

Grower Summary

FV 364

Novel approaches for the
management of cabbage root fly

Annual 2012

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Before using all pesticides check the approval status and conditions of use.

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Further information

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

HDC
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

HDC is a division of the Agriculture and Horticulture Development Board.

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Project Title:	Novel approaches for the management of cabbage root fly
Project Leader:	Dr Andy Evans
Contractor:	Scottish Agricultural College James Hutton Institute
Industry Representative:	Mr Andrew Orr, East of Scotland Growers
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Headline

Research is ongoing to identify the chemicals that cabbage root fly larvae use to find calabrese roots. These chemicals will be evaluated as treatments that divert or prevent colonization of roots by cabbage root fly larvae. Other treatments are also being evaluated that can 'switch on' natural defences against cabbage root fly.

Background

Cabbage root fly is an economically important specialist insect pest of plants in the Brassicaceae family. Damage is caused by below-ground larvae feeding on plant roots. Plants can be attacked at any growth stage but the most serious damage is caused to young transplants soon after planting in the field.

Cabbage root fly control in the UK is currently reliant almost predominantly on pest forecasting (e.g. the HDC Pest Bulletin), pre-planting application of an organophosphorus insecticide (chlorpyrifos), use of crop covers (where applicable), and plant resistance. Current pesticide legislation is placing a greater emphasis on Integrated Pest Management (IPM) programmes. Under an IPM system, growers are encouraged to employ a combination of available chemical, cultural, and biological control methods in order to minimise the harmful side effects that can result from exclusive use of chemical insecticides. The ongoing review and withdrawal of several pesticides as a result of environmental, food safety and operator health concerns, means that growers are faced with fewer chemical control options to utilise while alternatives are being researched and developed.

The number of generations of cabbage root fly per year depends on prevailing climatic conditions. In the UK, there are normally two generations in the north and three in the south during a growing season. The life cycle involves an above ground adult stage and soil dwelling larval stage. Females oviposit at the base of the shoot or in the soil near the roots. Larvae that emerge from eggs move through the soil to locate host-plant roots to feed on in order to survive.

While only limited information exists about how cabbage root fly larvae detect and find roots, the consensus is that chemical cues released in Brassica plant root exudates, either as volatiles or in solution, play a key role in root location. Through a combination of techniques, including choice-test bioassays, metabolomic analysis, detailed behavioural observations, glasshouse and field trials, this project aims to identify compounds in root exudates that larvae exploit to locate roots to feed on. This will facilitate testing and development of

potential control methods, utilising attractant and repellent compounds, to disrupt normal orientation behaviour for use as part of a sustainable IPM programme.

Plants protect themselves against insect attack using many defense strategies, such as secondary compounds that are toxic, repellent or anti-digestive, or morphological traits, which can negatively affect the performance of the herbivore. Elicitors are compounds that characterise attack and whose perception by the plant can induce a defensive response both locally in herbivore-attacked regions and systemically in undamaged parts.

Sugar sensing and signalling pathways interact with plant hormone signalling mechanisms to control metabolism, growth and stress responses. It has recently been hypothesised that extracellular sugars, occurring outside their normal compartment, indicate a disrupted or damaged plant cell, triggering hormone-mediated defense responses. The aims of this work are to investigate how sugar sensing affects Brassica plants' defense system and growth, and whether exogenous foliar and root applications of aqueous solutions of sugars can mimic and elicit inducible resistance against cabbage root fly.

Gucosinolate-containing plants in the Brassicaceae family, incorporated into soil as biofumigants, represent a potential source for pest, disease and weed control. Isothiocyanates, products of glucosinolate-myrosinase hydrolysis, are unpalatable and toxic to many generalist and specialist insects. Despite the fact that several specialist insects including *Delia* spp. have evolved mechanisms to cope with the toxicity of these compounds, beyond certain levels even these insects can be repelled and/or deterred. Using glasshouse pot tests and field trials, this work aims to evaluate the effect of an isothiocyanate-containing liquid biofumigant formulation ('Caliente' mustard), applied as a root drench, on cabbage root fly oviposition, egg survival, and larvae, along with resulting crop yields.

Summary of the results and main conclusions

This research aims to utilise the chemicals present in root and plant exudates that newly hatched cabbage root fly larvae use to locate roots to feed on, to disrupt their behaviour and reduce the larval colonisation of calabrese plants.

Sugar sensing in plants has recently been discovered to be involved in triggering inducible and systemic resistance to insects, nematodes and fungi. This project will determine whether the application of sugars and other 'elicitors' to foliage and/or seed can induce defence mechanisms in calabrese plants that can protect roots from cabbage root fly damage.

The most effective treatments will be utilised in a novel system of cabbage root fly pest management that disrupts host-plant location by the larvae. This will be evaluated in field trial. The potential delivery of these treatments will be in the form of incorporation into soil-applied slow-release granular formulations, seed coatings, foliar /soil sprays and/or treated plugs for transplants.

Promising results from laboratory, field (Figure 1) and glasshouse experiments to date, along with ongoing glasshouse studies investigating combinations of treatments, will form the basis for the 2012 field trial to further evaluate effective treatments for cabbage root fly management. Behavioural bioassays testing compounds identified from root volatiles experiments (Figure 2) will continue in efforts to elucidate the mechanisms underpinning larval host-plant location and avoidance of negative root signals (e.g. repellent compounds).



Figure 1. Field trial 2011 (Kelso, Scotland)



Figure 2. Root volatiles collection

Financial Benefits

At this stage in the project (end of Year 2 out of 3) we are not at a stage to be able to give an accurate estimate of financial benefits to growers. The financial benefits will become clearer once data from field trials in Years 2 & 3 have been obtained and fully analysed.

Action Points

At this point trials are underway to determine the optimal approaches for the application of these alternative treatments to reduce cabbage root fly damage, so it is too early to offer growers specific action points to achieve significant benefits for cabbage root fly management.