Grower Summary

FV 279

Biology and control of currant-lettuce aphid (*Nasonovia ribisnigri*)

Annual report 2007

Project title:	Biology and Control of the Currant-Lettuce Aphid, *Nasonovia ribisnigri*
Project number:	**FV 279**
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Location of project:	Warwick HRI**,** Wellesbourne, Warwick, CV35 9EF
Project co-ordinators:	David Norman
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Signed on behalf of: **Warwick HRI**

Signature:…………………………………………… ***Date***: ……………………………

Name Professor Simon Bright
Director and Head of Department

The results and conclusions in this report are based on an investigation conducted over one year. The conditions under which the experiment was carried out and the results obtained have been reported with detail and accuracy. However because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial product recommendations

CONTENTS

GROWER SUMMARY

FV 279: Outdoor salads: Biology and control of currant-lettuce aphid (*Nasonovia ribisnigri*)

Headline

- Progress has been made in understanding various aspects of the life cycle and survival of the currant-lettuce aphid. This will form the basis of developing potential control measures in future years of the project.
- At present there are no changes to grower practice.

Background and expected deliverables

UK lettuce crops are infested commonly by four species of aphid. Of these, the currant-lettuce aphid, *Nasonovia ribisnigri,* is of greatest economic importance, being difficult to control, particularly on crops that are close to maturity. Imidacloprid seed treatment (Gaucho) is effective against the currant-lettuce aphid, although it may not persist for the full life of the crop. There are sometimes concerns about the crop safety of this treatment. Whilst they may be effective early on, insecticides applied as foliar sprays to hearted crops often have relatively little effect because the aphids are hidden within the foliage.

There is considerable annual (and regional) variation in the abundance of currant-lettuce aphid and resultant crop damage and it is likely that an early warning of the timing of infestation and likely abundance would facilitate a more effective control strategy. Although the nature of the life-cycle of the currant-lettuce aphid is known, almost nothing has been published on the developmental biology of the currant-lettuce aphid and on its relationship with temperature and daylength. This is the type of information that is necessary for a clearer understanding of the life-cycle and to provide the basis for development of a robust forecast and an effective control strategy. The aim of this project is to clarify and 'quantify' key aspects of the life cycle of the currant-lettuce aphid in the UK.

Once the currant-lettuce aphid has infested lettuce crops in early summer, aphid numbers increase rapidly for several weeks. In most years, currant-lettuce aphid populations (and populations of other species of aphid) then undergo a mid-season 'crash'. The reasons for this decline in numbers are not clearly understood. In most years, numbers of the currant-lettuce aphid increase subsequently in late summer and it is generally the dominant pest aphid on lettuce at this time of year. This project will attempt to determine the role of natural enemies and fungal disease in regulating currant-lettuce aphid populations. Whilst we are unlikely to develop a full explanation for the crash in this time-frame, the project should identify areas to focus on in future research.

The project should provide growers with the following:

- Quantification of the life-cycle of the currant-lettuce aphid and, in particular, its overwintering biology.
- A forecast of the timing of key events in the life-cycle/population development of the currant-lettuce aphid.
- Information on the currant-lettuce aphid biology (e.g. the mid-summer crash) that can be used to improve the control strategy for the currant-lettuce aphid.

Summary of the project and main conclusions

The overall aim of this project is to quantify all aspects of the life-cycle of the currant-lettuce aphid and the relationship between the currant-lettuce aphid and its natural enemies on lettuce. The objectives of the project are:

1. To quantify the rate of currant-lettuce aphid reproduction on lettuce at different constant temperatures.
2. To record currant-lettuce aphid and aphid predator numbers and apparent causes of aphid death on lettuce throughout the growing season.
3. To quantify the temperature and / or photoperiod requirements for egg production and egg hatch.
4. To determine whether the currant-lettuce aphid is able to overwinter in its parthenogenetic form on secondary hosts and to identify which secondary host plants might serve as good overwintering sites.

1. <u>To quantify the rate of currant-lettuce aphid reproduction on lettuce at different constant temperatures</u>

This information is necessary for a clearer understanding of the life-cycle and to provide the basis for development of a robust forecast and an effective control strategy. It is being obtained through constant temperature experiments in the laboratory at 16 hours light and 8 hours dark (16L:8D) in every 24 hours, which is approximately equivalent to the photoperiod in the UK in early to mid-summer. In an initial trial to determine the efficacy of reported methods, constant temperature experiments were performed at a single temperature (20°C). A winged female aphid was placed on each of twelve 3-week old lettuce (cv Iceberg) seedlings in pots, allowed to reproduce, and then all but one nymph per plant was removed after 24 hours. Daily observations then ensued and a record was made of mortality, moulting, and the number of new-born aphids produced (new-borns were removed from the plants immediately). One of the 12 aphids died before producing any offspring. This aphid died two days after inoculation.

Finding - Developmental time (time from birth of nymphs to adult) was 8 days, and total offspring per aphid was 35. This initial experiment is being repeated at a range of temperatures.

2. <u>To record currant-lettuce aphid and aphid predator numbers and apparent causes of aphid death on lettuce throughout the growing season</u>.

The aim of this objective is to record aphid numbers (including cadavers and apparent cause of death) and aphid natural enemy numbers on lettuce throughout the growing season, and to subsequently analyze the data for correlation and possible causation regarding changes in aphid numbers. In summer 2006, lettuce was planted out into plots in the field and was either (1) inoculated with currant-lettuce aphids and covered with insect-proof netting, or (2) inoculated with currant-lettuce aphids and left uncovered, or (3) not inoculated and not covered.

The first planting in 2006 took place in the week beginning Monday 19 June. However, inoculation with wingless aphids did not lead to their establishment on the lettuce plants. By the time of the second planting, in the week beginning Monday 24 July, it was suspected that the seed used in plantings 1 and 2 may have been treated with insecticide. Some plants from the second planting were therefore inoculated with aphids in the laboratory and colonization was compared with that on other lettuce seedlings. Once again, aphid populations did not establish on these plants, neither in the field nor in the laboratory. They did establish on the other lettuce plants, leading to the conclusion that the seed used for field trials on 19 June and 24 July was insecticide-treated.

The third planting (using different seed) took place in the week beginning 21 August 2006. Aphids did establish, but this planting was too late in the year to provide any usable information regarding the aphid crash, which typically occurs in late July or early August.

Finding – What it did show was that aphid numbers rose strongly in the covered environment between mid-September and mid-October, and that this rise was not matched in the lettuce plots that were left uncovered. The presumption in the design of this experiment is that by covering the lettuce, aphid natural enemies are excluded, and hence if higher numbers of aphids are seen on covered lettuce, this is due to lack of predation or parasitism. There are other effects of covering a crop with netting that also need consideration, however. Perhaps the most important is that winged aphids are forced to remain in the plot, probably adding significantly to the numbers compared with an open plot. Also, the micro-climate within a covered plot may at times be more favourable to the aphids. The impact of heavy rain, for example, is dissipated at the surface of the net and hence aphids are not knocked off the plants as they might otherwise be. In a similar fashion, strong winds have less of an impact in a covered plot.

There was a decline in the numbers of aphids in all three plots at the end of the study period, from mid- to late October. The autumn 'peak' in aphid numbers occurred on 10 October in the covered plot and on 24 October in the open plots.

3. <u>To quantify the temperature and / or photoperiod requirements for egg production and egg hatch</u>

In late autumn, shorter days and lower temperatures lead to the production of winged 'migrants' and both male and female aphids are produced. These migrants leave the lettuce and settle on currant (*Ribes*) species such as blackcurrant, redcurrant and gooseberry. When they have settled on the currant plants, the females produce wingless females, which mate with the males and lay eggs. The eggs are deposited most frequently in the angle between the stem and a bud. The overwintering egg stage is an adaptation that allows the currant-lettuce aphid to withstand the cold, wet weather of winter. The eggs spend the winter in diapause (a form of hibernation), during which they will not hatch, even if exposed to relatively high temperatures. Once diapause ends, spring temperatures determine when the eggs will hatch, which is usually in March or April. The newly-hatched aphids complete one or two generations on the currant plant before winged forms migrate to lettuce in May or June.

One of the first aims of this project was to develop a technique for obtaining overwintering eggs so that their development could be studied in more detail. In August 2006, lettuce plants infested with currant-lettuce aphid were enclosed in an aphid-proof cage with *Ribes* bushes, most of which were blackcurrant, but also some gooseberry. The currant bushes were monitored weekly for aphids.

Finding - Currant-lettuce aphids were first seen on the bushes on 17 October, when both winged and wingless forms were observed. Eggs were first observed approximately 4 weeks later, on 15 November. By this time, although not counted and recorded, the number of wingless aphids per currant bush was as high as 50, although numbers per plant were very variable, with a small number of plants having < 5 aphids per plant. The variation in the number of eggs per plant was more extreme, with > 100 eggs on some plants and none on others.

The migration of the currant-lettuce aphid to its winter host observed in this experiment occurred in October / November and this coincides exactly with the literature on this subject. Although aphids were not counted on the currant after 27 October, they were still monitored, as already reported. It was considered that a good indicator of migration to the currant was the number of winged aphids attached to the roof of the cage on a still, sunny day: by mid-November this rough guide to migration was showing that the migration 'peak' had passed. By 7 December no winged aphids had been seen attached to the roof of the cage for one week. By this time also, 33 of the 55 currant bushes had no viable foliage remaining.

Although the winter migration event was complete before December, wingless aphids still populated the lettuce plants in the cage at this time. The population of currant-lettuce aphid remained in the deteriorating lettuce, which was left in the ground for the purpose of monitoring after the currant plants and the cage were removed in early December. New host plants were planted or placed around the original lettuce through December (lettuce) and January (lettuce and potential weed hosts), to provide the aphids with alternative hosts. Predictably, the lettuce plants did not prosper; they either died completely or remained alive with a tiny ‘stub’ of leaves. Although the weed hosts remained alive, none provided the enclosed head typical of lettuce and hence left any colonizing aphids open to the elements. In spite of this, aphids were still present, albeit at very low numbers, until 27 February, after which none were seen. It is also noteworthy that the aphids appeared to be reproducing right up to their demise in February.

The eggs overwintering on currant bushes at Wellesbourne were subjected to different regimes of daylength and temperature to discover the conditions likely to induce diapause completion and egg-hatch in the spring.

Finding - In a preliminary trial, a regime of 16L:8D and constant 16°C induced egg hatch in early February 2007 in the currant-lettuce aphid eggs laid in October and November 2006.

4. <u>To determine whether the currant-lettuce aphid is able to overwinter in its parthenogenetic form on secondary hosts and to identify which secondary host plants might serve as good overwintering sites</u>

In warmer climes (e.g. Australia), it appears that female currant-lettuce aphids continue to produce nymphs throughout the year, rather than producing sexual forms in autumn that lay eggs. It is thought that the same thing happens in southern Britain during mild winters when, in the absence of lettuce crops, the aphid reportedly makes use of weed species such as chicory, hawkweed, and speedwell. Potential alternative hosts are being assessed for their suitability as hosts for currant-lettuce aphid at a range of summer and winter temperatures. Preliminary tests in which weeds and lettuce were made available to the aphid in an enclosed container showed that after 4 weeks at 20°C the currant-lettuce aphid numbers on speedwell (190 per plant) were equivalent to those on lettuce (192 per plant) but that numbers on chicory were lower (123 per plant).

Finding -The most important conclusion to draw from the above is that both weed species (speedwell and chicory) are potential hosts and their suitability for overwintering necessitates field trials at appropriate temperatures.

Financial benefits

- There are no direct financial benefits from this project at this stage.

- Lettuce crops occupy over 5,000 ha of land each year and are worth currently about £70M per annum (Defra Basic Horticultural Statistics 2005). Without adequate insecticidal control, a conservative estimate is that about 10% of crops would be rendered unmarketable by aphids.

- The cost-benefit relationship will be in the order of £21K/£7M, which equates to about 1:350, or 0.3% of the estimated benefits in a single year.

Action points for growers

To date this project has not identified any specific action points for growers.