Extension of current knowledge on nematode management

PW17001 Final report Appendix 1 Integrated pest management of nematodes in sweetpotato

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The Department of Agriculture and Fisheries proudly acknowledges all First Nations peoples (Aboriginal peoples and Torres Strait Islanders) and the Traditional Owners and Custodians of the country on which we live and work. We acknowledge their continuing connection to land, waters and culture and commit to ongoing reconciliation. We pay our respect to their Elders past, present and emerging.

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Introduction

Practices to reduce losses from RKN in vegetable crops are detailed in Hay and Stirling (2014) (Horticulture Australia Limited project MT09067). Little work on nematodes specific to the Australian sweetpotato cropping system had been conducted in the past. HAL project VG09052 conducted commercial scale observational trial comparing the efficacy of Vydate® L by chemigation and the soil incorporation of molasses in conjunction with best bet cover crop management strategies. The project also demonstrated Improved varietal tolerance levels to RKN under Australian conditions with two imported USA varieties, Evangeline and Bienville. (McCrystal, et al., 2014).

There was limited information on which nematode species were occurring in sweetpotato producing soils as no widescale surveys had been conducted. Information on nematode species identified as part of soil sampling within HAL project VG09052, mostly conducted at designated field trial sites would need to be collated. Limited information on nematode life cycles and population dynamics had been provided to sweetpotato growers in the past.

Sweetpotato Soil health Masterclasses

Introduction

A series of Masterclasses were conducted early in the project to extend current knowledge on nematode management in vegetable crops to sweetpotato farmers, improve grower's understanding of root-knot nematode and encourage them to develop more effective strategies for managing the pest. An important focal point of the masterclasses was to improve biological health of the soils used for sweetpotato production and to enhance natural biological mechanisms that regulate nematode populations for long term sustainability.

Methodology

The masterclasses were modelled on the successful sugar industry series which were designed to improve grower's understanding of root-knot nematode. Classes consisted of theory and group sessions along with hands-on practical sessions with a focus on interactivity, thus classes were limited to 15 to 20 participants A second focus was the introduction of existing farm practices to reduce losses from RKN in vegetable crops and detailed discussions on soil Health, soil biology and integrated pest management.

The masterclasses incorporated the below key topics:

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

Results and discussion

51 growers and stakeholders attended one of 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. 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. 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.

Masterclass handbook

Attendees were presented with information on RKN management in vegetable crops and damage caused to sweetpotato and a 92 page handbook 'Sweetpotato Masterclass – Soil health and Integrated nematode management' developed for the workshop. This can be found as appendix 1.

As part of the masterclasses, and extension of current knowledge on nematodes, eleven fact sheets wre developed to provide sweetpotato growers with information on the topics discussed in the classes. Titles are listed below. The factsheets are included in the Sweetpotato masterclass handbook in attachment 1.

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

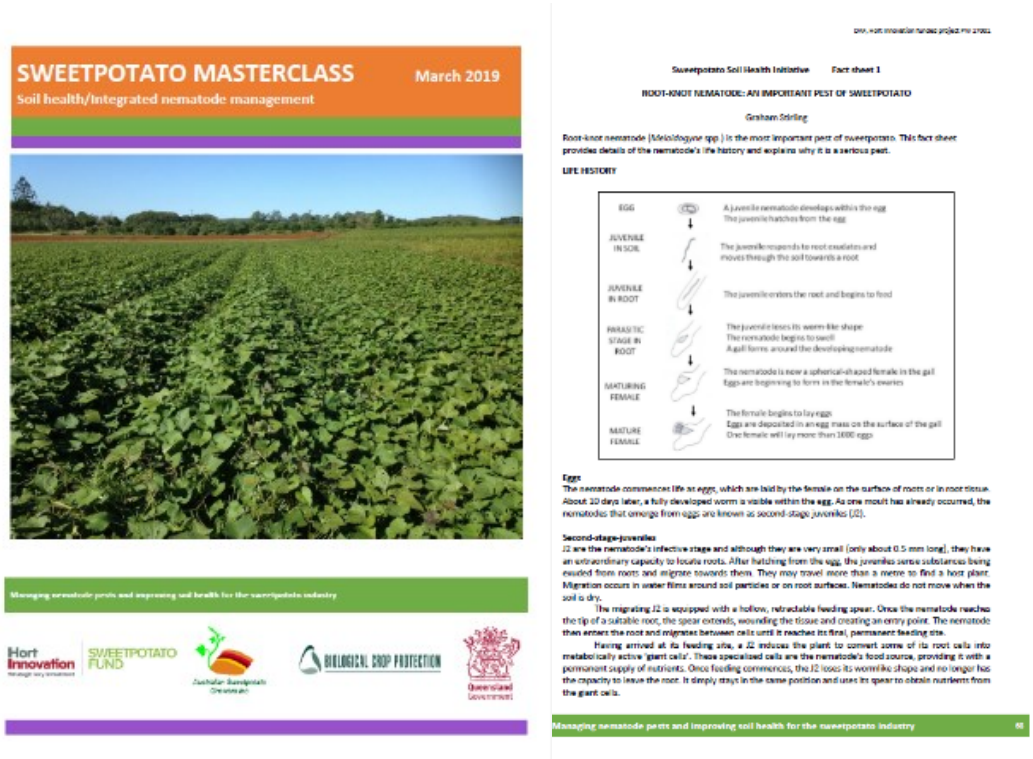

Image 1 Left, Sweetpotato masterclass handbook (92 pages).Right Fact sheet 1, Root-Knot nematodes.

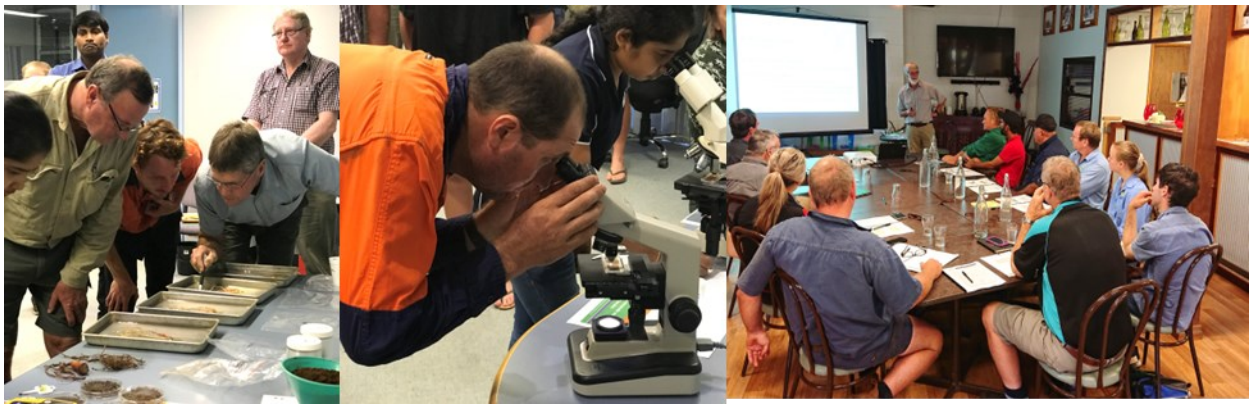

Image 2 Left, Growers view roots galls, nematodes under the microscope (centre) and discuss sustainable management options in Kairi (Right).

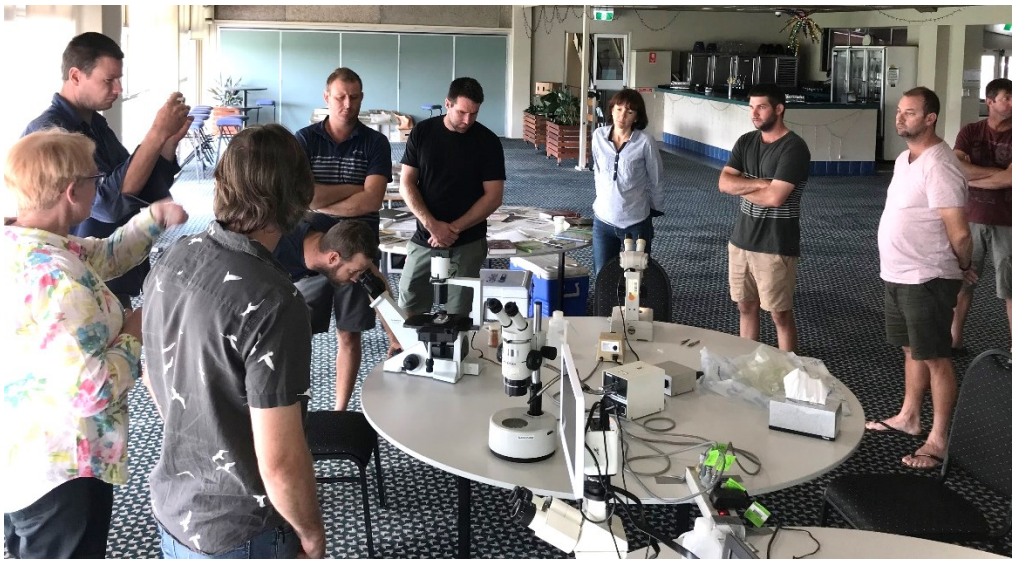

Image 3 Growers discuss the soil biome and microarthropods in Cudgen.

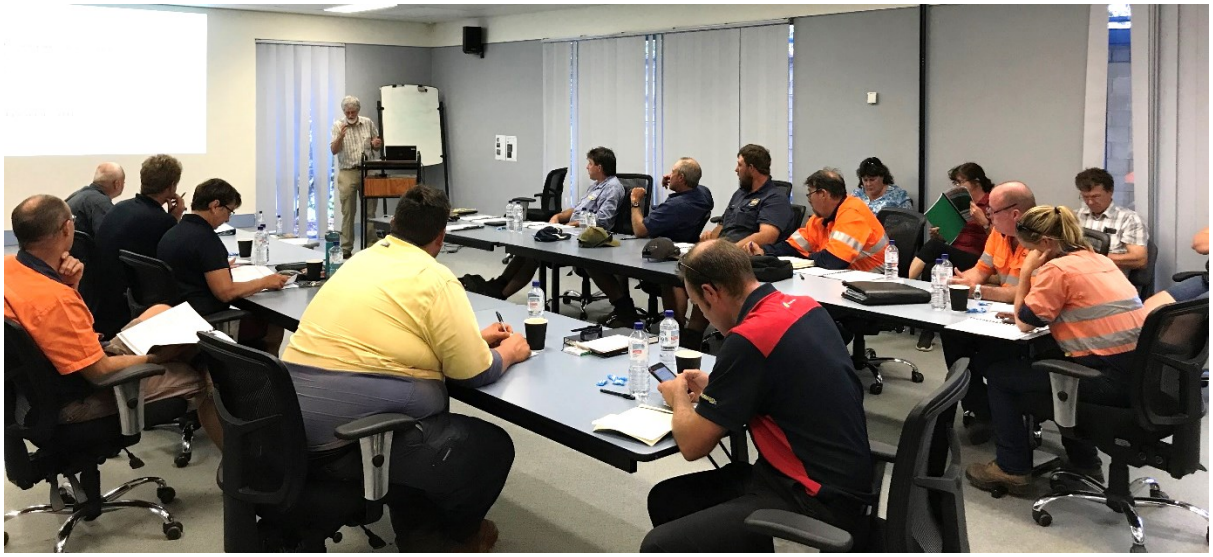

Image 4 Growers in Bundaberg are presented with information on organic amendments in Bundaberg by Dr Grahame Stirling.

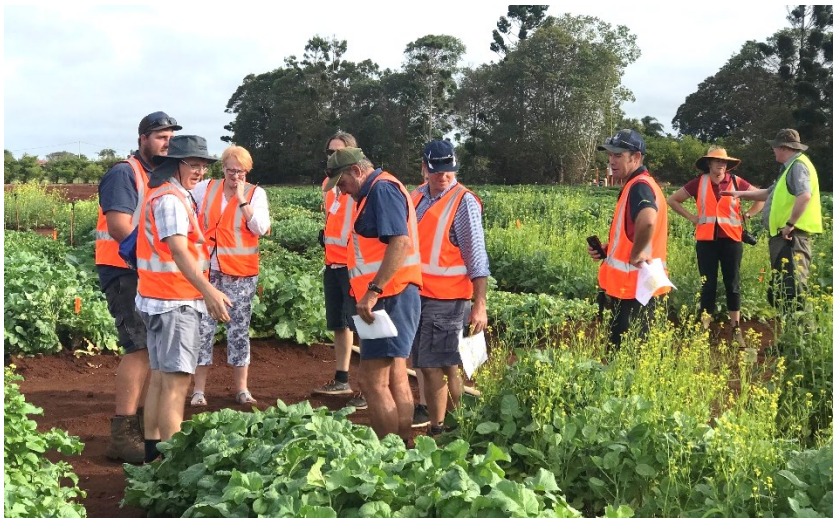

Image 5 The Bundaberg workshops concluded with a field walk by John Duff (DAF) at Bundaberg Research Facility to view potential rotation crops.

Nematology skills transfer

Introduction

Early in the project, a nematology training workshop was conducted to extend knowledge and understanding within the project team. Of particular relevance to DAF sweetpotato researchers were techniques such as collection of soil for nematode identification, sampling protocols, storage and transport of samples, preparation of galled-root inoculum for use in field trials and setting up of pot rials, inoculation and bioassays to assess a soil's suppressiveness to nematodes.

Methodology

Training sessions were designed to encompass theoretical and practical aspects of the below topics:

- Maintenance of RKN inoculum
- 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 using Solvita™
- 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

Results and discussion

Nematology training workshops were conducted at the Biological crop protection (BCP) laboratory, 26th and 27th of September and 10th of October 2018 and at DAF Ecoscineces precinct (ESP) 9th of October, 2018. An additional practical exercise was conducted at Gatton Research facility (GRF) on the 5th of October 2018. Training sessions were delivered by Graham Stirling (biological crop protection) and DAF nematology staff Jennifer Cobon and Wayne O'Neill. New DAF, nematology staff (1), the DAF sweetpotato team members (6), one Central Queensland University (CQU) technician gained knowledge on infield soil sampling protocols and an understanding of the nematode extraction process.

A seminar was held at DAF Ecosciences precinct (ESP) in December 2018 for visiting nematologists from Louisiana State University, Prof. Charles Overstreet and Prof. Ed McGawley, both of whom have extensive

experience with Reniform and Root-Knot nematode. The project team facilitated farm visits to a number of sweetpotato farms in the Cudgen (NSW) area and a soil health trial site (managed by BCP) from the 16th to the 18th of December 2018.

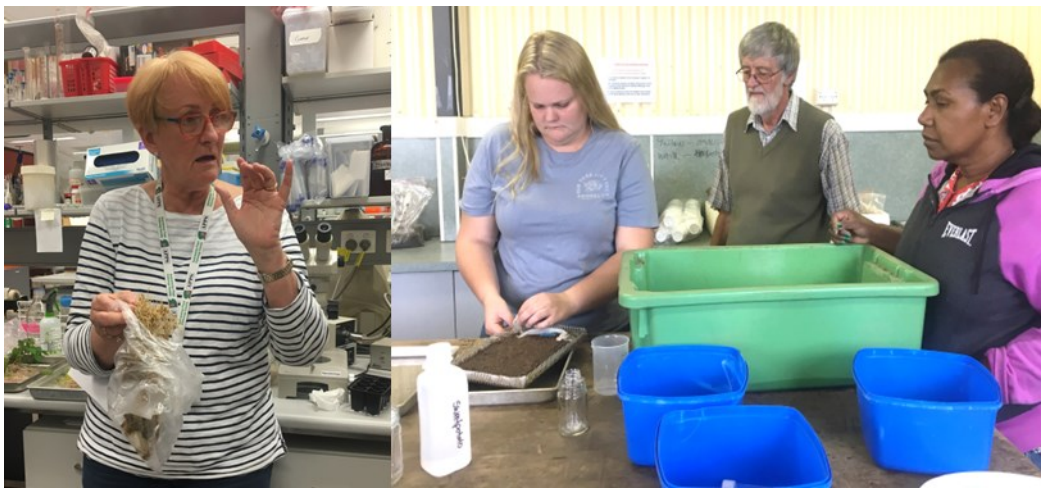

Image 6 Left, DAF nematology expert Jennifer Cobon explains the process to extract nematode eggs from infested roots. Right, DAF sweetpotato team staff Emma Coleman and Jean Bobby conduct a nematode extraction supervised by Dr Graham Stirling at Gatton Research Facility.

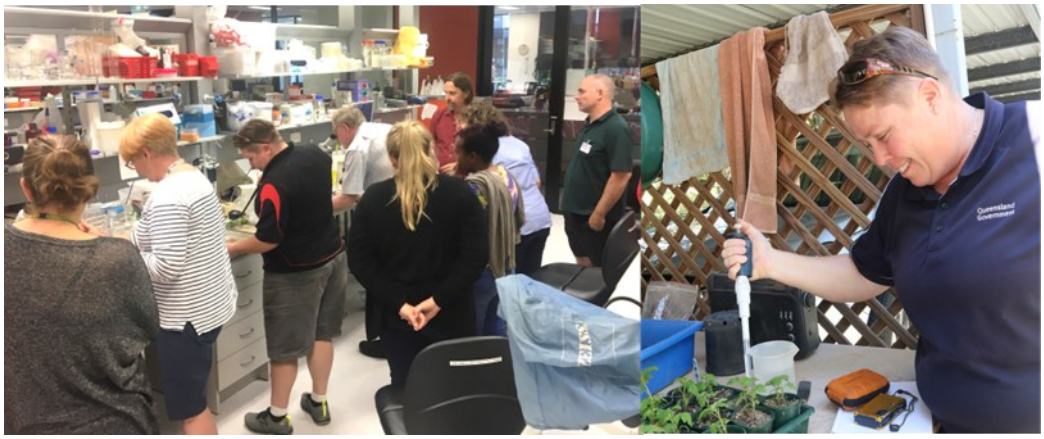

Image 7 Left, Jennifer Cobon instructs the group on nematode identification. Right, Rachael Langenbaker inoculates tomato host plants with nematode eggs at the Biological Crop Protection laboratory.

Survey of current grower practices

Introduction

Running parallel with the initial nematode surveys, a second survey was conducted to collect information on current on farm production and pest control practices. These surveys were completed throughout the major sweetpotato cropping regions of Wide Bay, northern NSW, Central Queensland, Southeast Queensland and Far north Queensland.

Methodology

A survey was designed to capture current grower practices in relation to sweet potato production, with a focus on nematode control, cover crops and soil health. The survey collected data on; Soil type, area and varieties of sweetpotatoes grown, planting density, row spacing, crop losses due to nematodes, time of year, nematicides

applied, rates used, effectiveness, rotation crops, timing of rotations, machinery used, GPS, minimum till, volunteer control, s chemicals used and use of nematode testing services pre plant?

Results and discussion

Over 40 on farm surveys were conducted from October 2019 to August 2019. Block rotation times varied between 6 months and 5 years, with an average of 2 years. When asked about the methods used to control volunteers, 31% said used chemical control, 14% physical control methods, 6% used cultural control methods and 50% of growers surveyed used a combination of methods on their farm. Growers that had used strip till equipment reported that it was not suitable for use during planting of sweetpotato cuttings due to cover crop residues causing machinery blockages due to the level of soil moisture required at planting. Later follow up growers using cover crops in wet years bad lesions. Zunker soil health cover crops but some susceptible.

Table 1 List Responses to survey questions (per cent of responses from total growers surveyed).

Question	Yes	Sometimes /occasionally	No	Unsure
Do nematodes cause losses on your farm?	58	24	18	
Are currently registered nematicides effective?	81	12	4	4
Would you conduct pre plant nematode tests if they were readily accessible and affordable?	71	11	18	
Do you use rotation crops?	89		11	
Do your rotation crops assist in nematode control?	88		12	
Do you remove volunteers?	92	3	5	
Do you use any organic amendments?	25		75	
Do you use GPS?	46		54	
Do you use chemicals to control volunteers?	31			

Current knowledge of nematode species occurring in sweetpotato production soils - collation of historical data

Introduction

There was limited information on which nematode species were occurring in Australian sweetpotato producing soils as no widescale surveys had been previously undertaken. Information on nematode species identified as part HAL project VG09052 (McCrystal, et al., 2014), were mostly from samples collected at designated nematicide field trial sites and variety evaluation trials as part of HAL project VG13004 (Dennien et. Al., 2014). Prior to commencing the initial sweetpotato nematode surveys under this project, historical results from samples collected to 2013 were collated to provide information on which nematode species had been detected.

Methodology

Between April 2010 and August 2013, 500 sweetpotato soil samples were received at the DAF Nematology Diagnostic Laboratory. Information on the location of where some of the samples were collected was not often provided to the laboratory. Many of these samples were field trial samples which meant that it was difficult for the nematologists to draw conclusions from this data.

Results and discussion

Where location information was available, 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.