Horticultural
Development
Company

Grower summary

CP 67

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

Annual Report 2010

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Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

HDC
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

Headline

- Host-plant resistance-breaking (Rb) *N. ribisnigri* develop at the same rate as wild type (WT) *N. ribisnigri* at 10, 15, 20 and 25 °C. Five wild host plants support both Rb and WT *N. ribisnigri* populations. The survival of WT *N. ribisnigri* was equally poor on resistant butterhead cultivars from different breeding companies.

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. While some insecticides are effective for part of the crop's life, in particular the imidacloprid seed treatment (Gaucho) and a new systemic insecticide spirotetramat (Movento), other insecticides applied as foliar sprays to hearted crops often have relatively little impact because the aphids are hidden within the foliage. In addition, there is evidence that some populations of *N. ribisnigri* have reduced sensitivity to pirimicarb or pyrethroid insecticides.

Several new insecticides may soon become available to lettuce growers through full or off-label approvals. Some of these appear to be more effective against *N. ribisnigri* than older active ingredients, but may still not give complete control on maturing crops. In addition, there is concern that some insecticides may be withdrawn in the future as a result of the EU thematic strategy for pesticides.

In recent years, lettuce cultivars with resistance to *N. ribisnigri* have been developed and released commercially but many growers still grow susceptible cultivars. Reliance on insecticides is likely to be important for many years to come. In addition, in continental Europe and more recently in the UK, certain clones of *N. ribisnigri* have overcome this host plant resistance, which is based on a single gene (Nr), suggesting that widespread failure of this asset could soon be possible. Therefore, it is important to continue to develop an integrated control strategy for this pest.

The expected deliverables from this work include:

- 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 currant-lettuce aphid biology (e.g. the mid-summer crash, important natural enemies, alternative hosts) that can be used to improve the control strategy for this pest.

Summary of the project and main conclusions

The following experiments were done at Warwick HRI, Wellesbourne:

Experiment 1 **Quantifying the temperature requirements for summer development of wild type (WT) and resistance-breaking (*Rb*) *N. ribisnigri* on susceptible and resistant (*Nr*) lettuce cultivars**

The 6 treatments which included a control are shown in Table A. WT and Rb *N. ribisnigri* were reared on three cultivars of lettuce (cvs Saladin (susceptible), Eluarde (resistant), Rotary (resistant)) with each treatment consisting of 10 lettuce plants. Each lettuce plant was inoculated with one aphid and the treatments were kept at 10, 15, 20 or 25°C (further temperatures will include 5 and 17.5°C).

The aphids were monitored and their development times to adulthood; whether they were winged or wingless; their survival time; fecundity, and positional behaviour were recorded.

Table A **Treatments used in Experiment 1**

Treatment Number	Aphid type	Lettuce cultivar	Replication
1 Control	1 WT *N. ribisnigri*	Saladin	10 plants
2	1 WT *N. ribisnigri*	Rotary (*Nr*)	10 plants
3	1 WT *N. ribisnigri*	Eluarde(*Nr*)	10 plants
4	1 *Rb N. ribisnigri*	Saladin	10 plants
5	1 *Rb N. ribisnigri*	Rotary (*Nr*)	10 plants
6	1 *Rb N. ribisnigri*	Eluarde (*Nr*)	10 plants

Temperature had a significant impact on the development of both WT and Rb *N. ribisnigri*. Higher temperatures resulted in a shorter development time while lower temperatures increased development time. At 10, 15, 20 and 25 °C the average development times to the adult stage for the control treatment were 17.75, 11.38, 7.6 and 6.25 days respectively, and the development times of the other treatments were similar to this. Rb *N. ribisnigri* developed at the same rate as WT *N. ribisnigri* at each temperature.

It was expected that WT *N. ribisnigri* would suffer 100% mortality on the resistant lettuce cultivars (Rotary and Eluarde) but, unexpectedly, at 15°C 3 WT aphids developed to adulthood on cv Eluarde and at 10°C, 1 WT *N. ribisnigri* aphid survived to adulthood on cv. Rotary. While such aphids did survive to adulthood they often had a longer development time and also suffered earlier mortality.

Preliminary observations suggest that Rb *N. ribisnigri* are more likely to develop into winged adults compared with WT *N. ribisnigri,* meaning they may have an enhanced dispersal potential.

Experiment 2 Identifying wild plant species that might serve as overwintering hosts

The aim of this experiment was to determine which alternative hosts *N. ribisnigri* could potentially use to overwinter as adult aphids during mild winters.

Including a control, there were 12 treatments as summarised in Table B. Alternative host plant species were sown at intervals so that all the species reached a pre-determined size, appropriate for aphid inoculation, on 3 August 2010. Plants were raised in a controlled environment room (20°C, 16h light 8h dark light regime). Five new born nymphs were then inoculated per plant. Plants were assessed on 10, 12, and 19 August. The number of surviving aphids and the occurrence of reproduction were recorded.

Six potential host plants were assessed for capacity to support both Rb and WT *N. ribisnigri* population development and reproduction. These were wall speedwell (*Veronica arvensis*), smooth hawksbeard (*Crepis capillaries*), chicory (*Chichorium intybus*), spiked speedwell (*Veronica spicata*) and orange hawkweed (*Hieracium aurantiancum*) and prickly sowthistle (*Sonchus asper*). Survival of aphids on these species would indicate that they could be potential overwintering hosts.

When comparing the numbers of surviving aphids on the control (chicory) to the other plant hosts, the numbers on smooth hawksbeard, spiked speedwell, and wall speedwell were not significantly different. These three were the best hosts, whilst orange hawkweed and prickly sowthistle were the least successful in supporting populations. Both Rb and WT *N. ribisnigri* inoculated onto prickly sowthistle were dead by the second assessment date.

Except for orange hawkweed, there were no survival differences between WT and Rb *N. ribisnigri* on the same host plant species. The differences seen when comparing orange hawkweed were probably due to the inconsistent growth of this plant species, which led to the use of a range of plant sizes in the experiment, with the larger plants being the better hosts.

Table B **Treatments used in Experiment 2**

Treatment Number	**Aphid type**	**Alternative host specie**	**Replication**
1 Control	5x WT *N. ribisnigri*	Chicory (*Chichorium intybus*)	5 plants
2	5x WT *N. ribisnigri*	Wall speedwell (*Veronica arvensis*)	5 plants
3	5x WT *N. ribisnigri*	Smooth Hawksbeard (*Crepis capillaris*)	5 plants
4	5x WT *N. ribisnigri*	Spiked Speedwell (*Veronica spicata*)	5 plants
5	5x WT *N. ribisnigri*	Prickly Sowthistle (*Sonchus asper*)	5 plants
6	5x WT *N. ribisnigri*	Orange Hawkweed (*Hieracium aurantiacum*)	5 plants
7	*5x Rb N. ribisnigri*	Chicory	5 plants
8	*5x Rb N. ribisnigri*	Wall speedwell	5 plants
9	*5x Rb N. ribisnigri*	Smooth Hawksbeard	5 plants
10	*5xRb N. ribisnigri*	Spiked Speedwell	5 plants
11	*5x Rb N. ribisnigri*	Prickly Sowthistle	5 plants
12	*5x Rb N. ribisnigri*	Orange Hawkweed	5 plants

Experiment 3 Determining the role of predators and entomopathogenic fungi in regulating populations of N . ribisnigri

Including an untreated control, there were 9 treatments which had various fungicide (Nativo- strobilurin + triazole), insecticide (Decis - pyrethroid) and netting regimes. Table C summarises the treatments used. There were 2 replicates of each treatment (18 plots in total) and the experiment was repeated on three occasions to allow continuous observations over the summer.

The fine mesh netting was used to exclude natural enemies from entering particular plots, (thereby reducing their impact on the aphid population), and to stop the movement of aphids in and out of the plots. Fungicide and insecticide treatments were used to attempt to reduce the numbers of entomopathogenic fungi and natural enemies respectively.

Table C Summary of treatments used in Experiment 3

Treatment Number	Aphid Inoculation	Insect proof netting	Fungicide treatment	Insecticide treatment
1	5 WT *N. ribisnigri*	Yes	No	No
2	5 WT *N. ribisnigri*	No	No	No
3 Control	No	No	No	No
4	5 WT *N. ribisnigri*	Yes	Yes	No
5	5 WT *N. ribisnigri*	No	Yes	No
6	5 WT *N. ribisnigri*	Yes	No	Yes
7	5 WT *N. ribisnigri*	No	No	Yes
8	5 WT *N. ribisnigri*	No	Yes	Yes
9	5 WT *N. ribisnigri*	Yes	Yes	Yes

The seed (cv. Saladin Supreme) was sown on 19 May, 16 June, 20 July, and transplanted into the field on 9 June, 19 July, and 31 August respectively. The plants were raised in a greenhouse.

Data were collected between June and October through the destructive sampling of 3 lettuce plants per plot each week (54 plants) over a period of 5 - 6 weeks. Once the lettuce plants had been cut they were kept in a cold store (5°C) until they were destructively sampled. Aphids, predators and entomopathogenic fungi were counted and identified on each plant. The insects recovered were stored in 70% ethanol for further examination and classification.

Data collection (from a field experiment) to determine the role of predators and entomopathogenic fungi in regulating populations of *N. ribisnigri* is still ongoing. Once the complete data set has been collected and summarised, comparisons between treatments should help explain the reasons for changes in aphid numbers, particularly during the mid-summer aphid crash where aphid populations remain low for 6-8 weeks.

Experiment 4 Preliminary comparison of resistant and susceptible butterhead lettuce cultivars collected from different plant breeding companies

The aim of this experiment was to determine whether varying Nr gene introgression backgrounds used by different plant breeding companies have an impact on the level of resistance in their cultivars.

Including a control, there were 12 treatments as summarised in Table D. The seed (cvs Clarion, Charles, Aljeiva, Malfalda, Skyphos and Rotary) was sown on 5 April in vermiculite before being transplanted on 12 April into pots. Plants were grown in a controlled environment room for a further 2 weeks. On 27 April each plant was inoculated with 8 aphids per plant.

Beginning on 29 April the numbers of surviving aphids were assessed each day for a period of 9 days.

Table D Treatments used in Experiment 4

Treatment	**Aphid type**	**Butterhead cultivar***	**Breeder**	**Replication**
1	8x WT *N. ribisnigri*	Clarion (Sus outdoor)	Enza Zaden	5 plants
2	8x WT *N. ribisnigri*	Charles (Sus greenhouse)	Nunhems	5 plants
3	8x WT *N. ribisnigri*	Aljeva (Nr outdoor)	Enza Zaden	5 plants
4	8x WT *N. ribisnigri*	Malfalda (Nr outdoor)	Nunhems	5 plants
5	8x WT *N. ribisnigri*	Skyphos (Nr red, organic)	Rijk Zwann	5 plants
6	8x WT *N. ribisnigri*	Rotary (Nr outdoor)	Elsoms	5 plants
7	8x Rb *N.ribisnigri*	Clarion	Enza Zaden	5 plants
8	8x Rb *N. ribisnigri*	Charles	Nunhems	5 plants
9	8x Rb *N. ribisnigri*	Aljeva	Enza Zaden	5 plants
10	8x Rb *N. ribisnigri*	Malfalda	Nunhems	5 plants
11	8x Rb *N. ribisnigri*	Skyphos	Rijk Zwann	5 plants
12	8x Rb *N. ribisnigri*	Rotary	Elsoms	5 plants

*sus- susceptible butterhead cultivar, *Nasonovia ribisnigri* (Nr) resistant butterhead cultivar)

When comparing the effectiveness of the resistant cultivars in controlling WT *N. ribisnigri*, there were no significant differences between the cultivars, suggesting that there is no effect of genetic background on the control of WT *N. ribisnigri*.

Rb *N. ribisnigri* had relatively high survival on all the butterhead cultivars indicating that Rb *N. ribisnigri* can survive on both the resistant and susceptible lettuce cultivars equally well.

Conclusions

- Rb *N. ribisnigri* has the same development rates as WT *N. ribisnigri* at 10, 15, 20 and 25°C.
- Some WT *N. ribisnrigri* can develop to adulthood on resistant lettuce cultivars, but their survival and reproduction is often negatively affected.

- Preliminary observations indicate that Rb *N. ribisnigri* are more likely to develop into winged adults on both resistant and susceptible lettuce cultivars compared to the WT *N. ribisnigri* on susceptible lettuce cultivars. Therefore they may have an enhanced dispersal potential.
- Different resistant butterhead lettuce cultivars do not show any variation in their ability to control WT *N. ribisnigri*.
- Both WT and Rb *N. ribisnigri* can develop and reproduce equally well on wall speedwell, smooth hawksbeard, chicory, spiked speedwell and orange hawkweed.

Financial benefits

Currently there are no direct financial benefits from this work

Action points for growers

Currently there are no action points for growers