Milestone Report

Project title:

Integrated Pest Management of Nematodes in Sweetpotatoes

Project code:

PW17001

Milestone number:

103

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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:

Initial planning meeting
Masterclasses
Collation of existing knowledge
Field days conducted
Nematology capacity training
Initial fact sheets completed
Intensive survey plans completed

Milestone achievement criteria:

Project technical advisory panel formed
4 Initial masterclasses held and fact sheets produced
Collation of previous data
2 field days held
Project team training completed
Plans for intensive surveys and sampling techniques in place

Funding statement:

Levy and co-investment funding – R&D projects

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Abbreviations

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

General project overview

Nematodes are an important pests 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

Four very successful sweetpotato nematode masterclasses were held in the major production areas of Bundaberg, Cudgen and Atherton. Classes consisted of presentations and hands-on practical sessions with a focus on participant interactivity to provide sweetpotato growers with the most up to date information on sustainable soil health management and a variety of nematode control options. Participants were encouraged to discuss how various management practices could be integrated into their sweetpotato farming systems. DAF sweetpotato researchers also participated in several nematology Training workshops conducted by BCP and DAF nematology group at ESP.

Intensive field surveys to gain an understanding of region specific nematode species occurrences and identify any potential biosecurity issues have almost concluded throughout the major cropping regions. Over 90 survey samples have been processed with plant-parasitic nematodes being the main focus, free-living nematodes are also being identified to give an overall indication of the soil's biological status. Information on previous cropping history and a range of soil parameters, such as soil type, organic carbon, pH and carbon dioxide respiration will be used to assess the impact of these factors on nematode occurrence and population density.

Preliminary results suggest that as per historical detections, RKN *(Meloidogyne* spp) are by far the most important nematode in sweetpotato cropping regions, with *Rotylenchulus reniformis* again recorded from a few fields in Central Queensland and Bundaberg, with a new detection in South East Queensland. Lesion nematodes were also detected in some regions. Initial molecular identification of RKN species by SARDI on the first 44 samples, identified *M. javanica* as the most dominant species in Bundaberg and *M. incognita* as being dominant in the Cudgen region. Additionally, *M. arenaria* and *M. hapla* were also detected.

Project results were communicated to farmers and researchers through field days and project updates held in Bundaberg and Cudgen. Information discussed during the masterclasses was translated into 11 fact sheets to provide sweetpotato growers with information on a range of topics including plant parasitic nematode species, life cycles, ecology, pathogenicity, organic amendments, cover crops and minimum till to enhance soil suppressiveness and reduce losses from nematode pests.

A long-term farming system trial has been established and will run throughout the life of the project to assess a range of tillage options, soil amendments, cover crops and mulches to improve biological soil health and provide long-term sustainable nematode management.

Achievements

Project technical advisory panel formed
Four Initial masterclasses and fact sheets
Collation of previous data
Two field days held
Project team training completed
Plans for intensive surveys and sampling techniques in place

Project technical advisory panel

As per MS102, the Project technical advisory panel or project reference group (PRG) was formed in September 2018. Further meetings were held in Cudgen on the 28th of February 2019 and by teleconference on the 21st of August 2019. (Minutes attached).

Initial masterclasses

Four initial masterclasses were held in Cudgen on the 4th of March, 2019, in Bundaberg on the 6th and 7th of March 2019 and in Atherton (Kairi) on the 14th of March, 2019.
The masterclasses modelled on the successful sugar industry series were designed to improve grower's understanding of root-knot nematode. 51 attendees were presented with information on RKN management in vegetable crops and damage caused to sweetpotato. Classes consisted of presentations and hands-on practical sessions with a focus on interactivity. In Cudgen a peer grower, already involved in improving soil health, presented to the class. A second focus was the introduction of existing farm practices to reduce losses from RKN in vegetable crops. Open discussion sessions encouraged participants to exchange ideas on how various management practices could be integrated into their sweetpotato farming system.

Theory, practical sessions and group discussions

- Soil organisms and the soil food web
- Plant pathogenic nematode species
- Nematode population dynamics and damage thresholds
- The life history of RKN
- Beneficial organisms, bacteria, fungi and free living nematodes
- Impact of environmental factors on nematode survival and multiplication
- The importance of carbon
- Sustainable farming systems for healthy soils
- Resistant cultivars
- Nematode monitoring as a management tool
- Rotation crops, organic amendments and mulching
- Minimum tillage, control of volunteers and weeds
- Suppressive soils and early bed formation

The Sweetpotato soil health Masterclass workbook was included in Milestone 102.

Fact sheets

Eleven fact sheets to provide sweetpotato growers with information on the topics discussed in the classes were produced by the project team. Titles are listed below. These will be revised later in the project as new information comes to hand and published as stand-alone fact sheets.

1. Root-knot nematode: An important pest of sweetpotato
2. Ecology of root-knot nematode on sweetpotato
3. Monitoring as a tool for managing root-knot nematode on sweetpotato
4. Plant parasitic nematodes: An important pests of sweetpotato
5. Integrated nematode management in sweetpotato
6. Nematicides for use on sweetpotato
7. Crop rotation, cover cropping and bare fallows to reduce nematode damage on sweetpotato
8. Weed and volunteer control plays an important role in reducing losses from root-knot nematode on sweetpotato
9. Organic inputs to improve soil health and reduce losses from nematode pests
10. Management strategies to enhance a soil's capacity to supress nematode pests
11. Towards more sustainable sweetpotato farming systems

Collation of previous data

Between April 2010 and August 2013, 500 sweetpotato soil samples were received at the DAF Nematology Diagnostic Laboratory. Information on the location of where the samples were received from was not often provided to the laboratory together with the fact that many of these samples were field trail samples make it hard to make useful comments from this data.

However, where location information was provided it can be seen the *Rotylenchulus reniformis* (reniform nematode) was recovered from some blocks from the Central Queensland and the Bundaberg areas. *Meloidogyne* spp. (root-knot nematode) was present in samples received from Central Queensland, Bundaberg and Cudgen. No samples were received from sweetpotato growers from the Atherton Tablelands or South East Queensland during that timeframe.

Many field trials had been carried out at the Bundaberg Research Facility where there were high numbers of both reniform nematode and root-knot nematode.

Field days

The following extension events were held during 2019.

- 25th July, Cudgen growers visited the Bundaberg trial site, (six growers).
- 7th August, project update held in Cudgen, (14 growers and one agri service representative).
- 14 August, field day held in Bundaberg, (24 growers, four agri service representatives and three Hort Innovation representatives).

Attendees were presented with project updates on the following topics:

- Masterclass feedback
- Preliminary grower practice survey results
- Project team nematology training workshops
- Preliminary nematode survey results by region
- Soil testing parameters including CO_2
- Pathogenicity pot trials on potential cover crops
- Host range pot trials on sweetpotato cultivars
- Control of host plants and weeds
- Herbicides for volunteer control
- Long term farming systems trial (Bundaberg) field walk.

Project team training

Nematology training workshops were conducted at the Biological crop protection (BCP) and DAF Ecoscineces precinct (ESP) laboratories during September and October, 2018.

- BCP laboratory, 26th and 27th of September, 2018.
- ESP laboratory, 9th of October, 2018.
- BCP laboratory, 10th of October, 2018.
- GRF practical exercise 5th of October, 2018.

Workshops encompassed the following activities:

- Preparation of suspensions containing known numbers of nematode eggs;
- Extraction of nematode eggs from root galls, preparation of galled-root inoculum for use in field trials;
- Culturing of reniform nematode, root-lesion nematode and other plant-parasitic nematodes;
- Setting up bioassays to assess a soil's suppressiveness to nematodes;
- Extraction nematodes using the Whitehead tray method;
- Identification and counting of RKN in field samples.
- Maintenance of pure cultures of 2 RKN species, M. incognita and M. javanica
- CO2 measurements
- inoculation of pots with eggs or juveniles for pathogenicity bioassays
- Identification and culture of nematode trapping fungi and bacteria
- Extraction of microarthropods from soil samples

A seminar was held at ESP in December 2018 for visiting nematologists from Louisiana State University, Prof. Charles Overstreet and Prof. Ed McGawley, who both have extensive experience with reniform and root-knot nematode. The project team also accompanied the visitors to the Cudgen trial site (now managed by BCP) and visited a number of sweetpotato farms in the Cudgen area form the 16th to the 18th of December, 2018.

Plans for intensive surveys in place

Plans for intensive surveys were developed to sample a representative group of fields, both pre-plant and post-harvest. Surveys have been completed in central Qld and Cudgen, with a handful of surveys to be conducted during the next few weeks in far north Qld and Bundaberg. Information on each field's soil type and previous cropping history has been collected and will be used to assess the impact of these factors on nematode occurrence and population density.

Over 90 survey samples have been processed by DAF nematology team as well as a smaller number of diagnostic samples. Plant-parasitic nematodes were extracted, identified and quantified from all samples and results standardised per 200 grams of dry weight equivalent soil. Free-living nematodes were also identified to give an overall indication of the soil's biological status. 73 soil samples have been sent to SARDI for molecular identification of root-knot nematode. 44 samples have been tested and once all initial survey samples have been collected SARDI will process the remaining samples.

Initial survey results

- Root-knot nematode *(Meloidogyne* spp) are by far the most important nematode pest of sweetpotato. It was recorded in all regions and in the Bundaberg and Cudgen regions it was the nematode recorded in the highest numbers and with the greatest frequency
- *Rotylenchulus reniformis* was recorded in a few fields in Central Queensland and Bundaberg and poses a serious threat. There has been a new detection South East Queensland, a long way from its known geographic distribution. This nematode has not been found in Cudgen or the Atherton Tablelands to date
- *Pratylenchus zeae* was the most common lesion nematodes detected. It has been recorded in high numbers in one field in Cudgen. Need to assess its effects on sweetpotato varieties
- Spiral nematodes were relatively common, but are not a cause for concern as they have little impact on root growth
- *Rotylenchulus parvus* is in relatively low numbers suggesting sweetpotato is not a good host. Not detected in Central Queensland to date, but is a common nematode in other regions
- Stubby, stunt, ring and dagger nematodes were recorded in low populations also suggesting sweetpotato is not a good host of these nematodes.

SARDI molecular identification of *Meloidogyne* spp.

- In the Bundaberg region *M. javanica* is the most dominant species identified from 12 of 23 sites tested to date, with *M. incognita* identified from 3 of 23 sites and *M. arenaria* identified from 1 of 23 sites
- In the Cudgen region *M. javanica* was identified from 2 of 11 sites tested to date, with *M. incognita* identified from 3 of 11 sites and *M. hapla* identified from 5 of 11 sites
- In the Central Queensland region *M. javanica* was identified from 7 of 7 sites tested to
- In the South East Queensland region *M. hapla* was identified from 3 of 6 sites tested to date

Biosecurity issues

- On farm biosecurity to stop the spread of any plant-parasitic nematodes to fields that may potentially be free from nematode pests of sweetpotato. Measure include clean farm equipment, personal equipment, and clean planting material to stop the movement of potentially contaminated soil.
- Potential spread of *Rotylenchulus reniformis* from its known geographic distribution as this nematode is a known constraint to sweetpotato production in the US

Soil testing of survey samples

The survey samples are also being measured for parameters (e.g. total organic carbon, CO_2 respiration). Soil samples collected during surveys of grower properties have been sent to the Department of Environment and Science (DES), Chemistry Centre at ESP for analysis of a suite of characteristics to investigate any correlation with nematode populations and grower practices.

These samples have also been tested at GRF using the commercially available Solvita® CO_2 burst test kit. CO_2 respiration is an indication of soil microbial activity and thus potentially overall soil health. To date 37 samples have been tested from Bundaberg, 16 from Cudgen NSW, 7 from Central Queensland, 6 from South East Queensland and 2 from the Atherton Tablelands. There have been some issues associated with repeatability of data and this has resulted in the Solvita Digital Colour Reader (DCR) being returned

to the manufacturer for replacement. A selection of samples will be re-tested to ensure integrity of the data already obtained and further testing carried out as required.

In August 2019, soil samples were collected from the long-term trial at BRF and sent to DES for analysis. They will also be tested for CO2 respiration when the Solvita DCR is returned.

Outputs

- Subcontract with Biological crop protection signed and work completed
- Two PRG meetings
- Electronic grower update, June 2019
- Four masterclasses held in Cudgen on the 4th of March, 2019, in Bundaberg on the 6th and 7th of March and in Atherton (Kairi) on the 14th of March, 2019.
- Masterclass handbook developed for sweetpotato growers
- 11 sweetpotato fact sheets produced and distributed to growers
- Project update: presentation for sweetpotato SIAP members, Brisbane, March 2019
- Two project updates and field walks for sweetpotato growers and associated industries
- Draft document – Registered herbicides to control ipomoea species
- Draft document – Potentially suitable cover/rotation crops for sweetpotato farm systems
- Over 90 soil samples processed by DAF nematology group
- 44 soil samples tested by SARDI
- Over 40 individual sweetpotato growers surveyed
- A Lucid key developed in conjunction with Banana research projects is available to growers to select suitable nematode resistant cover crops, website constantly updated. https://keys.lucidcentral.org/keys/v3/crop_rotation_plant_parasitic_nematodes

Outcomes

- Project technical advisory panel running efficiently
- Project team trained in nematology techniques
- Increased grower knowledge on available nematode control options
- Increased grower knowledge on the importance of maintaining healthy soils for enhanced nematode suppressiveness and long term sustainability.
- Fact sheets available
- Knowledge on nematode species occurring in sweetpotato growing regions

Issues and risks

There are no apparent major issues or risks at this time. Management procedures for lesser risks are attached
(Attachment 1).

Other information

Below is a brief summary of additional activities conducted to date additional to milestone 103 requirements. These will be reported in detail as part of future milestone reports when results have been collated.

Contracts

The subcontracts with Biological crop protection and CQU have been signed. Biological crop protection has fulfilled all milestone obligations and has received their final payment. The subcontract with ASPG is awaiting signing on return to work of their secretary. The subcontract with USQ is awaiting approval for USQ.

Pathogenicity

Varieties of sweetpotato (Beauregard, Bellevue and Orleans) were inoculated with three species of

lesion nematodes (*Pratylenchus brachyurus*, P. *coffeae* and *P. zeae*) to determine the host status of these cultivars. Pathogenicity was determined by comparing root and shoot weight (total plant weight) and nematode abundance compared with un-inoculated sweetpotato plants.

Initial results indicate that the three Pratylenchus species caused no reduction in any of the measured plant parameters and failed to reproduce on sweetpotato roots.

Host range experiments – Root-knot nematode

Resistance to root-knot nematode 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 nematodes (initial population density Pi), measuring final population density (Pf) and then making the following calculation: Multiplication Factor (MF) = Pf/Pi.

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 for both *M. incognita* and *M. javanica.*

Table 1 Resistance categories

Multiplication factors	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)

Cultivars of *Brassica* spp. (Black Jack, BQ mulch, Nemat, Terranova and Tillage radish) were inoculated with two species of root-knot nematodes (*Meloidogyne incognita* and *M. javanica*) to determine the host status of these cultivars. Initial results indicate that cultivars Black Jack and Terranova showed some resistance to *M. incognita* while no cultivars tested showed resistance to *M. javanica*.

Varieties of sweetpotato (Beauregard, Bellevue and Orleans) were inoculated with two species of root-knot nematodes (*Meloidogyne incognita* and *M. javanica*) to determine the host status of these cultivars. Initial results indicate that Bellevue displayed some resistance to *M. incognita* while all other varieties tested were susceptible to both *M. incognita* and *M. javanica.*

Long term farming systems trial

A long-term farming systems trial has been established at Bundaberg research facility. The aim of the trial is to investigate if it is possible to grow sweetpotatoes in a manner that uses integrated management to minimise losses to plant-parasitic nematodes and improve biological soil health. Practices that will be included during the course of the trial include rotation crops, reduced tillage, traffic control and organic amendments. Various combinations of these practices will be trialed with regular monitoring of nematode populations, other soil/biological characteristics as well as yield data.

The trial block is subdivided into two trials:

1. Extensive Trial
    - Three SP crops in 5 years with longer rotation breaks
    - 40 plots (10 treatments X 4 reps)
    - Combinations of organic amendments vs Vydate vs no amendment
    - Early bed formation (soon after harvest)
    - Amendments incorporated at early bed formation (in a band), in a furrow prior to planting, or both
    - Rotations sprayed out or cut/mulched

2. Intensive Trial

- Four SP crops in 5 years with shorter rotation breaks
- 25 plots (5 treatments X 5 reps)
- Combinations of organic amendments vs Nimitz vs no amendment
- Organic matter/compost incorporated at bed formation or in a furrow prior to planting
- Rotations also incorporated at bed formation

Meloidogyne javanica was introduced to the trial block via transplanted infested tomato seedlings and in late November 2018. A sacrificial sweetpotato crop to increase the nematode populations was planted at the same with extra inoculum in the form of chopped infested tomato roots added under each vine. The sacrificial crop was harvested in May and any remaining crop material (potential volunteers) were removed mechanically and by hand. Soil samples were taken from every row and nematodes were extracted and counted. The counts showed an even distribution of root-knot nematode across the block with an average count of approximately 600 root-knot juveniles per 200 grams of dry soil.

Hills were reformed in the Extensive Trial and organic amendments in the form of sugar cane mulch and fresh chicken manure were added on May 14 at approximately 25 t/ha (each = 50 t/ha total) to the appropriate plots in a band prior to incorporation. White French Millet was sown across the trial site at 40 kg/ha on May 27 and irrigated for three hours per week.

Figure 1. Applying organic amendments to the long term farming systems trial.

Figure 2. White French Millet cover crop planted to the extensive and intensive trials.

Control of volunteers and weeds

Critical to the successful management of nematodes is the successful control of weed and volunteer storage roots.

- Most common weeds are also good hosts of RKN.
- As many weeds and volunteers as possible should be removed before rotation crops like sorghum are planted
- The only reason resistant rotations might fail is that nematodes are carried over on weeds and volunteers
- RKN can produce eggs within 3 weeks of volunteers producing roots in summer
- Two weeks later as many as 100 000 eggs on one root system
- An effective program to control volunteers is vital

Tillage is an option, but is a practice that also destroys much of the beneficial soil flora and fauna; so herbicides are the other alternative. The initial step in developing a successful herbicide management plan is to understand what resources are currently available to growers. A draft working document- *Herbicide control of sweetpotato volunteers: A working paper* has been produced.

As agronomically the emphasis is on growing sweetpotato, not killing them; there are no herbicides specifically registered for sweetpotato control. This working paper lists all the herbicides currently registered for control of *Ipomoea* species (of which sweetpotato is a member). As herbicide resistance is becoming an increasingly important issue in the agriculture sector, the document lists herbicides

first by their Mode of Action, with a brief explanation of the mode of action. (11 mode of action groups and 7 combination groups). The herbicides are then listed alphabetically by their chemical formulations (105 chemical formulations) and then by trade names (612 label names). The working paper also provides information on whether the chemical is systemic or contact and lists considerations about the herbicides use.

Survey of current grower practices

Running parallel with the nematode population surveys, a second survey is collecting information on current grower practices. As with the population surveys, grower practice surveys have been completed in central Qld and Cudgen, with only a handful of surveys to be conducted during the next few weeks in far north Qld and Bundaberg.

Appendices

Appendix 1. Masterclass feedback

Masterclass feedback
Feedback indicated that 80% rated the event as excellent quality, 20% rated it as good quality.
84% said the event was highly relevant to their business and 18% said the event was mostly relevant.
A summary of participant answers to the question "What did you like most about the masterclasses" is listed below:

- The combination of both theory and practical was most beneficial
- Heaps of information and knowledge on how to improve our crops and farming practices
- Showing things that can be implemented in our business
- Engaging, well thought out explanation of scientific terms, loved the microscopes and samples.
- Relevant to problems and issues to date and into the future
- The team are so excited about nematodes it's easier to take in information when the presenters are so keen
- Depth of information, plenty of trial results to verify, visually seeing everything in the microscopes
- New information and ideas for me.
- Hands on displays
- Well-presented easy to understand and I really like the microscopes.

When participants were asked how they thought the masterclasses could be improved they said:

- Couldn't think of anything, and I have a low tolerance
- Nothing, concepts and practical displays are the most retained when learning
- Probably just introduce some information on wireworms and other alternatives to Lorsban and Talstar
- Need more time to incorporate other aspects such as varieties of rotation crops?
- Nothing, perfect
- Probably showing economic loss by nematode and compare them with economic invested in soil amendments.
- Tillage options
- No improvement recommended
- Very good day one of the best
- Field visit, to look at soil texture with improved organic matter

When asked what they would like to learn about and why growers responded with the following:

- SARDI - services and costs
- Susceptibility of rotation crops to nematode types and other crops for biofumigation and green manuring and mulching.
- More about wireworm, false wireworm and other sweetpotato related pests.
- How to minimise chemical control of nematode
- The use of biologicals to control pests in sweetpotato.
- Soil health because there is lots to learn and it's so important
- Organic amendments
- I will be trying to find out a lot more about fungi in the soil.
- Cover crops, find a winter cover crop that can be used on our farm.
- Interested how I can introduce minimal till into sweetpotato growing.
- The impact that the minimal till would have on other pests in the soil that affect sweetpotato

The responses to the question "Do you intend making changes to any aspects of your business as a result of attending/participating in today's activity?" gave to following responses:

- Yes, try and reduce tillage and keep weed population down. Kill Sweetpotato volunteers better, try to add more cover crop, and try to add organic amendments.
- Yes, cover crops
- Yes, we are going to introduce green manure crops into our farming system and not just by using one species by using multiple species. Look at using chicken manure products in the farming system as well.
- Going to try, all suggestions come at costs to a product that doesn't sell well at the moment. Plus some land rotation issues.
- Do some of my own trials and experiments
- Yes concentrate more soil health
- Would like to plant cover crop into mounted beds instead of flat ground, less tillage.
- Taking away the skills and information learned on the day.
- Yes, probably try and get hold of more carbon sources.
- Possible means to reduce weed and volunteer, regrowth after harvesting without too much tillage
- A lot more reading about what's under the ground, how it all works.
- Will continue to evolve our system , to reduce tillage and increase carbon
- Possibly need to see what will work on our farm.
- Reinforcing existing ideas gives us confidence to keep trying new ideas.
- Yes more trials, plenty of new and old information. Great presentation by all people, has made me think a lot more about how we can manage our soils.

Appendix 2. Initial surveys

Initial survey preliminary results

Table 1. Average number of plant-parasitic and free living nematodes / 200 g dry soil (68 samples processed by DAF nematology team) with positive sites for each species appearing in brackets beside the average count for that species

Species	Bundaberg (n=37)	Cudgen (n=16)	South East Queensland (n=6)	Central Queensland (n=7)	Tablelands (n=2)
Meloidogyne spp. (Root-knot nematode)	289 (21)	297 (14)	8 (2)	98 (7)	1 (1)
Rotylenchulus reniformis (Reniform nematode)	29 (2)	0	53 (1)	265 (4)	0
Pratylenchus sp. (Lesion nematode)	49 (20)	32 (4)	28 (4)	33 (4)	13 (2)
Helicotylenchus dihystera (Spiral nematode)	215 (27)	133 (15)	16 (5)	31 (5)	0
Rotylenchus brevicaudatus (Spiral nematode)	224 (11)	0	16 (2)	24 (1)	0
Paratrichodorus sp. (Stubby root nematode)	18 (13)	3 (5)	3 (4)	4 (3)	0
Rotylenchulus parvus (Reniform nematode)	109 (16)	47 (2)	59 (4)	0	5 (2)
Tylenchorhynchus sp. (Stunt nematode)	7 (7)	0	0	27 (1)	0
Xiphinema sp. (Dagger nematode)	59 (4)	54 (2)	0	0	0
Criconemella sp. (Ring nematode)	22 (7)	5 (3)	0	201 (2)	0
Total Free-living Nematodes	855 (37)	1439 (16)	914 (6)	711 (7)	3020 (2)

Appendix 3. Grower practice surveys

Preliminary results from growers surveyed so far suggest the following:

Do have problems with nematodes on your farm?

- Yes 58%, no 24%, occasionally 18%

Do nematicides control nematodes your farm?

- 81% stated that nematicides work efficiently for them
- 11% said they worked sometimes, 4% said they did not work and 4% said they were unsure
- 74% used a combination of treatments, 26% used a single nematicide

Do you use rotation crops?

- 89% used rotation crops, 88% said they were working against nematodes
- Block rotation times varied between 6 months and 5 years, Average 2 years.

Do you remove volunteers?

- 92% said they removed volunteers, 5% didn't, and 3% only removed them sometimes
- 31% used chemical control, 14% physical, 6% cultural, and 50% used a combination of methods to remove volunteer sweetpotatoes on their farm

Do you use nematode tests?

- 48% said no, 45% said yes, 7% said sometimes

Do you use organic amendments, GPS or minimum till?

- 46% said they used GPS, 54% had not used GPS
- 75% said they didn't use any organic amendments, 25% of growers used either mill mud, cane trash, compost or animal manures
- No growers said they used minimum till equipment

Attachments

1. Minutes of PW17001 PRG meetings February, 2019 held in Cudgen.
2. Field day invitation.
3. Field trial handout.
4. Herbicide control of sweetpotato volunteers: A working paper
5. Draft list of potentially suitable cover/rotation crops for sweetpotato farming systems

Please note: Masterclass handbook containing 11 factsheets already provided as part of MS 102.