activities including multiple pathogenicity and host range trials are tracking ahead of required timeframes. Some activities such as herbicide fact sheets, microarthropod and NTF monitoring, and intensive soil assessments and continuing cover crop host range and sweetpotato cultivar pathogenicity are additional activities to this milestone (106) requirements.

Due to COVID-19 restrictions, it was not possible to conduct traditional field days. These were replaced by a Virtual Field Day in June 2020. COVID-19 travel restrictions also meant that some activities such as smaller scale intensive sampling (especially on NSW farms) and on farm cover crop trials had to be delayed during this reporting period. Alternative arrangements such as contracting NSW agribusiness staff to collect soil surveys and facilitate possible cover crop trials are being developed to facilitate continuation of these activities.

The first commercial sweetpotato crop has been harvested from the long term farming systems trial at the Department of Agriculture and Fisheries (DAF), Bundaberg Research Facility (BRF). Over the course of the crop cycle, root-knot nematode numbers increased from the pre-plant sampling, to levels of several hundred per 200g of soil in most plots across both trials. Reniform nematode is also becoming more prevalent at the trial site. However, all amended treatments had significantly more free-living nematodes than all unamended and nematicide treated plots. Biological soil monitoring data on microarthropod and nematode trapping fungi populations has been recorded as well as soil chemical and physical properties for each treatment.

Harvested roots (15 000) were individually weighed and assessed into eight size categories; extra small, small, small medium, medium, medium large, large, jumbo and three marketability grades, first or premium grade, second grade and non-marketable. A categorisation system was designed to capture 18 common defects found in commercial sweetpotato production. The large amount of data collected from this yield and quality assessment will undergo statistical analysis.

Following harvest, amendments were applied and incorporated and all beds were again reformed in the extensive trial and White French millet has been planted over both trials as the rotation crop.
A grower demonstration trial has been established to evaluate eight different cover crops from the grass and brassica families in Bundaberg.

Host range pot trials continue to evaluate nematode resistance or susceptibility of potentially suitable cover crops for use in sweetpotato faming systems. Signal grass, Sabi grass, Sunnhemp and Williams oats displayed good resistance to both to *M. incognita* and *M. javanica.* Pathogenicity pot trials also continue to evaluate commercially grown sweetpotato cultivars and gauge their susceptibility or resistance ratings to nematode infection.

A herbicide trial is underway to investigate efficacy in controlling sweetpotato volunteer plants. One fact sheet is awaiting Hort Innovation approval, "*Herbicides, what are they*?" A second factsheet, *"Environment and herbicide performance*" has been drafted.

Achievements

Latest findings communicated to industry at field days.

Monitoring of long term trials

Surveys complete, PreDicta samples sent

Metagenomics samples collected and biophysical soil monitoring

Soil biology training completed and field evaluation of cover crops underway.

Latest findings communicated to industry at field days

Due to COVID-19 control restrictions, it was not possible to conduct traditional field days. In view of this a Project Reference Group meeting was held as a phone conference on 26 May 2020, (Attached document). The planned field days for Bundaberg and Cudgen were replaced by a Virtual Field Day on 11 June 2020 using Microsoft Teams (Appendix 1 and 2). Uptake by industry was limited, possibly due to the time slot (lunch time), unfamiliarity with online presentations and varying degrees of technical knowhow. We are now producing a stand-alone video, with a link to be provided in a text message or email to send out to growers. Format will depend on DAF comms protocols (YouTube/ Microsoft stream). This will enable growers to watch at their leisure and DAF will follow up with individual phone calls to collate feedback.

Monitoring of long term trials

Monitoring of the long term trials has continued as planned. As per MS 104 the first commercial sweetpotato crop was planted in November 2019 in both the extensive and intensive trial areas. Fortnightly soil and leaf tissue samples were collected for nitrate analysis. Weekly monitoring and maintenance was performed including irrigation management, crop scouting and weeding.

The commercial sweetpotato crop was harvested on the 8th of June. Soil samples (195) for nematode, physical soil properties and soil biology analysis were taken just prior to the crop being dug. Results from these samples will allow investigation into correlation between soil characteristics, Root Knot Nematode (RKN) populations and soil biology.

Nematode analysis

Over the course of the crop cycle, root-knot nematode numbers increased from the pre-plant sampling, to levels of several hundred per 200g of soil in most plots across both trials, the highest count being 1938 per 200g of soil. Reniform nematode is becoming more prevalent at the trial site, and was detected at harvest in most plots in the extensive trial (highest count 1528/200g) and in the northern-most plots of the intensive trial which adjoin the extensive trial. The rate of increase over the course of the SP crop has been about the same for both RKN and Reniform which are both well hosted by sweetpotato.

No treatments (including Vydate) were successful at restricting root-knot nematode to consistently low levels in the extensive trial (Figure 1). The two “double amendment” treatments (double amendment with grass/brassica rotation and double amendment with grass/legume rotation) had the lowest average root-knot numbers at harvest, although analysis showed that this trend was not statistically significant. These two treatments had an incorporated amendment after the previous harvest and a v-furrow amendment prior to planting.

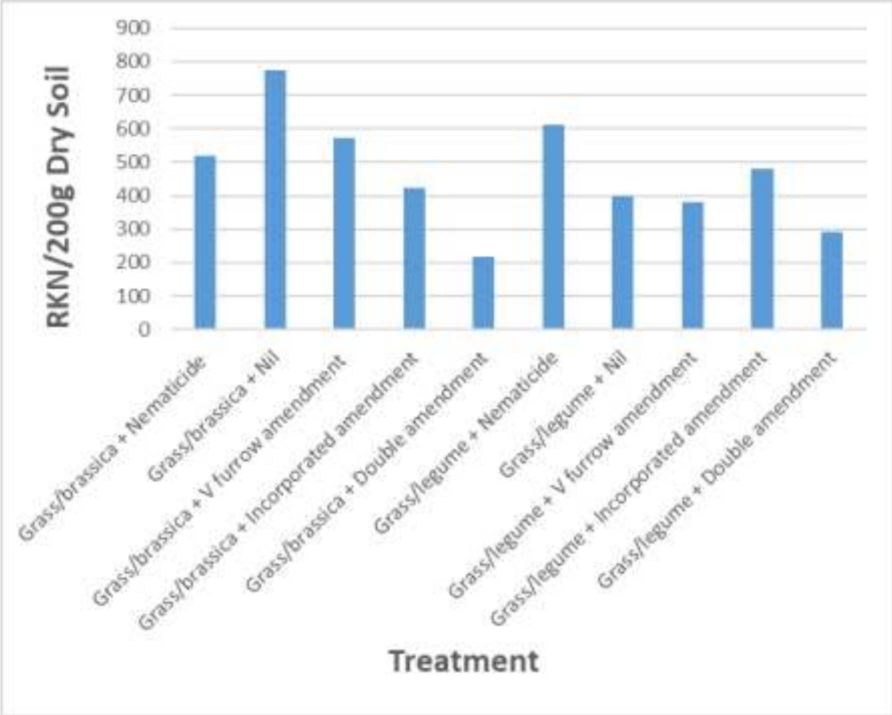


Figure 1. Extensive Trial: Average Root-knot Nematode Counts per 200g Dry Soil.

Average free-living nematode counts were highest in plots which received an amendment treatment, whether it was single incorporated, single v-furrow or double amendment (Figure 2). All amended treatments had more free-living nematodes than all unamended (nil) and nematicide treated plots and this difference was statistically significant (P<0.05). It is encouraging that this difference has persisted through the crop cycle as increased free-living nematode numbers are an indicator of improved biological activity within the soil.

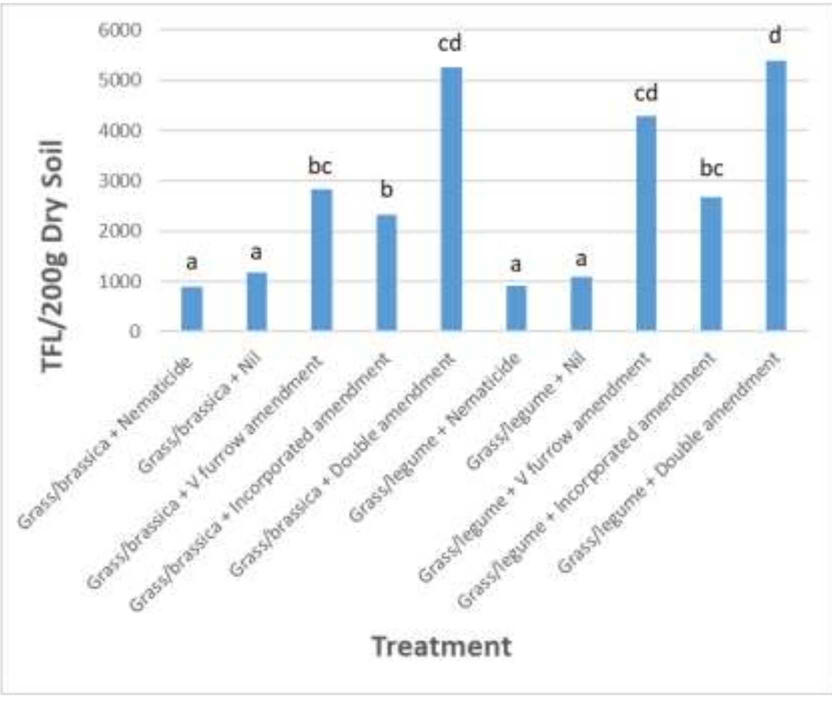


Figure 2. Extensive Trial: Average Free-living Nematode Counts per 200g Dry Soil

In the intensive trial as a whole, root-knot (RKN) numbers were a little lower at harvest compared with the extensive trial, which most likely reflects the use of a sorghum rotation. This was more successful at reducing root-knot numbers pre-plant, compared with brassica or soybean used in the extensive trial. There were no statistically significant differences among the treatments in the intensive trial, although the incorporated organic matter (poultry manure + sawdust) and v-furrow treatments had the lowest average root-knot counts at harvest (Figure 3).

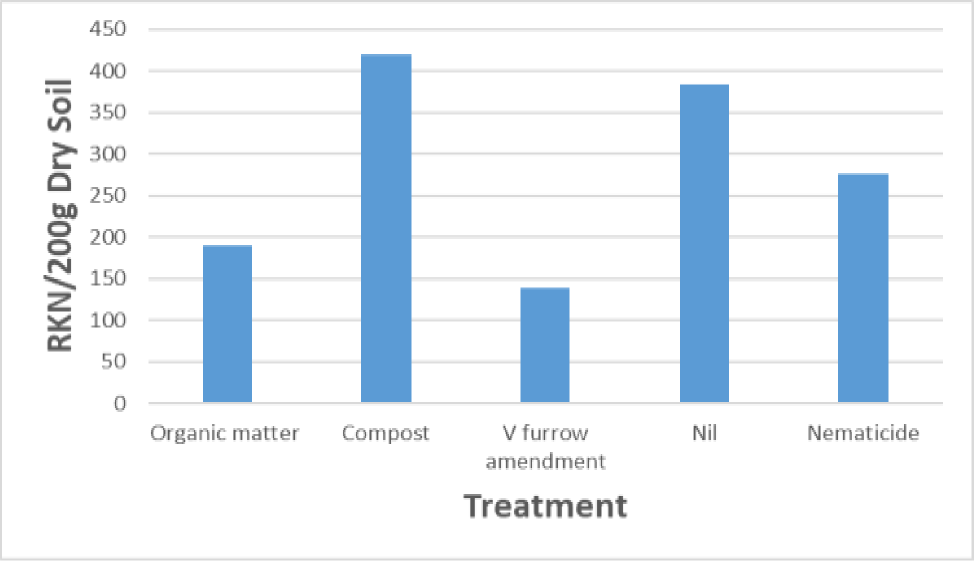


Figure 3. Intensive Trial: Average Root-knot Nematode Counts per 200g Dry Soil

Harvest and yield assessment

The commercial sweetpotato crop was monitored and watered in preparation for mulching to enhance skin hardening and limit harvest losses. A potato harvester was used to lift the sweetpotato roots to the surface where they were manually hand-picked into onion bags and placed into plastic half ton bins. Roots were freighted overnight to Gatton Research Facility (GRF), for washing and assessment.

Figure 4. Left, aerial view of both trials, extensive trial in the foreground. Right mulching of foliage prior to harvest.

Harvested roots were washed in a chlorine solution using a standard butternut pumpkin washer. Over the duration of 9 days, the 15 000 roots were individually weighed and assessed into eight size categories; extra small, small, small medium, medium, medium large, large, jumbo and three marketability grades, first or premium grade, second grade and non-marketable. A categorisation system was designed to capture 18 common defects found in commercial sweetpotato production. As the range and types of skin lesions than may or may not be attributed to nematode infection either directly or indirectly is unknown, all defects was recorded. Each root underwent close visual scrutiny and was evaluated using this system. A large amount of data was collected from this yield and quality assessment which will take some time to process. Data will be sent to a biometrician for a complete analysis.

Figure 5. The range of size and marketability categories.


Figure 6. Assessing harvested roots at GRF.

Following harvest, beds were again reformed in the extensive trial and White French millet has been planted over both trials as the first rotation crop. The extensive trial will have a longer rotation break than the intensive trial prior to the next commercial sweetpotato planting. Trial plans over the course of the project include three commercial sweetpotato crops in the extensive trial and four commercial plantings in the intensive trial block.

Amendments

On the 29th June 2020, each row in the grass/brassica + incorporated amendment and grass/legume + incorporated amendment treatments received a total of 56kg of organic amendments. This was made up of a combination of 28kg of sugarcane trash and 28kg of commercially supplied compost. Once applied, the amendment was incorporated during sweetpotato bed formation. All remaining hills in the extensive trial were then bed-formed on the 30th June 2020 in preparation for follow on cover crops.

Cover Crop Phase

The intensive and extensive trial blocks both were manually sown with White french millet at the rate of 60g seed/row (14m). Solid set irrigation pipes were installed to facilitate crop establishment. Three data loggers (soil temperature) have been installed throughout both trial blocks.

Figure 7. Left, Application of organic amendments, right, beds formed and seeded with White french millet.

Surveys complete, PreDicta samples sent

Initial surveys have been completed and all samples were sent to SARDI for molecular analysis. Survey results, both manual counts and SARDI data was outlined within milestone 104.

Metagenomics and biophysical soil monitoring

Soil has been collected at critical points during the long term farming systems trial for metagenomic analysis. Samples are stored at minus 20 degrees for future reference. Negotiations continue in relation to the USQ request for either increased funding or removal of metagenomic activities from the proposed subcontract. Pricing from alternative suppliers was presented to PRG as requested. Information from soil health experts on the practicality, interpretation of data and usefulness of this approach to the project aims was also presented to the PRG.

Soil Biology Parameters Long Term Trial

Plant parasitic nematodes in sweetpotato growing regions have a major influence on yield. As soil suppressiveness to nematode infection has been linked to healthy soils, this has prompted researchers and growers to consider 'what is a healthy soil?' Determining the status of soil health encompasses a range of different factors. These include soil structure, organic matter, carbon, soil nutrients, beneficial nematode populations and microarthropod communities to name a few. At the inception of this project soil biology training included extraction of microarthropods from soil and culturing and identification of nematode trapping fungi. This was reported upon in greater detail in MS102.

To better understand and evaluate tools for monitoring soil health in sweetpotato production areas, the use of microarthropod extraction and culturing of nematode trapping fungal (NTF) communities has been implemented at GRF, and continues to evolve. Monitoring microarthropod and nematode trapping fungal communities in the long term trial in Bundaberg over the duration of the experiment will allow for continued rigorous testing of these methods and evaluate whether these tests are suitable and applicable tools to aid sweetpotato growers in soil health monitoring.

In May 2020, prior to harvest of the first commercial sweetpotato crop from the long term trial soil samples were collected. Each of the 65 samples underwent microarthropod extraction and were divided across 260 growth plates of ¼ strength corn meal agar to detect NTF.

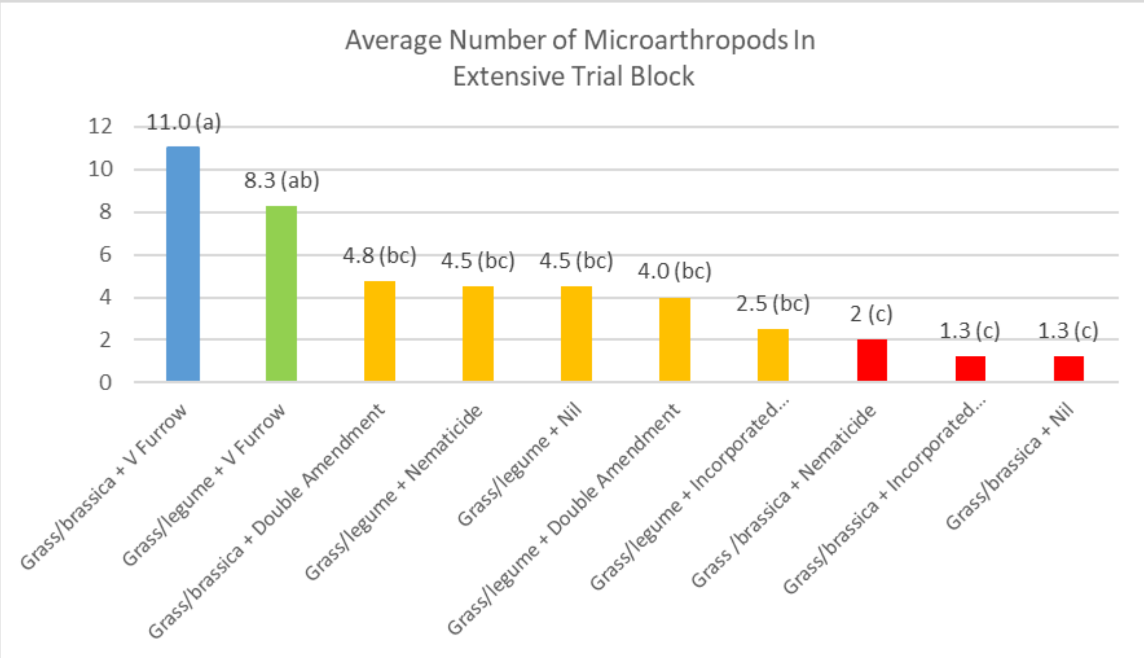
Microarthropod Results

Results outlined below give an average rating of microarthropod populations across treatments and groups them based on significant difference ratings. Importantly, microarthropods were detected in all treatments.

Extensive trial Block

All v furrow treatments in the extensive trial block (brass/brassica and grass/legume) had the highest number of microarthropods (Figure 8). The grass brassica v furrow treatment had the highest average of microarthropods (11), and these were significantly different (a). The lowest average number of microarthropods (c) were detected in the treatments; Grass/brassica with nematicide, Grass/Brassica incorporated amendment and Grass/Brassica nil. This may indicate that v furrow treatments provided a supportive environment for microarthropod reproduction.

Figure 8: Average Number of Microarthropods in Extensive Block



Intensive trial Block

Microarthropod results from the intensive trial (Figure 9) suggests that the addition of various organic amendments yielded a higher total number of microarthropods compared to both the nil and nematicide treatments which did not receive any amendments. The organic matter treatments had the highest total number of microarthropods and this was significantly different (a), followed by the v furrow (ab). Whilst the compost treatment had 6.6 microarthropods on average across the trial site, it is still statistically grouped with nil (2.8) and nematicide (2.6) treatments (b). This may indicate that the organic matter and v furrow treatments provided a more ideal environment for microarthropod reproduction.

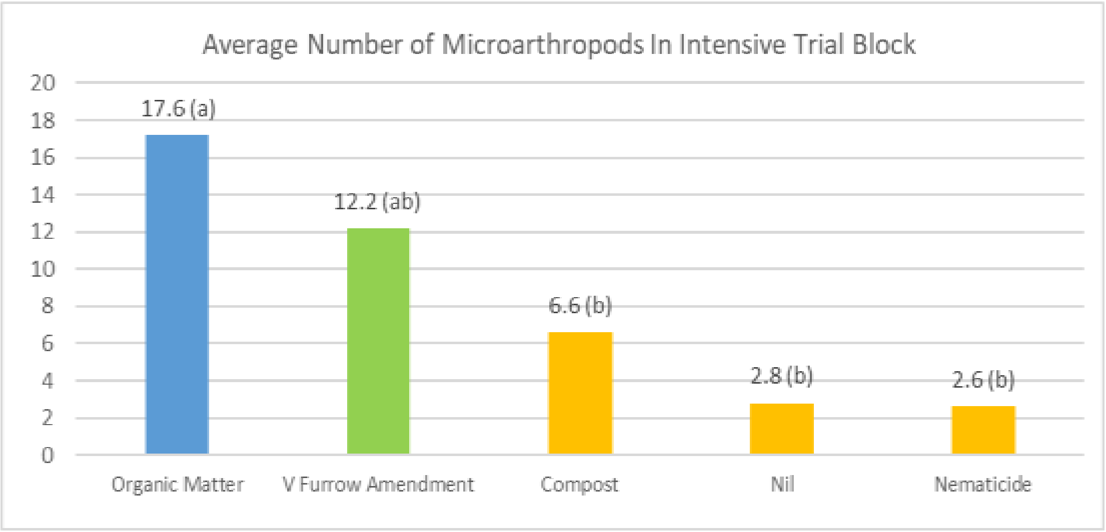


Figure 9: Average Number of microarthropods Intensive Block.

Figure 10: Left to right, Tullgren funnels and counting microarthropods.

Nematode Trapping Fungi (NTF)

Statistical analysis of data obtained from the nematode trapping communities is still ongoing. One important note to consider is that across the treatments at least one sample from each treatment displayed nematode trapping fungal communities.

Extensive trial

Data presented in Figure 11 indicates that all treatments showed reproduction of NTF. Of the top three highest incidence of NTF, two of these were grass/brassica and grass/legume with double amendments. This provides encouraging indications that double amendments regardless of the cover crops provided an environment for NTF to populate. Further studies and statistical analysis is required prior to making firm correlations.

Overall, it can be concluded that culturing of NTF in the long term trial was successful as NTF were successfully cultured from all treatments. Further soil sampling will give a better indication of relationships between treatments and NTF communities over time. Nematode trapping fungi populations and microarthropods will be further investigated and commented on in MS106.

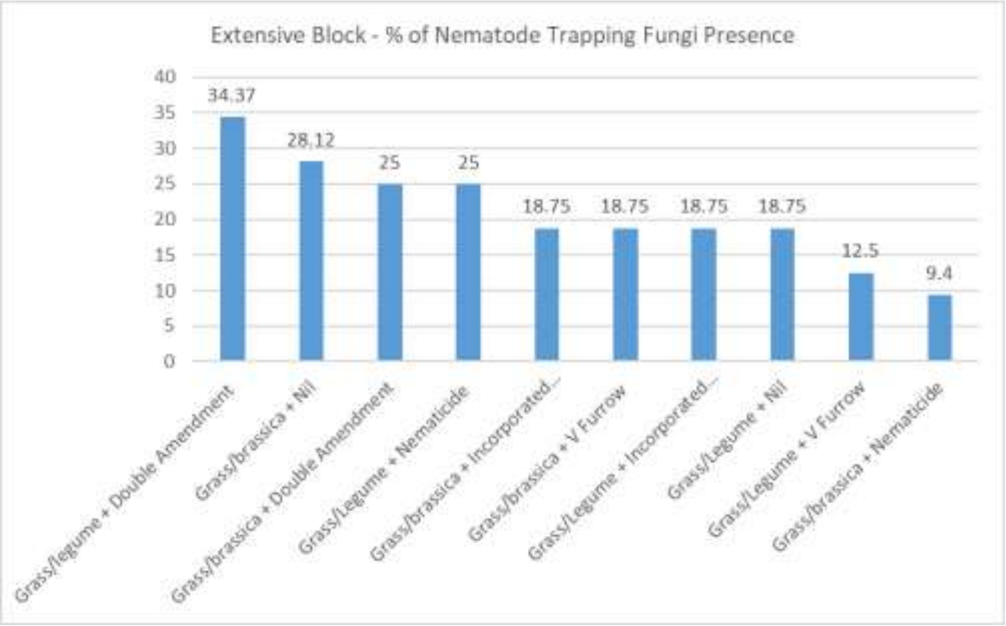


Figure 11: Extensive Block % of samples with presence of nematode trapping fungi

Intensive trial

Figure 12, below, suggests that the nil treatment had the greatest incidence of nematode trapping fungi (NTF) populations. The nil treatments detected NTF 40% of the time followed closely by compost which exhibited NTF 37.5% of the time. The v furrow and organic matter treatments both had the lowest incidence of NTF being observed 17.5% of the time. Importantly, all treatments saw NTF populations. Further data collection over the life of the trial and refinement of techniques will inform the status of NTF and soil health relationships.

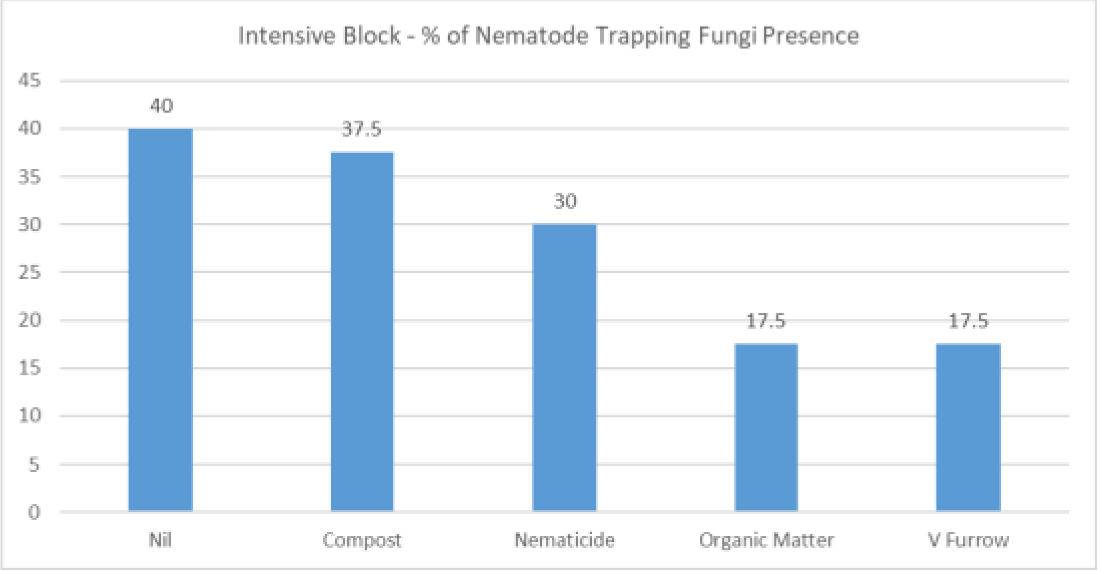


Figure 12: Intensive block % of samples with presence of nematode trapping fungi.

Figure 13: Left to right, Dispensing media, soil cultures, NTF showing conidia (Arthrobotrys oligospora).

Soil chemical and physical parameters

Meetings were held with the Department of Environment and Science (DES), Chemistry Centre staff in July 2019 to determine the most useful analyses that may correlate soil health with nematode populations. The scope of the informal agreement covered grower survey samples that had already been collected and ongoing analyses of soil collected at strategic times from the long term trial at Bundaberg Research Facility.

The suite of analyses most suited to our needs was determined as the following;

- pH
- Conductivity (EC)
- Chloride (Cl)
- Nitrate-Nitrogen (NO3-N)
- Phosphorous (P)
- Phosphorous Buffering Index (PBI)
- Total Carbon (TC)
- Total Nitrogen (TN)
- Total Organic Carbon (TOC)
- Permanganate Oxidisable Carbon (POxC)
- Particle Size Analysis (PSA) Coarse Sand, Fine Sand, Silt and Clay

Soil CO_2 respiration testing, using the Solvita® CO_2 Burst Method was conducted on grower survey samples at the Gatton Research Facility during 2018/2019. A faulty CO_2 reader led to variability in results for some of these samples but the reader was replaced in early 2020 by the Solvita® Company at no cost.

Letters have been sent to 40 growers with their test results along with an interpretation document that gives a summary of each soil characteristic tested and its relevance to sweetpotato soil health. Attached is a sample letter with the growers name removed (Attachment 4) and a Soil information handout (Attachment 5).

Soil testing for the Bundaberg long term trial (B6)

Soil samples collected from the B6 trial in June 2020 were sent to DES for analysis with results just recently received. Soil CO_2 respiration testing, using the Solvita® CO_2 Burst Method is being conducted on samples from the Bundaberg long term trial.

The following graphs display the Carbon and Total Nitrogen results from the June 2020 sampling of the Extensive Trial with the double amendment treatments, as expected, giving higher C and N percentages compared to the nil amendment treatment and also the nematicide treatment. This data will be further explored and analysed to determine if the differences are statistically significant. The cover crop/amendment interaction will also be statistically analysed to investigate whether the cover crop or the amendment or the combination of both is contributing to the differences in results.

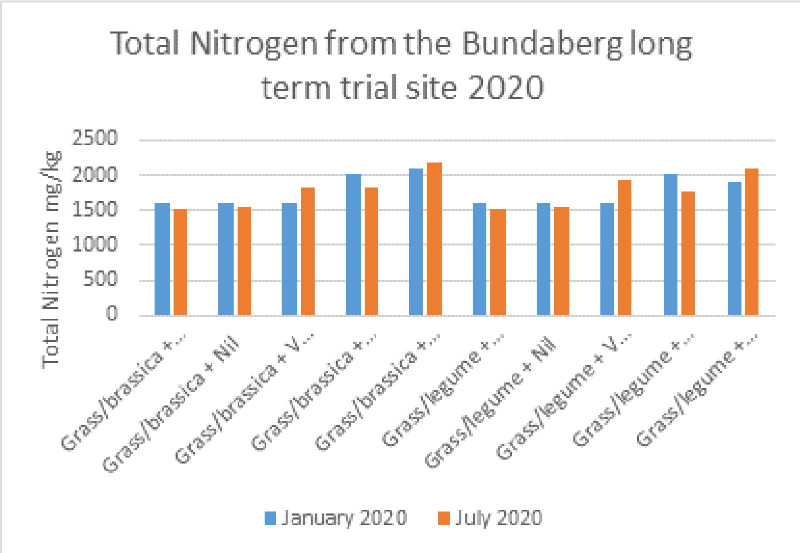


Figure 14: Graph showing Total Organic Carbon and Permanganate Oxidisable Carbon from January and June 2020 across the treatments.

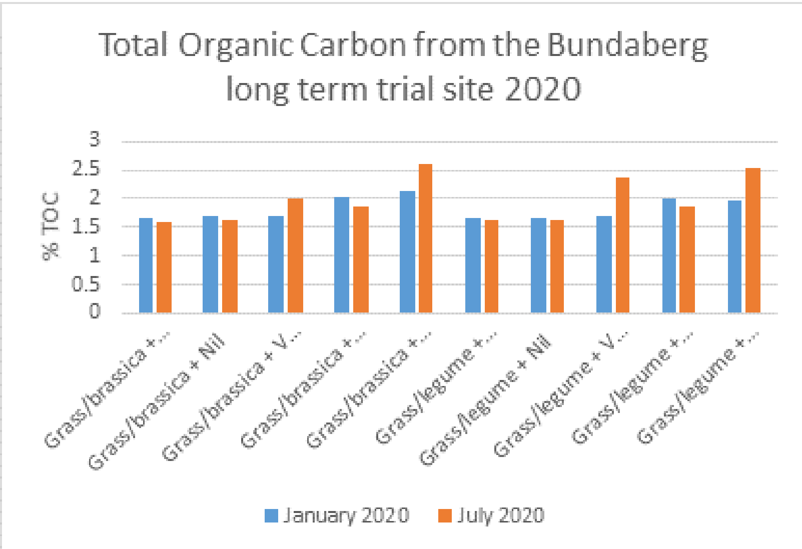


Figure 15: Graph showing Total Nitrogen from January and June 2020 from the different treatments.

Table 1: Total Nitrogen and Total Organic Carbon and Permanganate Oxidisable Carbon with treatments separated into cover crop and amendment.

Cover Crop	Amendment	Mean TN %	Mean TOC %	Mean PPOC %
Grass/brassica	Nematicide	0.15	1.59	0.12
Grass/legume	Nematicide	0.15	1.61	0.17
Grass/brassica	Nil	0.16	1.62	0.12
Grass/legume	Nil	0.16	1.63	0.15
Grass/legume	Incorporated amendment	0.18	1.88	0.19
Grass/brassica	Incorporated amendment	0.18	1.88	0.16
Grass/brassica	V furrow amendment	0.18	2.00	0.17
Grass/legume	V furrow amendment	0.19	2.39	0.21
Grass/legume	Double amendment	0.21	2.55	0.21
Grass/brassica	Double amendment	0.22	2.61	0.26

Soil biology training

Soil biology training was completed during September and October 2018 and previously reported on as part of Milestone 103.

Field evaluation of cover crops

An important output of this project is to investigate cover crops and their suitability to control plant parasitic nematodes. The grower demonstration site selected in Bundaberg was planted to eight different winter cover crops with a bare fallow used as a control. Cover crops from the grass (Poaceae) and Brassica families were chosen based on seasonal suitability and seed availability. The inclusion of biofumigants (Brassicas) allows investigation into claims that biofumigants can be effective in reducing soil borne pathogens. Any biofumigant effects will be investigated and glucosinolate levels determined at trial conclusion.

Cover crops in the demonstration trial include:

1. Mix of Terranova Radish and Saia Oats
2. Terranova Radish
3. Saia Oats
4. Genie Oats
5. Nemsol
6. Fungisol
7. Bare Fallow
8. Caliente
9. White French millet

Prior to planting, a representative soil sample was taken from each treatment. These soils underwent nematode extraction, CO_2 respiration, microarthropod extraction and were plated to examine if nematode trapping fungal communities were present. A further soil sample was taken 13 weeks after planting and prior to biofumigant incorporation. A subsequent soil sample will be collected after incorporation to compare soil microbiome populations. Biomass sampling has occurred across all nine treatments and these samples have been placed into oven drying facilities at 60°C and will be ground to determinate glucosinolate levels. This demonstration trial is on-going and will be reported on in full in the next milestone (106).

Figure 16: Left, Rach Langenbaker (BRF), grower collaborator Daniel Zunker measuring seed. Centre, Genie oats and left, Nemsol.

Additional achievements

Resistance pot trials to assess potential cover crops continue.

Pathogenicity trials continue for sweetpotato cultivars.

Herbicide review and pot trial continues, herbicide fact sheet developed.

Nematicide trial plans in place.

Project reference group meeting held and minutes provided.

Resistance pot trials to assess potential cover crops continue

Resistance to plant-parasitic nematodes is determined by the capacity of the nematode to multiply on a plant, with high multiplication rates indicating susceptibility and low multiplication rates indicating resistance. Levels of resistance or susceptibility were determined by inoculating plants with a known number of nematode eggs (initial population density Pi), measuring final population density (Pf) and then making the following calculation: Reproduction Factor (RF) = Pf/Pi (Table 2).

Since not all eggs in inoculum are capable of hatching and invading roots, a conservative figure of 1/10 of the Pf was used as Pi, i.e. 1,000 as each plant was inoculated with 10,000 eggs of either *Meloidogyne incognita* or *M. javanica*.

Table 2 Resistance categories

Reproductive Factor	Resistance Rating
> 100	Highly Susceptible (HS)
10 - 100	Moderately Susceptible (MS)
1 - < 10	Slightly Susceptible (SS)
0.1 - < 1	Resistant (R)
< 0.1	Highly Resistant (HR)

A mixed species experiment (sabi grass, signal grass, annual ryegrass, buckwheat, Culgoa11 oats, ryecorn, triticale, and sunnhemp) was inoculated with two species of root-knot nematodes (*M. incognita* and *M. javanica*) to determine the host status of these plant species.

- ***Brachiaria decumbens*** (signal grass) is highly resistant (HR) to *M. incognita* and resistant (R) to *M. javanica.*
- ***Urochloa mosambicensis*** (sabi grass) is resistant (R) to *M. incognita* and highly resistant (HR) to *M. javanica.*
- ***Crotolaria juncea*** (sunnhemp) is resistant (R) to both *M. incognita* and *M. javanica.*
- All other cultivars tested were susceptible to both *M. incognita* and *M. javanica.*

Similarly, cultivars of *Avena* spp. (Algerian, Bannister, Carrolup, Euro, Kojonup, and Williams) were inoculated with two species of root-knot nematodes (*M. incognita* and *M. javanica*) to determine the host status of these cultivars.

- **Williams oats** is highly resistant (HR) to both *M. incognita* and *M. javanica*.
- **Algerian oats** and **Carrolup oats** are both resistant (R) to *M. incognita* only.
- All other cultivars tested were susceptible to both *M. incognita* and *M. javanica.*

Further glasshouse experiments to determine host range resistance with another mixed species experiment are underway. This experiment includes oats varieties Saia, Swan, Eurrabbie and Genie and sorghum cultivars Dyna Powa and Dyna Dan.

Host range/pathogenicity experiments – sweetpotato and root-knot nematode

Two host range experiments were conducted on sweetpotatoes cultivars at the ESP glasshouses in Brisbane. Experiment 1 using varieties Beauregard, Bellevue, Orleans, Northern Star, Southern Star and Murasaki was inoculated with two species of root-knot nematodes (*M. incognita* and *M. javanica*). Similar treatments using sweetpotato varieties Bonita, Eclipse, New Cultivar 1, New Cultivar 2, New Cultivar 4 and WSPF were finalised in experiment 2.

- **Beauregard** is highly susceptible to both *M. incognita* and *M. javanica*
- **Bellevue** is slightly susceptible to *M. incognita* and moderately susceptible to *M. javanica*
- **Murasaki** is moderately susceptible to both *M. incognita* and *M. javanica*
- **Northern Star** is slightly susceptible to *M. incognita* and **highly resistant (HR) to *M. javanica***
- **Orleans** is highly susceptible to both M. *incognita* and *M. javanica*
- **Southern Star** is moderately susceptible to both *M. incognita* and *M. javanica*
- **Bonita** is moderately susceptible to *M. incognita* and **resistant (R) to *M. javanica***
- **Eclipse** is moderately susceptible to *M. incognita* and slightly susceptible to *M. javanica*
- **New Cultivar 1** is moderately susceptible to *M. incognita* and **resistant (R) to *M. javanica***
- **New Cultivar 2** is **highly resistant (HR) to both *M. incognita* and *M. javanica***
- **New Cultivar 4** is moderately susceptible to *M. incognita* and **highly resistant (HR) to *M. javanica***
- **WSPF** is moderately susceptible to *M. incognita* and **resistant (R) to *M. javanica***

Herbicide review and pot trial continues, herbicide fact sheet developed

A herbicide trial has been established at Walkamin Research Facility. Twelve herbicides that have a registration for control of a convolvulus species are being trialed to see their effectiveness in controlling sweetpotato volunteers.

The trial is a randomized block design with four replications. The pot trial was planted 19 March and on 1 April pre-emergent herbicides applied. On 9 July 2020, post emergent herbicides were applied and pre/post emergent herbicides reapplied as they did not show signs of effectiveness with the pre-emergent application. Trial data is still being collected on the herbicide effect on volunteer sweetpotatoes. Following this the roots will be removed and vine cuttings planted to identify plant back effects.

The factsheet, "*Herbicides, what are they?*" is now completed and undergoing DAF and Hort Innovation approval (separate attachment). A second factsheet, *"Environment and herbicide performance*" has been drafted.

Figure 17: Herbicide pot trials at Walkamin Research Facility, left emerged shoot from a herbicide treated root.

Nematicide trial plans in place

Site selection is underway for spring summer 2020 nematicide trials. The most important criteria in considering site suitability is the presence of high nematode populations. Potential sites will be surveyed in the coming weeks to provide nematode population data.

Project reference group meeting held and minutes provided.

A project reference group meeting was held on the 26 of May 2020. Meeting minutes are provided in a separate attachment.

Outputs

- Grower update and virtual field walk presented via Microsoft teams on the 11th of June.
- Report on nematode population changes in response to experimental treatments in the long term farming systems trial.
- Report on pot trials - nematode resistance of cover crop species.
- Report on pot trials - pathogenicity of commercial Sweetpotato cultivars.
- First commercial sweetpotato harvest conducted in the long term farming systems trial in Bundaberg and assessment criteria developed for yield evaluation and identification of nematode related losses.
- On farm demonstration cover crop trial underway
- Protocols developed and being refined for biological soil monitoring tools, (microarthropods extraction and NTF culture).
- Letters sent to growers with test results along with an interpretation document that gave a summary of each soil characteristic tested and its relevance to sweetpotato soil health.
- Herbicide trial under way.
- Herbicide fact sheet (*Herbicides, what are they?*) submitted for approval.
- Second herbicide fact sheet (*Environment and herbicide performance)* drafted.

Outcomes

Growers have increased knowledge on nematode resistance of additional cover crops species for use in sweetpotato production systems.
Capacity building continues as sweetpotato researchers develop protocols and enhanced skills for culturing NTF and extracting microarthropods from soil samples.
Growers have increased knowledge on soil chemical analysis in surveyed blocks.
Growers have increased understanding of herbicides in relation to sweetpotato production systems.

Intellectual property, commercialisation and confidentiality

No project IP, project outputs, commercialisation or confidentiality issues to report

Issues and risks

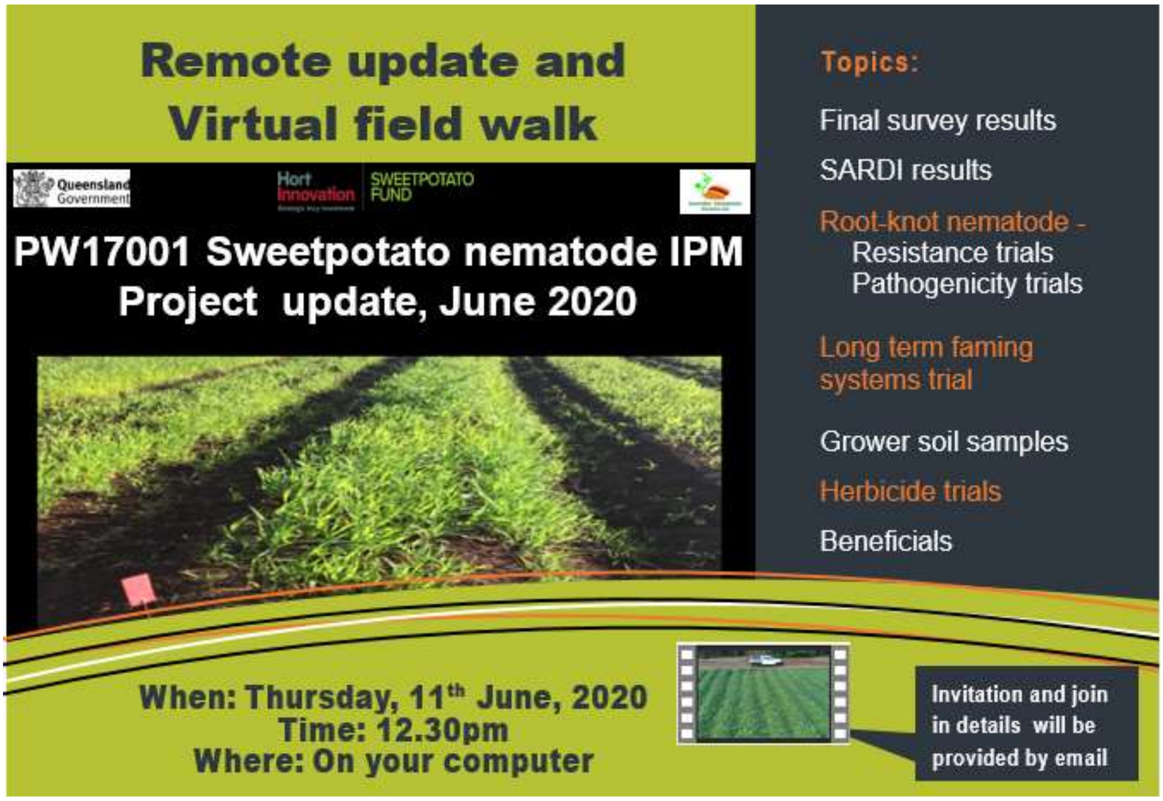
COVID-19 continues to be a risk. To date the project has been continuing to follow recommended practices. Field days and other planned gatherings have been replaced by webinars and teleconferences. Field activities are following recommended social distancing and hygiene protocols. This is expected to continue while this disease remains a threat. Recent Qld border closures may pose some restrictions on movement to/from NSW. Alternative arrangements are being investigated, such as enlisting local agribusiness staff to conduct soil sampling. Posting cover crop seed and trial plans to agribusiness staff to deliver to growers and assist with implementation of NSW grower demonstration sites and delivery of virtual project updates will ensure project work in Cudgen is maintained to some degree.

Other information

No additional information to report.

Appendices

Appendix 1



Flyer, grower update and virtual field walk sent out to sweetpotato growers June 2020.

Attachments

Attachment 1

Grower update and virtual field walk, Power point presentation.

Attachment 2

Herbicide fact sheet.

Attachment 3

Minutes of the PW17001 project reference group meeting held in May 2020.

Attachment 4

Example letter, grower soil test results

Attachment 5

Soil Test Information handout for growers