Grower Summary

FV 445

Carrots: Optimising control of willow-carrot aphid and carrot fly

Final 2016

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Before using all pesticides check the approval status and conditions of use.

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Further information

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GROWER SUMMARY

Headline

Treatment of seed with thiamethoxam was the most effective way of controlling willow-carrot aphid and foliar sprays of six coded treatments were also effective. All treatments increased yield significantly compared with the untreated control. For control of second generation carrot fly, treatment programmes based on a novel product were the most effective and there was no difference in the levels of control whether additional sprays of lambda-cyhalothrin were applied subsequently or not.

Background

Carrot and related crops are infested by three 'main' pests; willow-carrot aphid, carrot fly and cutworm. The risk of infestation by all three pests varies with season and geographical location. Cutworms in particular are sporadic pests. Willow-carrot aphid usually infests carrot crops during May-June following the migration of overwintered aphids from their winter host, willow. Willow-carrot aphid provides a threat to crops through its presence, direct damage and the transmission of several viruses, which have been implicated in crop damage. Again some insecticides are approved already for application of foliar sprays to control willow-carrot aphid and others have been identified in the SCEPTRE project, of which some are progressing towards approval. Growers are also able to import seed treated with thiamethoxam (Cruiser) to control aphids and this treatment may have activity against first generation carrot fly. Apart from direct efficacy of the treatments on aphid mortality there is an additional question about the control of virus transmission.

Until quite recently, control of carrot fly (*Psila rosae*), has relied on using pyrethroid insecticides, applied either as seed treatments or foliar sprays (lambda-cyhalothrin, deltamethrin, tefluthrin seed treatments). Although is no evidence that populations of carrot fly have become resistant to pyrethroids, the addition of a new active (Coragen®) has offered the industry another tool to control this pest and could reduce the risk of resistance developing through reliance on just one group of insecticides. Project FV 414 showed that a single spray of Coragen® can persist for at least 6 weeks but is insufficient, on its own, to provide more than about a 25% reduction in damage. However, two sprays of Coragen® timed 1 week before carrot fly emergence and 3 weeks after, or at 0 and 2 weeks after emergence, offered similar levels of damage reduction to a full pyrethroid programme. Timing of Coragen® applications may not be as critical as Hallmark applications but the current view is that they should be applied at the start of a programme to get maximum benefit from these treatments.

It seems that despite the addition of a new active ingredient to their armoury, some growers have been finding it more difficult to control carrot fly in recent years. This may be in part due to the unusual pattern of second generation emergence in 2013 and 2014 which occurred over a very long period and may have been the result of high temperatures. In addition, although work undertaken 15 years ago indicated that there was no need to control third generation carrot fly beyond the end of September (Julia Vincent, PhD project), as eggs laid after that did not lead to sufficiently large larvae to cause damage, this situation may be changing as a result of generally warmer weather in recent years. Changing conditions such as these may require some revision of the control strategy. Finally, the SCEPTRE project has identified a number of new active ingredients for control of vegetable pests. However, carrot fly was not considered as part of this project and so there is an opportunity to explore some of these insecticides for their performance against carrot fly.

The aim of this project is to evaluate a range of strategies for deploying approved products for aphid and carrot fly control to optimise timing and thereby efficacy and to determine how novel actives might be incorporated into programmes in future. Aphids of several species, including willow-carrot aphid, were particularly abundant in 2015 and led to virus problems in a number of crops, particularly carrot and lettuce crops.

Summary

Objective 1 Evaluate insecticide treatment programmes applied to control willow-carrot aphid, their impact on virus transmission and their role in control of first generation carrot fly.

Plots of carrot cv Nairobi were sown on 8 April 2015. The trial consisted of 8 treatments x 4 replicates. Most of the plots were sown with insecticide-free seed but one treatment was sown with seed treated with thiamethoxam (Cruiser) at the commercial rate. The remaining insecticide treatments were applied as foliar sprays. Willow-carrot aphids started to migrate from mid-May and once aphids were relatively abundant in the crop the plots were sprayed on two occasions: 21 May and 4 June. The trial was sampled to record the numbers of aphids on three occasions: 1 June (1), 9 June (2), 25 June (3). The numbers of alate (winged) and wingless (adults and nymphs) aphids were counted on the foliage.

There was no evidence of phytotoxic effects due to any of the treatments in any of the trials. On 1 June (11 days after the first spray) all of the insecticide treatments provided a good level of control compared with the insecticide-free plots. All treatments reduced numbers of wingless aphids (adults and nymphs) compared with the untreated control. When comparing the treatments the thiamethoxam seed treatment reduced numbers compared with all other treatments, HDCI 078 reduced numbers compared with HDCI 079 – 082 and HDCI 079 reduced numbers compared with HDCI 080 and HDCI 082. Numbers of winged aphids were reduced by the thiamethoxam seed treatment compared with all other treatments.

On 9 June (5 days after the second spray) adult wingless aphids and nymphs were assessed separately. All treatments reduced numbers of both life stages compared with the untreated control. When comparing the treatments the thiamethoxam seed treatment, HDCI 078, HDCI 079, HDCI 081 and HDCI 083 all reduced both life stages compared with HDCI 080 and HDCI 082 and the thiamethoxam seed treatment, HDCI 078 and HDCI 083 also reduced numbers of nymphs compared with HDCI 079. The total numbers of wingless aphids followed the same pattern as the nymphs. No treatment reduced numbers of winged aphids compared with the untreated control.

On 25 June (21 days after the second spray) wingless adults and nymphs were assessed separately and all insecticide treatments continued to provide a good level of control of both life stages. All treatments reduced numbers of both life stages compared with the untreated control. When comparing the treatments the thiamethoxam seed treatment and HDCI 078 all reduced the numbers of both life stages compared with HDCI 080 – 083, the thiamethoxam seed treatment and HDCI 078 also reduced the numbers of nymphs compared with HDCI 079. The total numbers of wingless aphids followed the same pattern as the nymphs. There were very few winged aphids and the analysis was not significant. Figure A shows mean numbers of wingless (adults and nymphs) willow-carrot aphid (50 plants) on 3 occasions.

Plant counts were made on two occasions and a sample of roots (2 m row) was harvested, washed, assessed for carrot fly damage and weighed on 28 July 2015. There was little or no seedling/plant mortality due to either carrot fly larvae or aphids. Damage due to carrot fly larvae when the roots were harvested was relatively low. However, the thiamethoxam seed treatment and HDCI 072 (two sprays) both reduced the percentage by number of roots with no and <5% damage. The total yield from all the plots treated with insecticide was greater than from the untreated control and the yield from the plots treated with the thiamethoxam seed treatment was significantly greater than the yield from any of the plots treated with foliar sprays of insecticide.

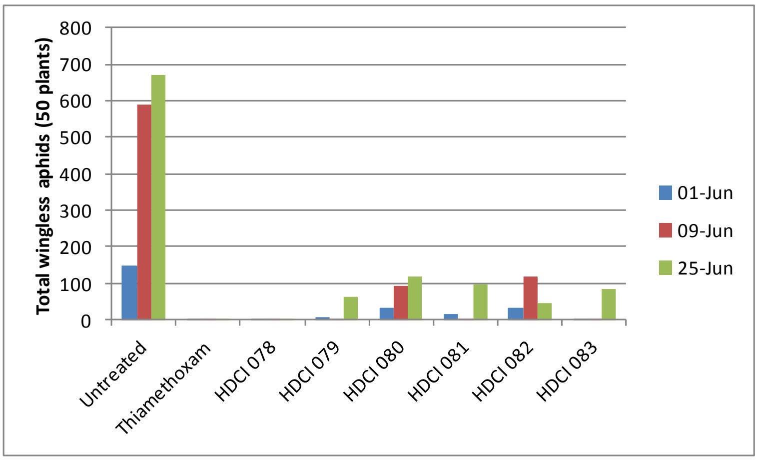

Figure A. Mean numbers of wingless willow-carrot aphid (50 plants) on 3 occasions.

Foliage samples were taken on 15 July from the four replicate plots of four of the treatments: the untreated control, two effective treatments – the thiamethoxam seed treatment, HDCI078 (coded foliar spray) and one less effective treatment (HDCI80 – coded foliar spray) and assessed for the presence of 3 viruses by Adrian Fox and his group at Fera to evaluate the approach i.e. can we evaluate the efficacy of treatments for virus control? For *Carrot red leaf virus* CtRLV, which is transmitted persistently, only the thiamethoxam seed treatment showed evidence of a reduction in virus. For *Carrot yellow leaf virus* (CYLV) which is transmitted in a semi-persistent manner there was evidence that the thiamethoxam seed treatment was more effective than the two other insecticide treatments, but levels were also consistently lower in the untreated control than in the sprayed plots. For *Carrot torrado virus-1 CaTV RNA1* levels were lowest in foliage from plots treated with the thiamethoxam seed treatment, but levels of virus were also lower than the untreated control in foliage from plots treated with the other two insecticides. Finally, samples of carrot roots (200/plot) were taken from untreated plots on 7 December and assessed for evidence of necrosis due to virus. Tip necrosis and internal browning have both been associated with virus in carrots. Up to 8% of roots showed tip necrosis and 6% internal browning.

Objective 2 Evaluate insecticide treatment programmes to control second, and potentially third, generation carrot fly.

Plots of carrot cv Nairobi were sown on 26 May 2015 to avoid infestation by the first generation of carrot fly. The trial consisted of 8 treatments x 4 replicates and all of the plots were sown with insecticide-free seed. The plots were subjected to treatment programmes shown in Table A. The timing of the first treatment was based on the forecast date of 10% emergence of carrot fly at Wellesbourne in 2015 (17 July).

Table A. Treatment programmes in Experiment 2. H = Hallmark (lambda-cyhalothrin) at 100 or 150 ml/ha; R = Coragen (Rynaxypyr); HDCI 087 (experimental treatment).

Weeks from predicted start of second generation		0	2	4	6	8	10
Date sprays applied		20 Jul	3 Aug	17 Aug	1 Sep	15 Sep	29 Sep
1	Untreated control						
2		H150	H100	H100	H100		
3		R	R				
4		R	R	H150	H100	H100	H100
5		R	R		H150	H100	H100
6		HDCI 087					
7		HDCI 087			H150	H100	H100
8		HDCI 087				H150	H100

The treatment programmes based on the experimental treatment (HDCI 087) were the most effective and indeed there was no difference in the levels of control whether additional sprays of Hallmark were applied subsequently or not (Figure B).

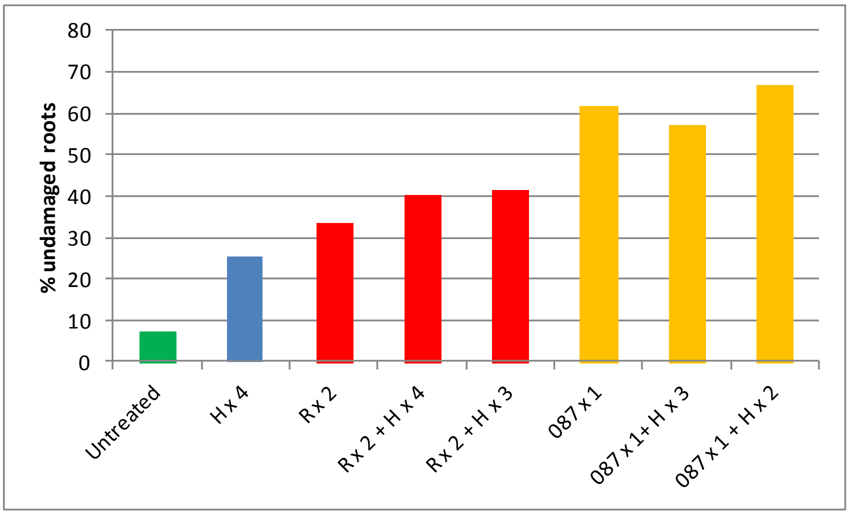

Figure B. The mean percentage of undamaged roots from each treatment. H = Hallmark (lambda-cyhalothrin) at 100 or 150 ml/ha; R = Coragen (Rynaxypyr); 087 = HDCI 087 (experimental treatment).

Finally, an un-replicated small-scale field trial was undertaken at Wellesbourne to assess the impact of third generation carrot flies on subsequent root damage. A small plot of carrots (cv

Nairobi) was sown 26 May and part of this (3m x 4 rows) was covered with insect proof netting immediately after sowing to avoid damage by the second generation of carrot fly. An adjacent area in the same plot was left uncovered. The net was removed 21 September when second generation carrot flies were no longer present. The carrots were strawed down to protect them from frost and were harvested on 20 January 2016. The roots were washed and assessed for carrot fly damage. The roots from the plot covered with fine mesh netting until 21 September suffered a considerable amount of damage although they were not damaged as heavily as roots from the adjacent area which had been uncovered all the time. This suggests that the importance of the third generation of carrot fly, in terms of its impact on damage suffered by overwintered crops of carrot, should be re-investigated in more detail.

Financial Benefits

The carrot crop is Britain's major root vegetable, producing over 700,000 tonnes of carrots each year from 9,000 hectares and the sales value of British carrots is around £290 million (British Carrot Growers Association). The data from untreated plots in these trials indicates the considerable potential for loss in quality and yield, and thus sales value, as a result of infestation by aphids and the associated transmission of virus as well as by carrot fly. Whilst the impact of carrot fly is well known, the effect of poor aphid control on yield loss has been less well-documented – but in this study the yield from plots treated with the most effective treatment (thiamethoxam seed treatment) was twice that from the untreated control plots.

Action Points

- Growers should use seed treated with thiamethoxam to maximise control of virus transmission by willow-carrot aphid and associated reductions in yield.
- Growers should aim to use the most effective foliar spray treatments to provide additional control of willow-carrot and these treatments should be timed using careful crop monitoring.
- Growers should control second generation carrot fly using the treatments and approach recommended currently but be aware that the strategy may change once new products with different modes of action become available.