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Herbs

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Glasshouse whitefly and leafhoppers in protected herbs: options for control within IPM programmes

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Options for the control of glasshouse whitefly and leafhoppers in protected herbs within IPM programmes were evaluated in a recent survey and literature search. This factsheet describes the main leafhopper species damaging protected herbs, identifies a potential new leafhopper egg parasitoid and provides guidance on the control of whitefly with the parasitoid *Encarsia formosa*. The efficacy of currently available IPM-compatible pesticides against both whiteflies and leafhoppers on protected herbs is discussed.

Background

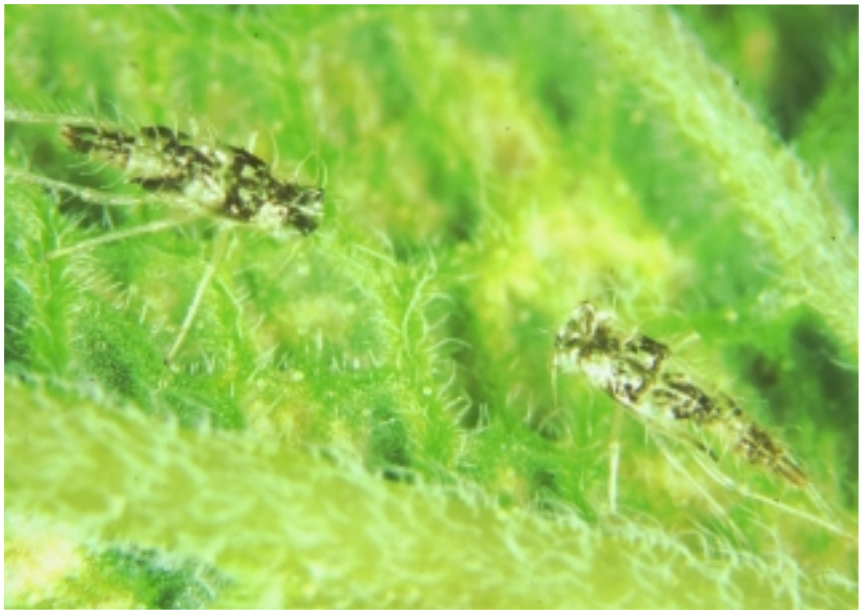
The annual value of the UK protected pot and cut herb industry is estimated at £17 million and £2 million, respectively. Whilst protected herb growers have successfully adopted IPM techniques as a means of sustainable pest control, control of leafhoppers and glasshouse whitefly can be a problem. At a conservative estimate of 10% susceptible plant losses due to leafhopper and 2% due to whitefly, difficulties in controlling both pests are causing losses to the protected herb industry of approximately £2 million annually. Effective control of all pests is essential due to the low or 'zero' tolerance for pests or damage on culinary herbs. Robust strategies for the control of leafhopper and whitefly within IPM need to be developed and this factsheet aims to outline currently available control options.

Adult chrysanthemum leafhopper or 'sage leafhopper', *Eupteryx melissae*

***Eupteryx melissae* nymph**

Leafhopper

The main leafhopper species damaging protected herbs has been confirmed as Eupteryx melissae, the chrysanthemum leafhopper, often known by growers as the ‘sage leafhopper’. Adult E. melissae are approximately 3 mm long, pale green with distinctive brown and black markings on the body and wings. They are very active and hop from the plants when disturbed. The eggs are laid in the leaf veins and petioles and are not easily detected even under a microscope. The young nymphs are pale yellowish green and the older nymphs develop dark brown bands across the body and tips of the wing buds. The nymphs are much less mobile than the adults and are usually found under the leaves next to a leaf vein. There are five nymphal stages and when each stage moults, the cast skins are left behind on the leaf, which can be mistaken for live leafhoppers.



Cast skins of *Eupteryx melissae* nymphs © Holt Studios

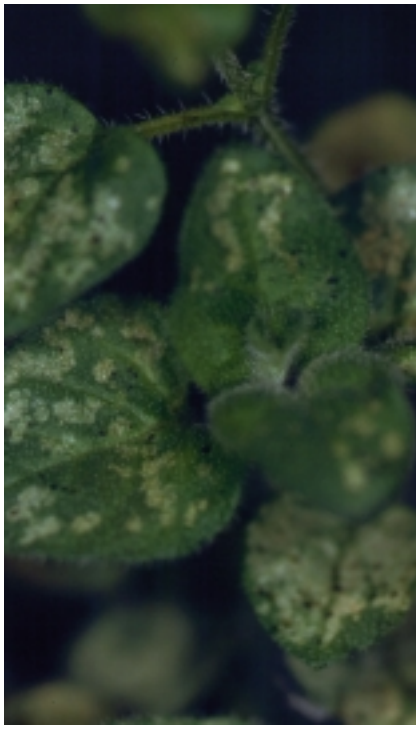
Leafhopper damage

Sages are the main herb species damaged by E. melissae but balm, basil, bergamot, French lavender, mints, marjorams, oregano, rosemary and thymes can also be affected. Leafhopper damage appears as white or pale yellow spots on the leaves which later coalesce to form bleached areas leading to necrosis. On badly damaged leaves, small black faecal spots are also visible.

Plant losses due to leafhopper can range from 1 to 50 % with significant additional costs incurred in time spent spraying, picking off damaged leaves prior to sale and selecting plants for cutting. In a survey of commercial nurseries, the pest was present all year round but damage was most severe during the late spring to early autumn period.

Leafhopper damage to thyme

Leafhopper damage to sage © Holt Studios



Leafhopper damage to marjoram

Leafhopper damage to rosemary

Leafhopper parasitoid

In a survey of commercial nurseries, naturally occurring leafhopper egg parasitoids were found on herbs collected from half the nurseries visited. The highest numbers of this parasitoid were found on organically-grown rosemary which had not been treated with pesticides. The parasitoids were confirmed as belonging to the Anagrus atomus species group. Adult A. atomus are tiny parasitic wasps, less than one mm long. The wings are fringed with long hairs. Female wasps lay their eggs inside the leafhopper eggs in the leaf veins or petioles. The A. atomus larva and pupa develops inside the leafhopper egg. Parasitised eggs turn a dark brown colour and with experience, some can be recognised with a hand lens. When the adult A. atomus is fully developed, it cuts a round hole in the egg and emerges onto the leaf.

A. atomus is commercially available for the control of the glasshouse leafhopper on crops such as tomato, but this parasitoid has been reported not to attack E. melissae. The A. atomus strain found in this project is likely to be adapted to E. melissae and may have potential for commercial rearing and use within IPM programmes.

Adult *Anagrus atomus* © Holt Studios

Glasshouse whitefly

Difficulties in controlling glasshouse whitefly on herbs with the parasitoid Encarsia formosa were reported during the survey of commercial nurseries. The pest was a severe problem on sages, lemon verbena, mints, marjorams, bergamot, basil, balms and rue. Infested stock plants were thought to be a frequent source of the pest.

No research has been done on the factors affecting the success of E. formosa against glasshouse whitefly on herbs. However, the success of Encarsia on other crops is known to be affected by whitefly density and potential sources of infestation, parasitoid introduction rate and timing, temperatures, crop species, production methods and pesticides used. The lack of supporting data for herbs means that no firm guidelines can be provided to herb growers on the use of Encarsia to control whitefly. Recommendations are based on the use of Encarsia in ornamental crops where there may be similarities in the production systems, but there is no guarantee that using the guidelines given below will lead to effective whitefly control on herbs.

Guidelines for optimising whitefly control by *Encarsia formosa*

- Introduction strategy: Introduce Encarsia weekly as soon as temperatures are suitable, rather than waiting until the 'first' whitefly is seen. Even at optimal temperatures, if releases start too late, Encarsia never catches up with the whitefly and control fails.

- Temperatures: Encarsia can walk or fly at 15°C but are more active at 18°C. On sunny winter days, temperatures can exceed 15°C in unheated glasshouses and tunnels. Start introducing Encarsia as soon as temperatures exceed 15°C for a few hours each day.

- Introduction rate: Specific introduction rates for herb crops have not been established. However,as a general rule, if too few Encarsia are released, control will fail. Therefore aim for 'overkill' by introducing Encarsia at a minimum of 1/m_2/week before whitefly is seen and from when temperatures exceed 15°C. Once whitefly is seen, higher Encarsia introduction rates are likely to be needed and these will depend on pest density, temperature and crop species.

- Herb production time: Pot herb crops are produced in only 5-6 weeks in the summer. Due to whitefly development rate there may be insufficient time for adult Encarsia to emerge from parasitised scales, or even for parasitised scales to turn black before marketing. Thus Encarsia host-feeding is likely to be more important than parasitism for whitefly control on herbs. To maintain adequate host-feeding, Encarsia need to be introduced every week.

- Herb plant characteristics: Control with Encarsia may not be reliable on all herb species. Plants producing strongly scented volatiles may be repellent to Encarsia. Encarsia searching for whitefly scales are likely to be slowed down on plants with many small or hairy leaves such as sage. Problem plants may need to be grouped and whitefly controlled with IPM-compatible pesticides.

- Pesticides: There are some IPM-compatible pesticides available for whitefly control on herbs and details are listed in the table. Pesticide applications may be necessary to reduce early season whitefly on stock or production plants when temperatures are too low for Encarsia, or to control whitefly 'hotspots'. The IPM-compatible pesticides listed in the table are either safe to Encarsia or harmful for up to only four days. However,even pesticides with short persistence can interrupt biological control if used too frequently.

- Cultural practices: To help minimise whitefly infestations, weeds should be controlled in and around glasshouses/tunnels. Infested stock plants can often be a source of early season whitefly infestations and should be kept in a separate structure to production plants and kept as free from whitefly infestation as possible.

Control of leafhopper and whitefly with pesticides

There is currently no biological control agent available for the main leafhopper species occurring on herbs and use of the most effective pesticide, Hostaquick (heptenophos) is no longer permitted as approval was revoked on 20 April 2001.
Control of glasshouse whitefly on herbs with the parasitoid E. formosa can be unreliable but guidelines have been provided to optimise control.

Approved IPM-compatible pesticides for both leafhopper and whitefly control are listed in the table.

Efficacy of currently available pesticides against leafhopper and whitefly

- Mycotal controls whitefly if temperatures and relative humidities are high enough (18°C and 80% RH respectively). Such conditions are only likely to occur regularly in herb propagation houses. Mycotal has not been tested against leafhopper.
- Savona should control whitefly adults and scale stages and give partial control of leafhoppers, but repeated sprays are needed and Savona may only be used once per crop on herbs.
- Nicotine products give limited control of whitefly adults and should give some control of leafhoppers. However, repeated applications are necessary which can disrupt IPM.
- Eradicoat should control whitefly pupae and give some control of younger scale stages. It has not been tested against leafhoppers.
- Spraying Oil may give some control of whitefly but neither leafhopper control nor safety to herbs has been tested.
- Dichlorvos may give some control of whitefly adults and leafhoppers but safety to herb crops should first be tested. Dichlorvos is currently being reviewed under the anticholinesterase pesticides review. The outcome of this review will be available shortly.
- Cypermethrin products may give partial control of leafhopper but are unlikely to control whitefly. Cypermethrin products are harmful to biological control agents for up to 3 months after application and in IPM should only be used as a clean-up treatment on stock plants at the end of the season or on plants just before sale.

Where next?

- A potential strain of the parasitoid, Anagrus atomus has been identified for the control of leafhopper on herbs. Further research is needed to assess its commercial potential.
- Reliable control of whitefly with Encarsia formosa may not be achievable on herbs and alternative biological control agents may need to be sought.
- HDC are investigating the potential for SOLA's for Chess (pymetrozine) for the control of whitefly and leafhopper on protected herbs, and for Applaud (buprofezin) for the control of leafhopper. The insect-pathogenic fungus Beauveria bassiana may be approved for control of whitefly on protected crops later this year. None of these products are currently approved for use on protected herbs.
- Since many of the IPM-compatible pesticides have contact action, methods of pesticide application to herbs need to be developed to improve in particular, coverage of the undersides of the leaves.

Further information may be obtained from the HDC Project Report available from the Office.

Table 1. IPM compatible pesticides approved for use on protected herbs with some efficacy against whitefly and leafhopper (October 2001)

Active ingredient	Trade name	Approval status	Application conditions	Rec. for whitefly control	Rec. for leafhopper control	Persistence against *Encarsia*
Dichlorvos	Luxan Dichlorvos 600#	SOLA 0625/99 for use on protected lettuce[1]	Use as a high volume spray	*	*	3-4 days
		SOLA 0626/99 for use on protected herbs[1]	Use as a thermal fog	*	*	
Fatty acids	Savona	On-label approval for use on lettuce[1,3]	Max. one application per herb crop	Yes	*	0 days
Natural organic plant extract	Majestik	Not subject to pesticide regulations[2]	Avoid treating close to harvest as may leave a sticky deposit	Yes	Yes	24 hours
Plant and vegetable oil extracts	Eradicoat	Not subject to pesticide regulations[2]	Apply to oil-tolerant plants only	Yes	*	0 days
Nicotine	Nicotine 40% Shreds	On-label approval for protected herbs	16°C or above needed during application	Yes	Some reduction	3-4 days
	Nico Soap	On-label approval for use on lettuce[1]		*	*	
	No-Fid			*	*	
	XL-All Insecticide / XL-All Nicotine 95%			Yes (partial control only)	Yes	
Petroleum oil	Hortichem Spraying Oil	Not subject to pesticide regulations[2]	Apply to oil-tolerant plants only	*	*	0 days
Verticillium lecanii	Mycotal	On-label approval for use on protected lettuce[1,3]	Needs minimum 18°C and 80% RH	Yes	*	0 days

[1] Can be used off-label at own risk under the Revised Long Term Arrangements for Extension of Use (2000). Pesticides approved or with Specific Off Label Approval (SOLA) for use on 'protected lettuce' or 'lettuce' (but not if label specifies only 'outdoor lettuce') may be used on protected herbs, provided that all label or SOLA conditions relating to use on lettuce are observed.

[2] Acts by physical means only, so is not subject to the pesticide regulations. Use on any crop and number of applications is at grower's own risk.

[3] Permitted by the Soil Association for use on organic crops.

* No label recommendation for this particular pest, but may have some efficacy.

Dichlorvos is currently being reviewed under the anticholinesterase pesticides review. The outcome of this review will be available shortly.

Note

Regular changes occur in the approved status of pesticides arising from changes in the pesticide legislation or for other reasons. For the most up to date information, please check with professional supplier or with the Information Office at the Pesticides Safety Directorate (PSD) Tel: 01904 640500.

- **Always read the label or the Specific Off-label (SOLA) notice of approval as appropriate.**
- **Use pesticides safely.**
- **Check with suppliers for full details of any side effects on biological control agents.**