Factsheet 10/14

Field Vegetables

Cabbage whitefly

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The cabbage whitefly, *Aleyrodes proletella*, has become an increasing problem for the Brassica industry in recent years, especially on Brussels sprout and kale. The reason for this is unknown but it is believed to be due to a combination of climate change, removal of certain active ingredients from use/insecticide resistance and later harvest times of crops. Little research has focused on this species as, historically, it has been regarded as a minor pest. Knowledge about the biology of the cabbage whitefly is limited and most of what is currently understood about its ecology has been inferred from anecdotal evidence or extrapolated from laboratory research.

Action points

- Monitor crops carefully for the presence of whitefly.
- Apply Movento as the first treatment in the spray programme and continue to monitor the crop afterwards, as this single treatment may be all that is required.
- Do not apply pyrethroid insecticides to control whitefly.
- Consider using a non-pyrethroid insecticide to control other pests (e.g. caterpillars).
- Improve spray efficacy by using a combination of dropleg and overhead applications at a rate of at least 200L/ha.

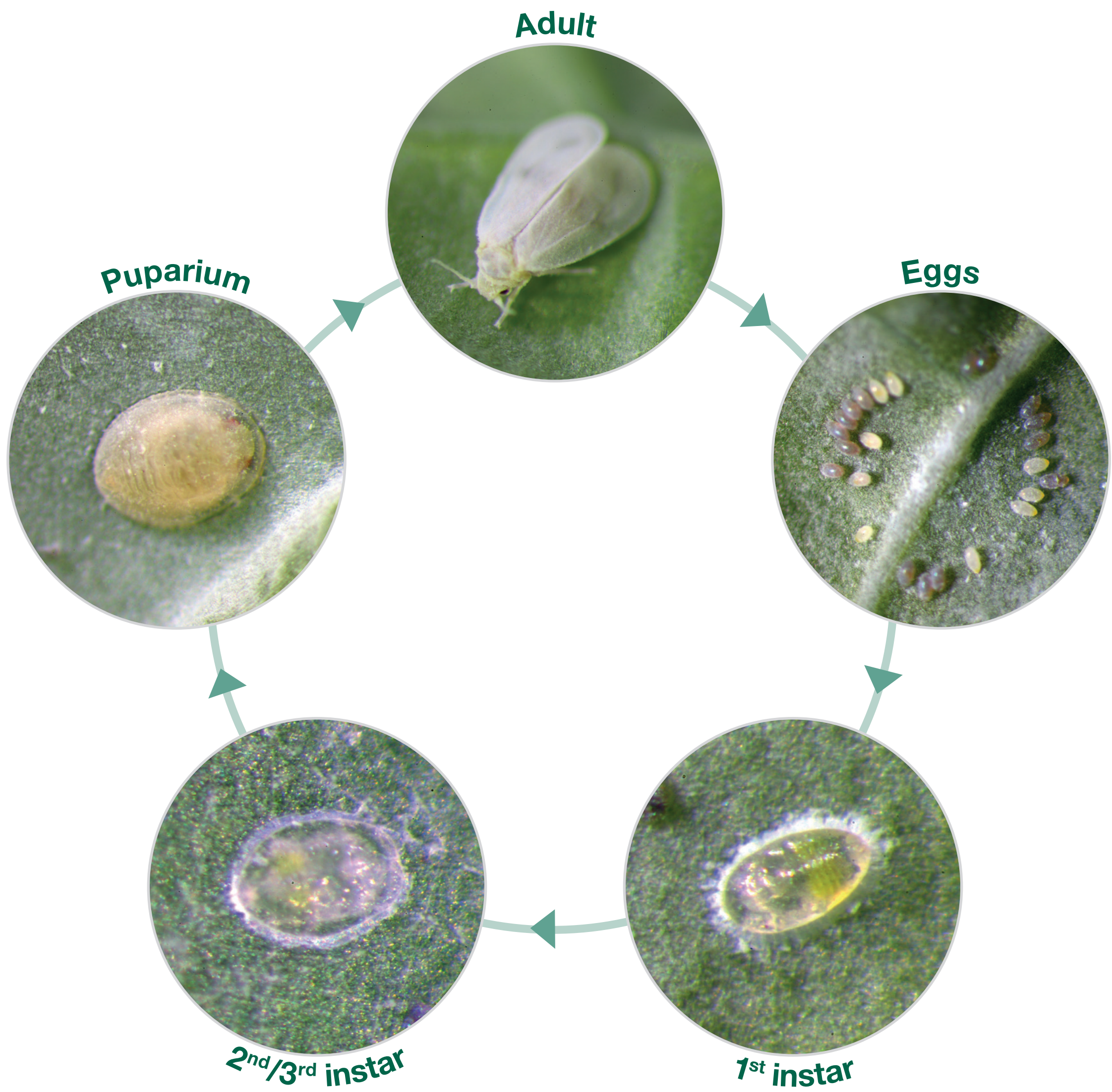
1. Whitefly infesting kale

2. Whitefly cause major problems when their waste products lead to moulds developing on the leaves

Damage

A range of Brassica crops may be infested by cabbage whitefly, but kale and Brussels sprout appear to be 'preferred' hosts and suffer the highest amount of damage in terms of a reduction in plant quality. Although feeding by whiteflies can produce white or yellow patches on infested leaves, the pest rarely reduces crop yield. It is a major problem because the immature stages (scales) and waste products (mainly honeydew which can lead to the development of mould) contaminate and reduce the quality of plant produce. The adult whiteflies feed mainly on the lower surface of leaves. With dense populations, the adults rise in clouds when host plants are disturbed. The presence of adults as well as scales can cause contamination issues in produce that is packed.

Identification



3. Stages of development

All life stages are likely to be accompanied by circular deposits of pale wax, which can be used as a sign of adult presence, even when no insects have been observed.

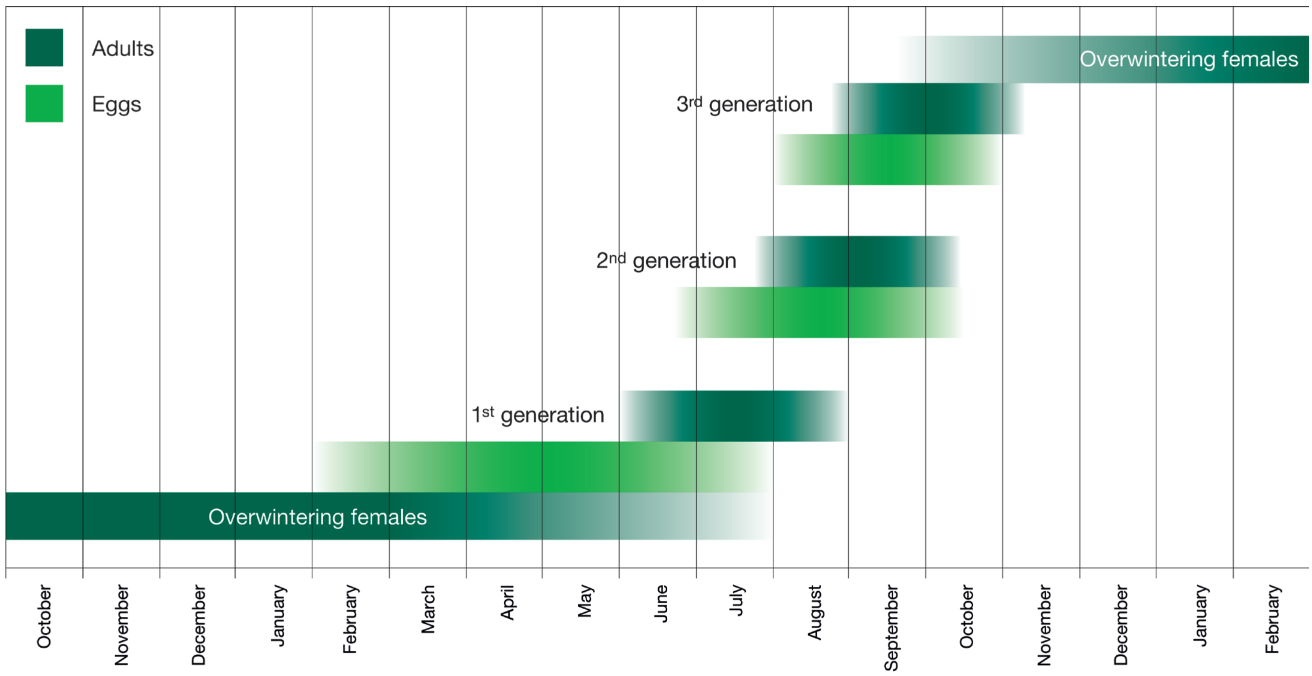
Adult	Small white moth-like insects about 1.5mm long with two pairs of black spots on the forewings.
Egg	Pale, elongated cylinders less than 0.1mm, laid in full or partial circles.
Larva	Flat oval semi-transparent scales from 0.3-1mm.
Pupa	Off-white to brown thickened scales with eyes visible in the later stages.

Biology and life cycle

Cabbage whiteflies are capable of multiple generations per year in the UK (2-5). As both the rate of development and the start of reproduction are determined by ambient temperature, climate and weather conditions will dictate the maximum number of generations and the size of the population. Egg to adult development takes 9-12 weeks at 15ºC or 3-5 weeks at 20ºC. Females may survive for more than a month in the summer and can produce greater than 300 eggs in a lifetime, resulting in significant overlap of successive generations.

Whiteflies overwinter mainly as adult females in protected locations. Increasing night length causes those developing in late summer to build up fat reserves and become darker in colour. These insects are in a state of diapause and will not lay eggs during the winter. In this state they can survive exposure to temperatures around -20ºC for short periods and -5ºC for several days. Males do not have this adaptation and rarely survive the winter. Adults may migrate in substantial numbers in early winter and spring on still, dry days with temperatures above 8ºC. As temperatures rise in the spring, the insects become active, their ovaries complete development and they will begin to lay eggs onto suitable plant leaves. However, they will stop if temperatures drop below about 10ºC. The winter of 2013-14 was relatively warm and egg laying had started by 19 January in Warwickshire. For a short time after the egg hatches, the larva has limited mobility but cannot leave the leaf on which the egg was laid. Once the larva finds a suitable location for feeding, it spends the rest of its development attached to the leaf. After 3 moults, the larva develops into a puparium from which the adult will emerge. Adult females will tend to disperse to the upper leaves of a plant or to other plants, depending on the health of the host or the density of insects present.

The host plant range of the whitefly includes various non-Brassica species, some of which are common UK weeds. However, development and survival of nymphs may be poorer on these plants. In practical terms, the combination of winter diapause and a broad range of less-preferred hosts will enable survival between Brassica plantings.

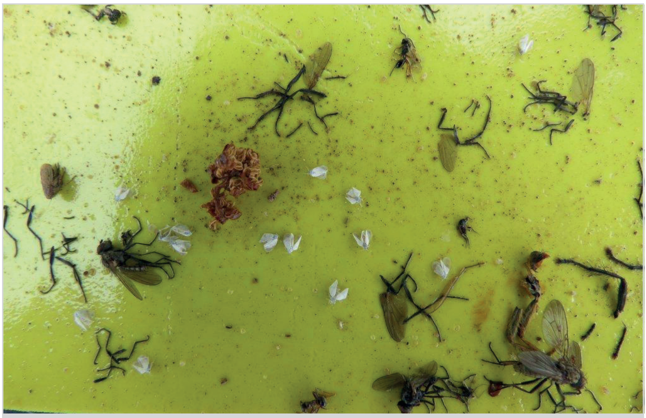


4. Annual life-cycle

Monitoring and Forecasting

Adult whiteflies can be captured on sticky traps. Both yellow and blue traps appear to be effective, but recent studies suggest that yellow traps may be more effective in capturing adult whiteflies near to ground level.

A current HDC-funded studentship (CP 091) is gathering information that can be used to develop a weather-based forecast for cabbage whitefly. The principle aim of a forecast would be to predict periods when crop colonisation occurs, together with the rate of population development on crops, so that control measures can be targeted to occasions when they are likely to have most impact. In 2013, at Wellesbourne, colonisation of new crops occurred in the last week of May. However, the spring of 2013 was relatively cold.



5. Yellow sticky traps are effective for monitoring whitefly

Resistance

Resistance to pyrethroid insecticides was found in samples of whitefly taken from crops in southern and central England in 2009-2011. Such resistance was shown to impair field control with deltamethrin in field trials (FV 399). No associated resistance to neonicotinoid insecticides was found at this time. However, whiteflies globally have shown the capability to rapidly develop resistance to a range of insecticides and effective products should be carefully managed to prevent this.

Control

Chemical

There are a number of possible insecticide products to control whitefly and programmes can be built around these products. However, since whitefly colonies are typically found on the undersides of crop leaves they pose a difficult target for the application of spray chemicals with a contact mode of action. Consequently products with systemic activity are likely to be more effective. Indeed, seed treatments with systemic insecticides e.g. neonicotinoids may provide a certain level of whitefly control, particularly early in the life of the crop.

Field trials and laboratory tests in FV 399 indicated that the systemic insecticide Movento (spirotetramat) is the most effective product for whitefly control approved currently. However, because the insecticide products were applied as part of programmes in the field trials, and with a 2-week interval between treatments, it is difficult to determine their relative efficacy and persistence of activity. Additional information will be obtained in further trials (FV 406a). The results indicated that the most effective programmes began with Movento and that the most effective strategy was to separate the two Movento applications rather than apply them consecutively. It is possible that Movento treatments could be separated by a longer interval than used in these trials, without reducing efficacy. This will be investigated in further trials (FV 406a).

In an HDC trial on kale in 2012 (FV 406), a single spray of Movento applied when the first whitefly generation was present on the crop provided similar levels of control to a second treatment where the early spray of Movento was followed by subsequent applications of Biscaya (thiacloprid) and Movento, applied one month and two months respectively after the first spray of Movento. However, neither spray programme prevented contamination of the crop. It is likely that the timing of the first application in this trial was sub-optimal for the insecticide's mode of action and that performance could be improved. Treatment timings will be investigated further in the new HDC project (FV 406a).

As some populations of whiteflies are resistant to pyrethroids, applications of this pesticide group may exacerbate the whitefly problem by killing some of their natural enemies. Since pyrethroid insecticides are unlikely to control whitefly, they should only be applied to crops if there is a specific susceptible target such as caterpillars.

A preliminary study in 2011 (FV 399) was aimed at using the controlled conditions in a wind tunnel to examine the extent to which the undersides of leaves could be targeted in Brussels sprout and kale crops using boom mounted application systems. The work addressed the application variables relating to nozzle design, application volume, forward speed and wind speed during application. Results of the study (looking at spray deposition) showed that it was not possible to achieve acceptable levels of under-leaf coverage using boom mounted nozzle systems operating in a range of different configurations. Some small improvement in under-leaf coverage could be achieved by operating in high wind conditions. However, this improvement did not result in adequate deposits/coverage and there is a substantial risk of spray drift that makes such an approach impractical. In addition, the adjustment of formulation properties and spray adjuvants would not alter the main finding that boom mounted nozzle systems could not be used to achieve under-leaf coverage in brassica crops.

In considering alternatives to such systems that may achieve under-leaf coverage, the use of dropleg systems was identified, together with the use of electrostatically charged sprays. The results from runs with a dropleg configuration, using mainly cone nozzles, showed a substantial increase in under-leaf deposits on Brussels sprout plants, although the level and distribution of such deposits did not consistently match those on upper leaf surfaces treated with nozzles operating above the crop. The shading effect of adjacent leaves within the canopy was evident in many situations, particularly at levels away from the mid-plant level at which the nozzles were mounted. The results with Brussels sprout plants indicated that in the centre of the plant, under-leaf coverage was generally good when operating with a system to apply more than 200 L/ha, although deposits on upper leaf surfaces then tended to be lower, as expected. Deposits at the top of the plant were reasonably good on under-leaf surfaces but were low on upper leaf surfaces. This approach could be addressed in practical arrangements by using a combination of dropleg and overhead applications and at least 200 L/ha is required if good coverage on upper and lower leaf surfaces is to be achieved. In kale the droplegs were less effective and low levels of under-leaf coverage were achieved, probably as a result of leaf shape, size and orientation.

The use of electrostatically charged spray units should be investigated further. The use of air-assisted sprays may also enable sprays to be delivered into a crop canopy with a high degree of mixing such that some under-leaf coverage is achieved. Such an approach would probably involve adjusting the delivering air flow to match the crop canopy so that mixing is maximised, while the risk of drift and physical damage to crop plants is minimised. It is recognised that the use of air assisted sprays and electrostatic charging systems involves specialised machinery with implications for both the cost and complexity of applications.

Cultural

Crop covers have been shown to reduce whitefly infestations by up to 71% when applied season-long in trials on Brussels sprout in Germany (for organic production). Fine mesh netting (0.8 x 0.8mm) reduced or delayed immigration, even with periodic cover removal for weeding. When combined with better knowledge of pest ecology and forecasting (CP 091), there is potential to disrupt pest infestations through targeted short-term covering after planting out.

Studies have provided evidence of host plant resistance to whitefly in some Brassica material. However, commercial kale and Brussels sprout varieties with specific resistance to cabbage whitefly are not available at present. There is the potential to screen material for resistance, which could be incorporated into commercial varieties, using gene bank or other collections of Brassica.

The potential for approaches based on polyculture (undersowing/intercropping/companion planting) has not been investigated in any detail for whitefly control.

Biological

Specialist whitefly natural enemies present in the UK include parasitoid wasps (*Encarsia inaron, Encarsia tricolor, Euderomphale chelidonii*), a ladybird beetle (*Clitostethus arcuatus*) and a fly (*Acletoxenus formosus*). In addition, generalist predators of aphids such as hoverfly and lacewing larvae will exploit whiteflies in the absence of their primary prey.

Natural suppression by whitefly predators is unlikely to provide substantial control in most crops. Alternative prey populations are largely restricted to woodland habitats and are likely to be localised and unable to support substantial background levels of natural enemies which could move into fields. Application of broad-spectrum insecticides in the past will have reduced natural enemy populations which may once have been associated with cabbage whitefly. However, ongoing HDC-funded research is exploring the potential of inundative parasitoid releases at an early stage in the infestation to provide significant control of cabbage whitefly in crops (FV 406a). The potential for using biopesticides (e.g. fungal pathogens) to reduce whitefly populations has yet to be explored.

6. Natural predators of whitefly being tested in HDC project FV 406

Notes

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