Factsheet 10/11

Speciality Salads

Project No. FV 376

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Leafminers of cruciferous salad crops

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Leafminers caused economic damage to cruciferous salad crops such as rocket and tatsoi in 2009 and 2010. This factsheet, an output from HDC project FV 376, provides details of the identity of the pest responsible for the damage and its biology in Britain. Possible reasons for the rise in importance of the insect are given and suggestions made about monitoring and control.

Background

Several plants of the family Cruciferae, including wild rocket, salad rocket, tatsoi, mizuna and watercress, are grown for pre-packed salads in the UK. Apart from watercress, these are usually raised as baby-leaf crops, in narrow beds for mechanical harvesting. The short duration of such crops in the field generally means that many of the more common cruciferous pests do not have time to establish, so that, historically, pest damage (as opposed to contamination) in these crops has been less important. However, from about 2005, symptoms of leaf puncturing and mining began to be seen in salad crucifers, and these culminated in widespread, serious economic damage to commercial crops in 2009 and 2010.

Damage symptoms caused by leafminers

Leafminers can damage crops in two ways. Firstly, female flies puncture the leaf surface (Figure 1) using ovipositors, the egg-laying apparati. Punctures are not always for egg laying purposes, as some are used for feeding. They do not affect the plant greatly, but can cause visible symptoms that are unacceptable to packers if sufficiently numerous. Punctures made by *Scaptomyza* leafminers are usually coarser

1 Leafminer punctures in a cotyledon

2 *Scaptomyza* mine in leaf of wild rocket.

than those made by Agromyzidae. Secondly, larvae feeding between the upper and lower epidermes of the leaf produce mines in the leaf that are visible as linear or blotch-like pale areas (Figure 2).

Severe mining, which can destroy most of the leaf tissue, can affect the growth of plants but the disfiguring effect is much more important as it renders the crop unmarketable.

The insects

Leafminers of Cruciferae

In Cruciferae, the leafminers of commercial importance are all flies. Those in the UK belong to two families, the Agromyzidae and the Drosophilidae. The Agromyzidae are probably more familiar to growers, as this family contains over 250 British species, with a wide range of hosts. Agromyzidae are small but robust flies, many patterned in black and yellow (see Figure 3).

3 Adult *Liriomyza strigata.* Typical Agromyzid – note black and yellow colouring.

The Drosophilidae have been less well known. There are only 5 species of leaf mining Drosophilidae in the UK, and this family may be more familiar as the 'fruit flies', one of which, *Drosophila melanogaster*, has been a mainstay of genetic research. The Drosophilidae tend to be a little larger than the Agromyzidae, and those found on Cruciferae are more uniform fawn to grey brown.

The leafminers that may attack Cruciferae are as follows:

Agromyzidae

i) *Phytomyza rufipes* Meigen (cabbage leafminer) feeds only on species belonging to the Cruciferae family. Host plants include leaf mustard *(Brassica juncea)*, swede and rapeseed *(Brassica napus)*, kale *(Brassica oleracea* var. *acephala)*, cauliflower *(Brassica oleracea* var. *botrytis)*, cabbage *(Brassica oleracea* var. *capitata)*, Brussels sprouts *(Brassica oleracea* var. *gemmifera),* broccoli *(Brassica oleracea* var. *italica)*, and turnip *(Brassica rapa)*.

ii) *Liriomyza strigata* (Meigen) is highly polyphagous, recorded feeding on species belonging to 18 plant families, including Brassica spp. and shepherd's purse *(Capsella bursa-pastoris)*.

iii) *Chromatomyia (Phytomyza) horticola* (Goureau) (pea leafminer) is, like *L. strigata*, highly polyphagous. Host plants include horseradish *(Armoracia rusticana)*, black mustard *(Brassica nigra)*, field mustard *(Brassica rapa)*, rapeseed, cabbage and many weeds.

Drosophilidae

i) *Scaptomyza flava* (Fallén) has been recorded feeding on host plants belonging to a range of plant families in Britain, including Cruciferae. Host crops include turnip *(Brassica rapa* syn. *campestris),* cabbage *(Brassica oleracea)*, wallflower (*Cheiranthus sp.)*, perennial wall-rocket *(Diplotaxis tenuifolia)*, garden radish *(Raphanus sativus)* and watercress *(Nasturtium officinale)*, but there are many others.

ii) *Scaptomyza graminum* (Fallén) has been recorded feeding on a single species, watercress, within the Cruciferae.

iii) *Scaptomyza griseola* (Zetterstedt) has been recorded feeding on Cruciferae, including species of *Brassica* and *Sisymbrium*.

In response to the serious economic damage experienced by salad growers in 2009 the HDC commissioned some research into the leafminer problem in 2010. Rearing larvae from mines and direct observation of leafminer activity in growing crops confirmed that the species responsible for the damage in 2009 and 2010 was *Scaptomyza flava*, rather than any of the other species mentioned above. It is assumed that *S. flava* also caused the damage reported from 2005 onwards. There was no evidence of the involvement of any of the other potentially-damaging species listed above.

Scaptomyza flava

Description

Adult *Scaptomyza flava* (Figure 4) are about 3mm long, fawn/light brown with 3 slightly darker, longitudinal stripes on the thorax.

They have the typical feathering of the arista (a hair on the antenna) found in Drosophilidae and the wings overlap the abdomen more than in most flies.

4 Adult *Scaptomyza flava*

5 *Scaptomyza* larva exposed in a mine. Note prominent, pointed rear spiracles.

The larvae are distinguished from the larvae of Agromyzid leafminers by their posterior spiracles shown in Figure 5.

6 Terminus of female *Scaptomyza* abdomen, showing minutely toothed, horny plates of ovipositor.

Biology

Scaptomyza flava is distributed throughout Britain. According to literature, adults are generally most abundant in September, but sticky trapping in 2010 showed that local peaks of activity could occur in July or August instead. Mated females oviposit in punctures made within the lower surface of the leaf - Figure 6 shows the structure of the female ovipositor. The hatching larva initially moves toward the midrib, creating a long 'corridor'. Once at the midrib the larva forms a large irregular blotch in the upper leaf surface with occasional excursions into the leaf blade. Several larvae may be present in the same mine and if the leaf is small the entire leaf may be occupied. Larvae usually drop to the ground to pupate but sometimes a separate pupation mine is used. Mines produced by this species have typically been seen in vegetable crops between July and October, but in oilseed rape they have been observed much earlier than this and some adult activity was seen in April in 2011, a very mild spring.

No information on the number of generations completed by this species in Britain exists, apart from references to 'several generations' in text books (Edwards & Heath, 1964; Alford, 1999).

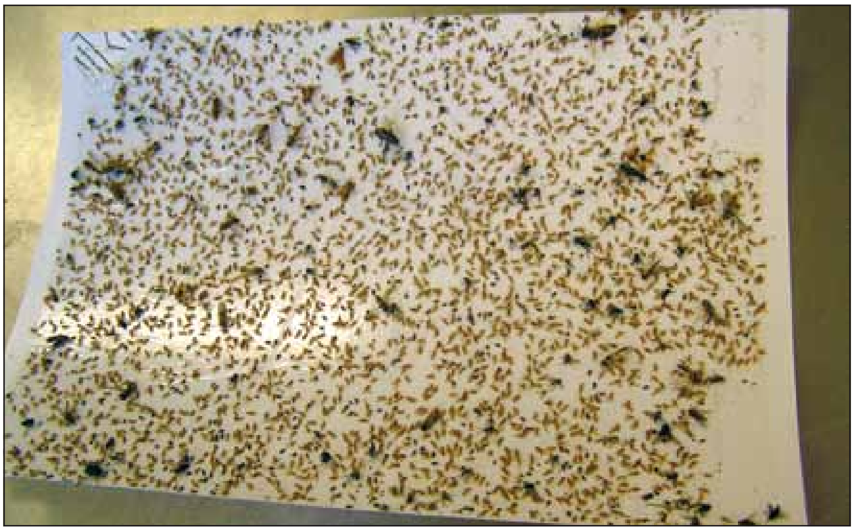
Insecticide resistance

Investigation in 2010 indicated that a population of *Scaptomyza flava* from Norfolk was resistant to the field dose equivalent of pyrethroid insecticides. This is significant because pyrethroid insecticides are widely used in salad crucifers to control pests such as turnip sawflies and flea beetles (and are likely to continue in use for this purpose as they have good knock-down properties and very short harvest intervals), but they are broad spectrum in activity and are likely to kill natural enemies of *S. flava* such as parasitoid wasps. The continuing use of pyrethroids may be resulting in reduced populations of natural enemies, which might be one reason for the recent rise of *S. flava* to prominence. It is now unlikely that the application of pyrethroid insecticides to salad crucifers will control *S. flava* in Britain.

Management

Monitoring

Investigation at 2 sites in 2010 showed that populations of *S. flava* were variable, with one sudden, massive peak of activity at each site. These peaks, however, took place at different times at each site. It seems therefore that it will be necessary to monitor the flies at individual sites throughout the high-risk periods rather than to rely on a general warning on their activity. Experience has shown that white sticky traps placed at crop height are efficient at catching *S. flava* (Figure 7) and it is recommended that these are deployed in crops at risk. Once familiar with *S. flava* it is relatively easy to pick them out on traps from other species.



7 White sticky trap with many *Scaptomyza* attached.

Control

Relatively little work has been done on the chemical control of *S. flava*. To control a species that causes damage as the adult, which is highly mobile, would require a pesticide with rapid knockdown capability. It is ideal to use actives with a short harvest interval. Pyrethroids would normally fit the bill but the confirmation of resistance to this group of insecticides in *S. flava* means that they are no longer a viable alternative. In a single HDC-sponsored trial in the UK, dimethoate proved the most effective at reducing damage, but this does not have, nor is likely to have, approval on salad crops. In New Zealand, avermectin was confirmed as being effective but there is no relevant approval in the UK. Insecticides such as the neonicotinoids may be effective against the larvae of *Scaptomyza* but are too slow in action to have much effect on a damaging population of adults.

The current practice in many commercial crops is to monitor the activity of *Scaptomyza* using sticky traps, and, when numbers are increasing, to cover the crops with insect proof mesh at crop emergence to exclude immigrating adults.

Further 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 product approval and label recommendations and seek guidance from a BASIS qualified consultant.

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