Factsheet 30/12

Field Vegetables

Biology and control of spinach and chard leafminers

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Leafminers cause damage to chard and spinach crops by creating unsightly mines that reduce crop quality and value. A much worse scenario occurs when the leaf or stem mines go unnoticed and the larvae are able to feed for two weeks. Larvae develop into 6 mm long white maggots whose presence in speciality salad crops is unacceptable. This factsheet, an output from HDC project 397, provides details on the identity of the pest responsible, the damage it causes and summarises information on pest biology in Britain. Management strategies are also presented.

Action points

- Remove volunteer chard, spinach plants and any other host plants in spring to reduce host availability for leafminer populations emerging from winter diapause.
- Prepare fields early in the year, by ploughing in leafminer host plants. This should reduce populations by killing pupae present in the soil.
- Establish a leafminer monitoring system to inform decision making and ensure timely application of controls.
- When monitoring data indicates the need for sprays, chemical products with different modes of action should be alternated to prevent resistance development and thus ensure sustainable long-term chard and spinach production.

1. Adult *P. hyoscyami* female that, to the non-specialist, looks like many other fly species

Background

Growers of high value leafy salads use mesh netting to protect some crops from a complex of insect and vertebrate pests. Unfortunately, it is impractical to use netting to protect Swiss chard (*Beta vulgaris* subsp. *cicla*) and spinach (*Spinacea oleracea*) as these crops often cover much larger areas and are prone to damage by the netting. The two crops have succumbed to recent increases in pest pressure from leafminer species. Effective methods of managing the problem were required by growers as a matter of urgency. HDC project FV 397 was commissioned in 2011 to find solutions to problems caused by leafminers on spinach and chard crops.

Leafminers causing economic damage to chard and spinach differ from the species attacking leafy salad Brassicas. At least five Diptera (fly) species are responsible: *Pegomya hyoscyami* (the beet leafminer or "mangold fly"), *Amauromyza flavifrons*, *Delia echinata* (the spinach stem fly), *Pegomya betae* and *Clanoneurum cimiciforme*. These leafminers have relatively wide host-plant ranges and so, in addition to attacking commercial crops, pest populations often develop on native weed species such as *Chenopodium album* (fat hen).

In 2011 the beet leafminer or "mangold fly" *Pegomya hyoscyami* (Figures 1 & 2) was found to be the only leafminer species causing significant damage to chard and spinach crops in the UK. The pest is sporadic in nature and seems to have local 'hot-spots'.

2. *P. hyoscyami* larva mining a leaf

Pegomya hyoscyami biology in Britain

Adult females (Figure 3) lay between 30 - 50 eggs under ideal conditions, in comparison to other pest species, such as noctuid moths, which produce several hundred eggs per female.

Females lay characteristic white ridged eggs in batches of 1 - 6 on the underside of leaves (Figures 4a & 4b).

3. An adult female *P. hyoscyami* that emerged from field-collected pupae. Pupae are the brown 'seed' like objects in the central, lower-half of the image indicated by the white arrows

4a. The characteristic, easily recognisable, batches of 1- 6 eggs laid by female *P. hyoscyami* leafminers

4b. A close-up view of *P. hyoscyami* eggs

Larvae hatch after 4 - 5 days, chew their way into the leaf and then spend the next three to four weeks mining leaves, before turning into pupae. Late instar larvae are very mobile, especially at night, and emerge from mines to crawl between plants and leaves. At the end of the final larval instar, larvae migrate down to the soil to pupate. Pupae remain in the soil for 2 - 3 weeks during summer before emerging as adult flies.

Prior to project commencement literature suggested that *P. hyoscyami* had more than three generations per year, implying that populations could reach high numbers in late season, particularly when summers are hot and dry. Project work began in April 2011 and so it was assumed that the overwintering population that gave rise to collected pupae must have emerged in mid- to late March. Adults emerging from the pupae provide the first real pest pressure of the season. Insect rearing confirmed that there are probably only three generations of *P. hyoscyami* in most years in the UK, which to some extent explains the sporadic nature of the pest. Although more detailed monitoring would be required to confirm this, it is expected that leafminer problems are most likely to occur in south Kent during late May to mid-June and from mid-August to September.

From mid-September onwards oviposition ceased which coincided with larvae entering pupal diapause. Results from HDC project FV 397 showed that there is considerable geographic variation in the abundance of this pest and there may be local 'hot spots' where careful monitoring is required.

Damage caused

The type of economic damage caused by leafminers falls into two categories. Mines caused by larvae are unsightly and reduce the value of the crop. The presence of late instar larvae in speciality salads render the crops unmarketable (Figure 5 & 6).

5. A fully developed *Pegomya hyoscyami* maggot - the 'late instar' larva

6. Many *P. hyoscyami* larvae occupying a large mine made in a red chard leaf

Management – monitoring and control

Chard and spinach leafminer damage can be reduced to commercially acceptable levels by using a combination of monitoring, cultural practices and insecticides.

Monitoring

Blue sticky traps (an attractive colour to Diptera) should not be used to monitor *P. hyoscyami* as they 'catch' a wide range of fly species in a short time. Many of the caught species are not pests, but they would be hard to distinguish from *P. hyoscyami* to the untrained eye. A much more effective monitoring method is to plant a small area of 'trap' red chard at monthly intervals, adjacent to the chard and spinach growing fields (Figure 7). *P. hyoscyami* could often be seen ovipositing on trap plants in the late afternoon in HDC project FV 397. Trap plants should be monitored regularly for the presence of distinctive white eggs. When new eggs are found, this should serve as a cue to scout the main crop(s) followed by the application of insecticide sprays, if appropriate.

7. An example of 'trap' plants used to collect eggs of chard and spinach leafminer species in HDC project FV 397

Control

Once larvae have created mines they occupy a protected environment where they can only be reached by systemic insecticides or parasitoids. Nine products were evaluated for insecticidal activity against leafminers in HDC project FV 397. Of the actives tested, Decis Protech (deltamethrin), a coded product HDCI 015 and Gazelle (acetamaprid) all reduced leafminer damage substantially and prevented larvae maturing into later instars. Both deltamethrin & acetamaprid are standard actives already used by leafy salad growers and both products have EAMUs for use in outdoor spinach (August 2012). Acetamiprid has an EAMU for use on chard but deltamethrin does not. HDC are discussing (August 2012) registration of the coded product with the suppliers as it caused the almost immediate death of leafminer larvae (Fig 8a & 8b overleaf).

The effect achieved by deltamethrin was unexpected, mainly because synthetic pyrethroids are not reported to have any systemic activity within plants. It is likely, however, that its activity was achieved by an ovicidal effect, as well as knock-down or irritant effects on adult flies visiting the crop. Either of these modes of action would reduce oviposition by adult females and the subsequent survival of any eggs they managed to lay. The behaviours of *P. hyoscyami* larvae may also contribute to deltamethrin's efficacy. Larvae were observed to leave their mines, particularly at night and during the early morning. The behaviour increased the likelihood of picking up lethal doses of deltamethrin while crawling over the sprayed leaf surfaces.

The effective actives all have different modes of action, which is very encouraging, because this should reduce the risk of resistance development and thus ensure the longer-term sustainable production of spinach and chard crops, even in *P. hyoscyami* 'hot-spots'.

8a. Leaf before spraying

8b. The same leaf two weeks after spraying with the coded product (HDCI 015)

Additional Information

Regular changes occur in the approval status of pesticides arising from changes in legislation or for other reasons. For the most up to date information, please check with your preferred supplier, BASIS registered adviser or the Communications Branch at the Chemicals Regulation Directorate (CRD), Tel (01904) 455775, www.pesticides.gov.uk.

This factsheet is based on a research project and may include mention of crop protection ingredients or products. The publication is intended to inform growers about work undertaken by the HDC or other research organisations and is not intended to endorse or recommend the use of any of the products or active ingredients mentioned. Growers should particularly note that the research project may have included trials of substances which are not registered as crop protection products in the UK or are not approved for commercial use on the crop in question. Only products officially approved as plant protection products should be applied to control pest, disease and weed problems or used as plant growth regulators. Before using any such substance growers should refer to the product approval and label recommendations and seek guidance from a BASIS qualified consultant.

More information on work done as part of HDC project FV 397 can be found on-line at www.hdc.org.uk.

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