Grower Summary

CP 115

Enhancing the soil food web to control soil dwelling pests of field vegetables

Annual 2015

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Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.
Before using all pesticides check the approval status and conditions of use.
Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the AHDB Horticulture office (hort.info.@ahdb.org.uk), quoting your AHDB Horticulture number, alternatively contact AHDB Horticulture at the address below.

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Contents

HEADLINE

To increase the potential for natural regulation of cabbage root fly, identification of beneficial agronomic practices can potentially help reduce costly protection inputs in brassica fields.

Background

With changing EU legislation and consumer pressure leading to a reduction in pesticide availability, new sustainable strategies are urgently needed to control damaging field vegetable pests. The current tools available to fight cabbage root fly are unfortunately regularly failing growers and AHDB Horticulture is actively involved in the search for new strategies to reduce the impacts of this serious pest of brassica crops. This 4 year studentship, in collaboration with Teagasc (Ireland), is specifically looking at how soil management can impact cabbage root fly survival and if agronomic practices leading to better soil suppression of cabbage root fly can be identified.

Cabbage root fly is still a problem

The cabbage root fly (Delia radicum) is a very serious pest of brassica crops. The adults are equipped with finely tuned senses to find brassica plants (wild or crop) and move through large swathes of landscape easily. The eggs laid around the stem of the plant hatch to produce the damaging part of the lifecycle of the fly, a small white grub that is able to feed on a very wide range of hosts. Feeding results in serious root damage that can lead to wilting and plant death on young brassica plugs, or reduced marketable yield on more mature plants. With up to three damaging generations a year, cabbage root fly requires pest management solutions over the entire growing season.

The most commonly used pesticide to fight the cabbage root fly (chlorpyrifos) is at risk, as it is under European legislation review and its future is still uncertain. Tracer (spinosad) is a likely candidate to replace chlorpyrifos as it has proven its efficacy, but is still costly and often does not perform as well to control damage on the lower stem area (between the module and the soil surface). Other products are also currently being tested, after being identified through SCEPTRE (FV416b) but no timeline is available, and those products might not be available on the market quickly. It has also been noticed by growers than pre-planting modular drenches are not enough to fight three generations a year, as recently seen in overwintering cabbages in Cornwall.

Mesh protection is widely used by growers, as it is the only line of defence available for root brassicas. It is still costly and can also trap overwintering fly populations emerging from wild brassica weeds in previous crops, resulting in heavy damage, as recently seen in Fife. The mesh does exclude further egg laying, however, it also excludes beneficial predators and parasitoids that could help reduce damage. It has also been noticed that because of dew accumulated on the mesh, eggs laid on the top of the mesh can hatch and young larvae can make their way down through the mesh towards brassica roots to start feeding.

Why look at soil management in Integrated Pest Management?

Soil is a complex system that we have barely started to explore and understand. It sustains so many essential functions for human life that increasing our knowledge is essential to better manage its wide range of services. The FAO has declared 2015 the International Year of Soil,

demonstrating international recognition of the importance of this non-renewable resource that needs to be carefully managed (www.fao.org/soils-2015).

Healthy soils are at the heart of productive horticulture cropping systems. AHDB Horticulture project CP 107 helped to identify gaps in the knowledge of horticulture soil management and subsequently two further soil focussed projects are currently being funded, one on precision farming technologies and soil assessment (CP107a) and another on soil health (CP107b), demonstrating further commitment to expending knowledge on soil management in horticulture.

As soil is the source of numerous diseases and pests, soil management should be an integral part of IPM. But it also supports a wide range of beneficial organisms that can help regulate pests and diseases. Soil suppressiveness studies are being carried out to test the potential of management choices to influence the capacity of the soil to reduce negative impacts of bacterial and fungal diseases, as well as plant parasitic nematodes. Results of published studies are encouraging and significant correlations are found between several soil characteristics and suppressiveness of some soil borne pathogens.

Insect pest regulation involves a different community of soil organisms than plant pathogen suppression. Specific bacteria, nematodes, fungi and mites and also on a larger scale predators and parasitoids all have the potential to be part of a wide community of soil antagonists playing a part in reducing the impacts of insect pests on commercial crops. As soil management does impact this wide antagonist community, it is important to understand the impact of different management, to possibly identify best practice and help growers boost the natural regulation of insect pests in their fields. In studying soil management impacts on natural regulation of the cabbage root fly, this project will help determine how to make healthy soil work harder, helping natural pest regulation and hopefully contributing to reducing costly inputs and physical barriers failure.

SUMMARY

Project set up

The aim of the project is to assess cabbage root fly success and survival under different conditions and investigate if organic and conventional agronomic practices influence its natural regulation. The project consists of different complementary elements. Providing the backbone of the project, field monitoring is carried out in two long term experimental rotations, one belonging to Teagasc in Kinsealy in the north of Dublin (Figure 2) where broccoli is grown and the other at Nafferton farm, which is part of Newcastle University, where cabbages are grown. Both sites were set up to compare impacts of organic versus conventional management. Soils sampled from those sites are then used for further experimentation in greenhouse and laboratory conditions. Exclusion experiments are also carried out on those sites using mesh cages to limit the numbers of factors influencing fly survival.

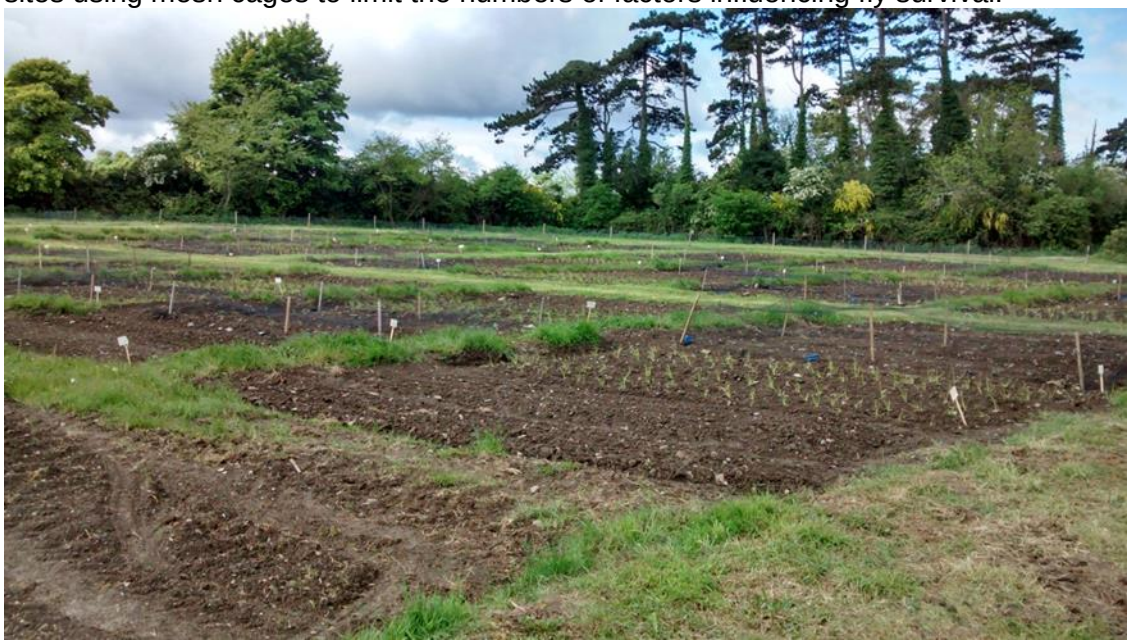

Figure 2 - Teagasc site in Kinsealy, Ireland

Field monitoring: soil fertility and variety choice impact egg numbers, as well as damage score on the crop

In order to understand the dynamics of the local cabbage root fly population, different elements regarding the fly are monitored on both sites. These include cabbage root fly egg numbers, pupae numbers and predator diversity in conventional and organic systems. Differences in broccoli variety susceptibility to cabbage root fly have been found, and there are some differences in damage depending on organic or conventionally grown crops. Collection of data and analyses are ongoing, and full conclusions will be obtained towards the end of the project.

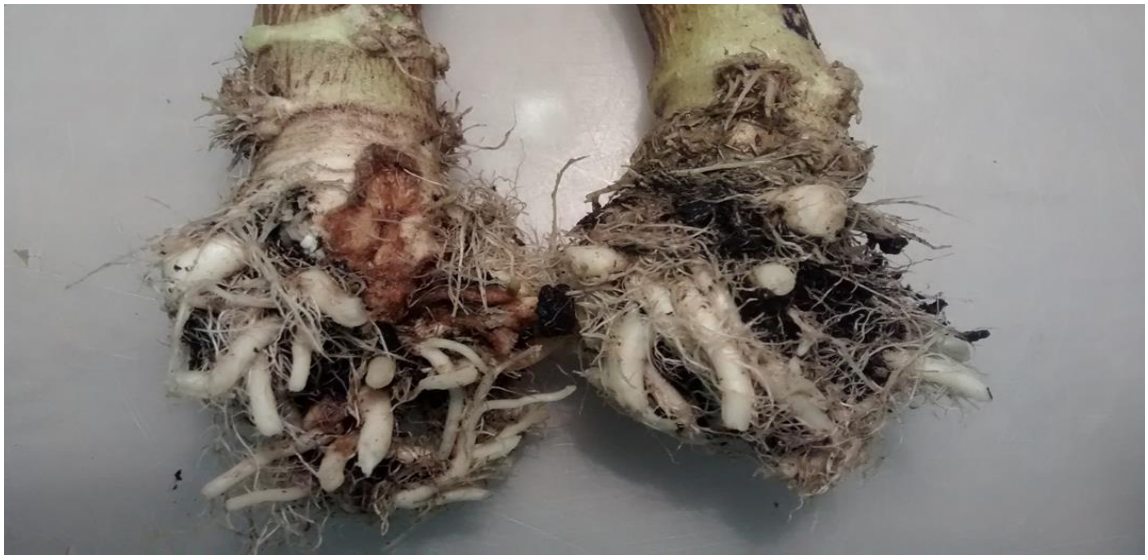

Figure 3 - example of undamaged (left) and damaged broccoli roots and stems

Field experiment: exclusion cages could reveal if organic soil and its soil microbiota suppress cabbage root fly

This year in Kinsealy, exclusion cages were set up to test the survival of the flies without the influence of predators of parasitoids. The trial is currently being assessed for pupae numbers. If the egg/pupae ratio differs between soils and varieties, this would give an indication of an increased suppression of the pest.

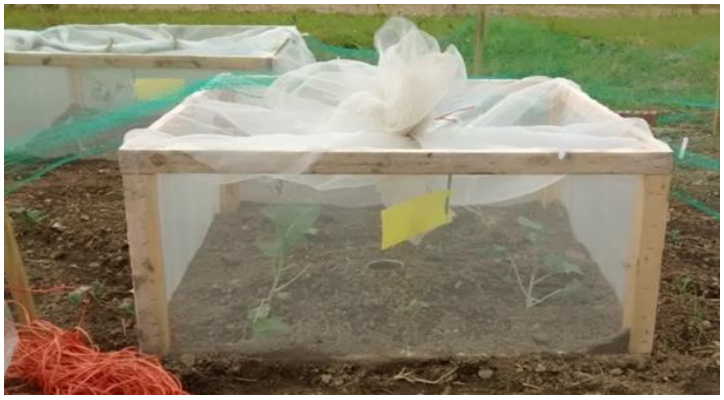

Figure 4 - exclusion experiment field cages

Figure 5- Predatory beetles caught on sticky trap (Staphylinidae)

Greenhouse experiment: does the fly fair better in organic or conventional soil or on one of the varieties?

Similar to the field experiment, fly survival and success is being tested in greenhouse conditions, without the impact of predators and parasitoids. Soils from the field are processed then used to grow Belstar and Fiesta broccolis in controlled conditions. Half of the plants are then inoculated with eggs freshly collected from our cabbage root fly culture (Figure 6). Plants and larvae are then left to develop and a month later all plants are destructively sampled to assess cabbage root fly success and subsequent damage on the plants.

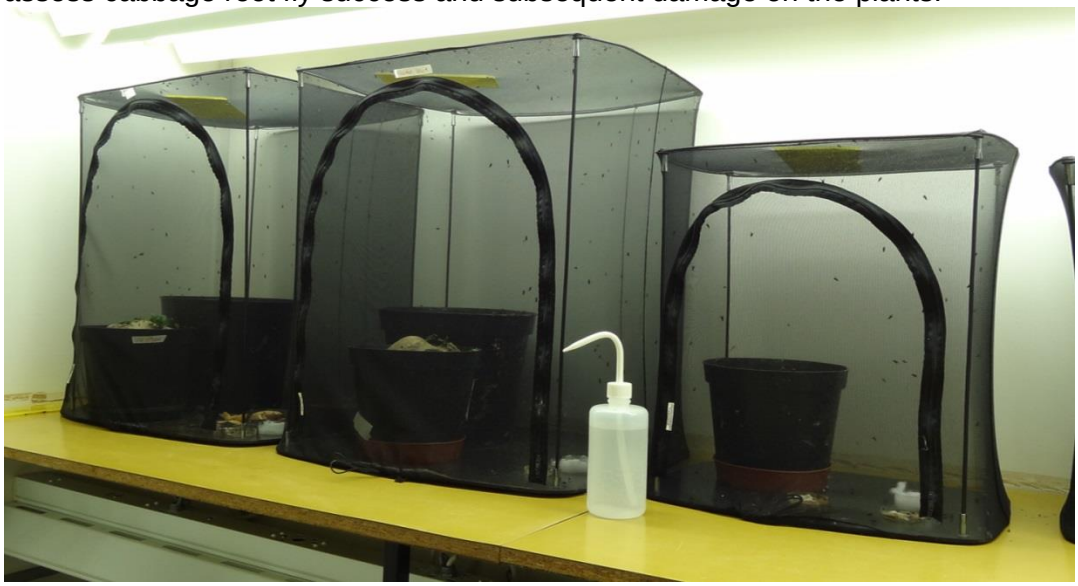

Figure 1 - cabbage root fly culture in Edinburgh

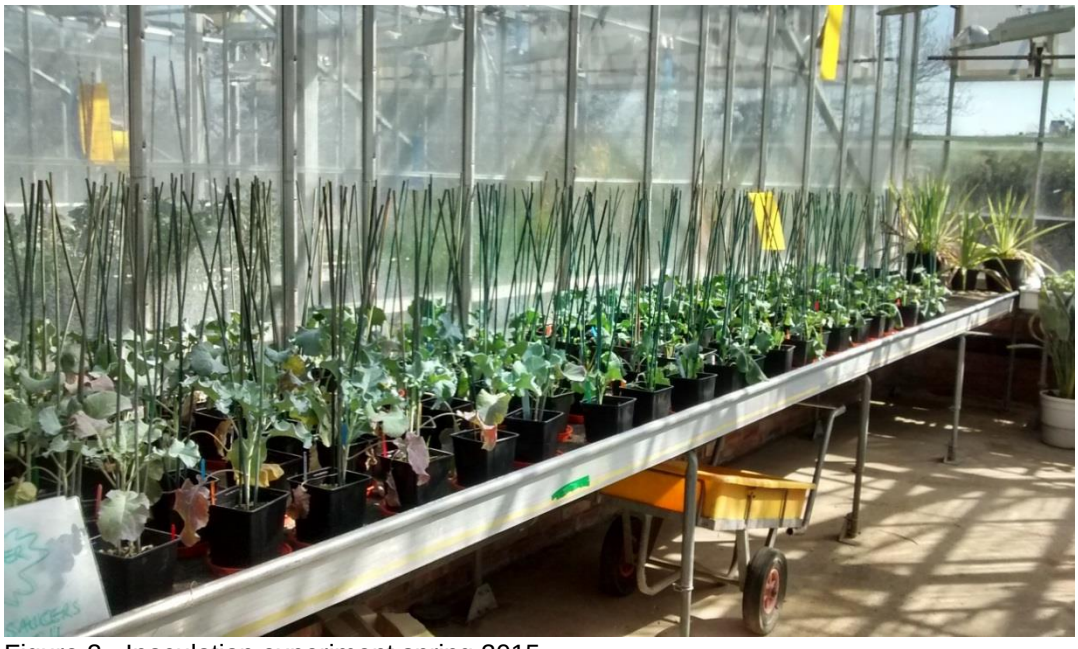

Figure 2 - Inoculation experiment spring 2015

Laboratory investigations: agronomic practices impact soil parameters and potentially naturally present insect pathogens

The last element of the project concerns agronomic practice impacts on the soil itself. Chosen parameters such as pH or total carbon are measured in order to compare the impacts of the different practices on the soil, informing on how the soil as habitat might differ between practices.

Focussing more on direct fly natural regulation, the presence of soil entomopathogens such as nematodes or fungi is being assessed in the different soils. Kinsealy soil baiting has revealed the presence of naturally occurring pathogens known to impact cabbage root fly, namely *Metarhizium* fungi species (Figure 8 and 9) and potentially *Steinernema* nematodes species (Figure 10 and 11), both available commercially as formulated biocontrol products. Baiting will be repeated with improved methods to help better pathogens identification and mortality assessment.

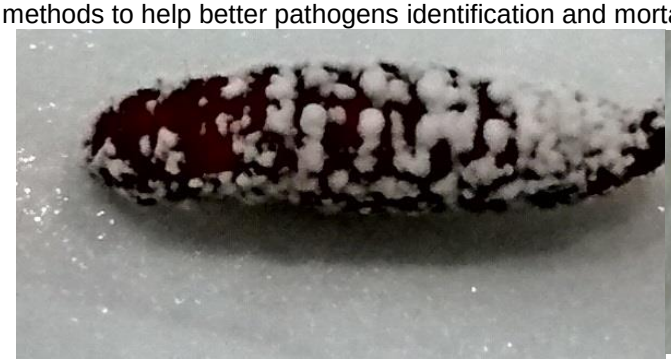

Figure 3 - wax moth larva infected with Metarhizium fungi (early stage)

Figure 4 - wax moth larva infected with Metarhizium fungi (later stage)

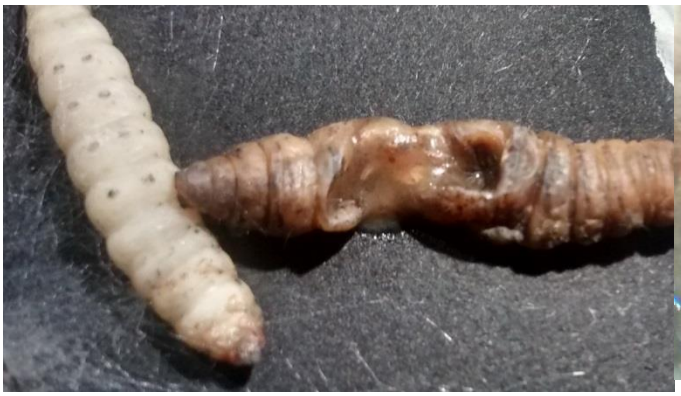

Figure 5 - healthy wax moth larva (left) and larva infected with nematodes (right)

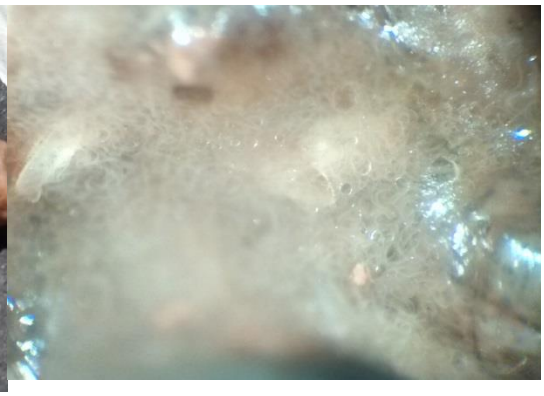

Figure 6 - nematodes infection of larva (x20)

Work carried out so far has been presented in several international conferences, such as the European Conference of Entomology (York, August 2014), PURE IPM concluding conference (Poznan, January 2015) and IOBC-WRPS IPM in field vegetables expert group meeting (Hamburg, October 2015).

Next steps for the project include the processing of remaining field samples for 2015, as well as repeated soil baiting and greenhouse inoculation experiments. Results from the following will inform which hypotheses to focus on in 2016.

Financial benefits

Financial benefits cannot be clearly identified at this point of the project. If beneficial soil management techniques can be identified, long term costs of cabbage root fly protection can be identified.

Action points

Until completion of the project no action points can be identified. Depending on completing experiments and data analysis, recommendations on agronomy such as choice of variety and choice of fertiliser could be recommended to help growers reduce the impacts of the cabbage root fly.