

HDC Project Report

Project no. FV 162a

Evaluation of Imidacloprid for Aphid Control on Outdoor Lettuce

By

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Final report date: 8 December 1995

Project number: FV 162a

Project title: Evaluation of Imidacloprid for Aphid Control on Outdoor Lettuce

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Date project commenced: 1 April 1995

Date project completed: 8 December 1995

Key words: Outdoor lettuce, aphid control, imidacloprid

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PRACTICAL SECTION FOR GROWERS

Project objectives

To assess the overall efficacy and persistency of imidacloprid ('Gaucho') seed treatment for foliar aphid and lettuce root aphid control on lettuce, and to identify the optimum dose-rate required to achieve a consistent level of foliar and root aphid control.

Key results

Imidacloprid applied as a seed treatment at four different dose-rates gave *c.* 80% control of lettuce root aphid in a fully-replicated trial in Cambridgeshire. However, the level of infestation was generally low. Additional evidence from HRI Stockbridge House suggests that the highest permitted rate of imidacloprid (125 g a.i./ha, equivalent to approximately) will be required to provide effective control of severe root aphid infestations.

Control of foliar aphids in this trial was variable. However, 78% control of a significant aphid infestation was achieved by harvest with all seed treatment rates. Results from related work have already shown that imidacloprid can give excellent control of foliar aphids, although supplementary spray treatments may still be required close to harvest.

Opportunity for application

An application for a specific off-label Approval (SOLA) for the use of imidacloprid on lettuce will be made in early 1996. If this is successful, imidacloprid-treated seed will be available for the 1996 season. However, it is important that a 'blanket' treatment approach on all lettuce plantings is avoided, as this may quickly lead to the development of insecticide resistance and the loss of a very useful product.

EXPERIMENTAL SECTION

Summary

The efficacy of four different dose-rates of imidacloprid seed treatment against foliar and root aphids on lettuce (cv. Saladin) was tested in a fully-replicated trial in Cambridgeshire. The dose-rates were 30, 60, 90 and 180 g/100,000 seeds. A moderate lettuce root aphid attack developed on the trial. Approximately 80% control was achieved with all four rates of imidacloprid by hearting and, with the exception of the 30 g rate, this level was maintained until harvest. A significant foliar aphid infestation also developed. Control of this was relatively poor at hearting (57%) but had improved to 78% by harvest. Possible reasons for this are discussed.

Introduction

Since the withdrawal of diazinon in 1993, the UK lettuce industry has lacked Approved insecticides with label recommendations for the control of lettuce root aphid (*Pemphigus bursarius*) on outdoor lettuce. This aphid is probably the most serious pest of outdoor lettuce in the UK and has the potential for causing total crop failures. It is a particular problem in the drier areas of the country such as eastern and south-eastern England. The lack of effective control measures was further demonstrated in 1994 when serious lettuce root aphid attacks occurred in eastern and southern England. Similarly, foliar aphids, particularly the currant-lettuce aphid (*Nasonovia ribisnigri*), can also be problematic to control with existing Approved insecticides. These do not always provided acceptable control, even when applied regularly throughout the life of a lettuce crop.

The recent commercial launch of imidacloprid as a seed treatment ('Gaucho') for aphid control on sugar beet has highlighted the potential of this product for use in horticultural crops. As a highly active aphicide, it is particularly appropriate for use in lettuce where controlling aphids is a high priority. Imidacloprid has now been entered into the HDC-funded Specific Off-label Approval (SOLA) programme at HRI Stockbridge House, to generate the necessary residue data to support an application for Off-label Approval as a seed treatment on outdoor lettuce for root and foliar aphid control. However, there is only very limited data from UK-based trials on the efficacy of this product against lettuce aphids. It is essential that such data is generated to ensure 1) that the product is effective and 2) that if a SOLA is granted, the product can be used at a rate consistent with reliable aphid control.

Objectives

1. To assess the overall efficacy and persistency of imidacloprid seed treatment for foliar aphid and lettuce root aphid control on lettuce.
2. To identify the optimum dose-rate required to achieve a consistent level of foliar and root aphid control.

Materials and methods

Experimental work was carried out in commercial lettuce crops in Cambridgeshire during June and July 1995 during the peak of lettuce root aphid activity.

Trial site location

To maximise the chances of obtaining a substantial lettuce root aphid infestation, trials were set up at three different locations; only the site with the highest infestation was used for full assessments (see below). Sites were all located within a 10 mile radius of Barway, Cambs., and were identified as Stretham, Fyfes and Soham Mere.

Seed supply & seed treatment

A supply of lettuce seed treated with different rates of imidacloprid was obtained courtesy of G's Fresh Salads Ltd (seed supply) and Seedcote Systems Ltd (film-coat seed treatment facilities). Actual treatments were as follows:

- A. Blank seed treatment (no insecticide).
- B. Imidacloprid seed treatment applied at 180 g a.i./100,000 seeds.
- C. Imidacloprid seed treatment applied at 90 g a.i./100,000 seeds.
- D. Imidacloprid seed treatment applied at 60 g a.i./100,000 seeds.
- E. Imidacloprid seed treatment applied at 30 g a.i./100,000 seeds.

Experimental design & analysis

Each of the five treatments was replicated four times in a randomised block design. Plot size was 10 m x 1 bed (bed width approx. 1.83 m). At least one guard bed was included either side of the trial area (see Appendix 2 for trial design plan).

Analysis was by analysis of variance and, where appropriate, the use of Duncan's Multiple Range Test to identify differences between treatments.

Propagation details & planting dates

Plants were propagated at ADAS Arthur Rickwood. The lettuce seeds (cv. Saladin) were sown on 11 May 1995 in Hassy 228 trays, using Fisons F2 compost. Planting dates were as follows: Stretham and Soham Mere: 14 June; Fyfes: 19 June.

Selection of trial site for full assessment

When plants started to heart, 20 plants taken from buffer plots in each of the three trials were visually checked for the presence/absence of lettuce root aphid infestation. The site with the highest percentage of plants infested was chosen for full assessment (see below).

Assessments on trial used for full assessment

Assessments of aphid infestation levels on all plots were made at the following times:

1. At hearting, i.e. when the heart leaves *start* to form an identifiably dense head.
2. At harvest.

Root aphid infestation

Infestation was assessed using standard ADAS procedures on each of 20 plants/plot. This technique categorises the aphid infestation level on the roots of each plant

according to a logarithmic index ranging from 0 (no infestation) to 7 (severe infestation).

Foliar aphid infestation

At each assessment, ten plants per plot were assessed for foliar aphid infestation by removing plants from the field and returning them to the laboratory, where each plant was carefully searched for aphids. All aphids found were retained for identification.

Results & discussion

Lettuce root aphid activity was relatively low in Cambridgeshire in 1995. Thus although infestations developed at all three trial sites, aphid populations were generally below the level likely to cause severe crop damage.

Table 1. Percentage plants infested with lettuce root aphid at hearting at each of the three initial trial sites.

Site	Assessment date	% plants infested
Stretham	11 July 1995	50
Soham Mere	11 July 1995	20
Fyfes	11 July 1995	10

The results of the initial assessments made at hearting at each of the three trials sites are shown in Table 1. On the basis of these results, the Stretham site was selected as the trial on which full assessments were made.

Table 2. Effect of different rates of imidacloprid (g/100,000 seeds) on mean lettuce root aphid infestation index at hearting (14 July) and harvest (27 July). Means are back-transformed from $\sqrt{n + 0.5}$, S.E.D. given is for transformed means. Means followed by the same letter are not significantly different at $p = 0.05$.

Treatment	Root aphid index	
	14 July	27 July
Untreated	0.56 a	0.66 a
Imidacloprid 180 g	0.40 b	0.43 c
Imidacloprid 90 g	0.40 b	0.42 c
Imidacloprid 60 g	0.42 b	0.43 c
Imidacloprid 30 g	0.43 b	0.55 b
F ratio	9.33 ($p=0.001$)	17.12 ($p<0.001$)
Degrees of freedom	12	12
S.E.D.	0.066	0.075

Table 3. Effect of different rates of imidacloprid (g/100,000 seeds) on mean number of foliar aphids/plant at hearting (14 July) and harvest (27 July). Means followed by the same letter are not significantly different at $p = 0.05$.

Treatment	Mean no. aphids/plant	
	14 July	27 July
Untreated	18.7 a	9.3 a
Imidacloprid 180 g	7.5 b	1.3 b
Imidacloprid 90 g	12.4 ab	1.8 b
Imidacloprid 60 g	13.6 ab	2.8 b
Imidacloprid 30 g	8.7 b	2.1 b
F ratio	4.91 ($p=0.019$)	8.32 ($p=0.002$)
Degrees of freedom	10	12
S.E.D.	2.83	2.04

At the Stretham site, full assessments of root and foliar aphid infestations were made on 14 July (hearting) and 27 July (harvest). The results of the root aphid assessments are shown in Table 3 (analysed results) and Figure 1 (untransformed data). These indicate that imidacloprid at all rates significantly reduced lettuce root aphid infestations, giving on average a 77% reduction in infestation levels at hearting (Figure 1). At the harvest assessment (27 July), the overall level of control was maintained at a similar level (82% reduction in infestation levels) for the three highest rates (180, 90 and 60 g/100,000 seeds), but was reduced for the 30 g rate (46% infestation reduction). This was the only evidence for a dose-related response in root aphid control levels. Clearly, the 30 g rate would not be persistent enough at higher infestation levels to provide effective control. Indeed, observations made on lettuce root aphid damage at HRI Stockbridge House in 1995 suggested that the 180 g rate would be required to control a serious root aphid attack. The Stockbridge House work also showed that imidacloprid residues could not be detected at harvest even where the highest seed treatment rates had been used.

The results of the foliar aphid assessments were more difficult to interpret, probably because it is likely that the trial was accidentally oversprayed with an aphicide by commercial farm staff sometime between 14 July and 27 July. At the first assessment, a substantial aphid infestation (mainly *Macrosiphum euphorbiae*) was present, averaging 18.7 aphids/plant (Table 3, Figure 2). Aphid infestations were significantly lower on some treated plots. However, the level of control was at best mediocre, averaging 57% control on the treatments with the lowest infestations, and was not related to insecticide dose. It is possible that there was a heavy influx of alate (winged) aphids at this time. By the time of the harvest assessment, the level of aphid infestation had dropped by c. 50% on untreated plots, and the level of aphid control given by the imidacloprid treatments had improved to an average of 78% across all dose rates.

Figure 1. Level of lettuce root aphid control given by different rates of imidacloprid at Stretham.

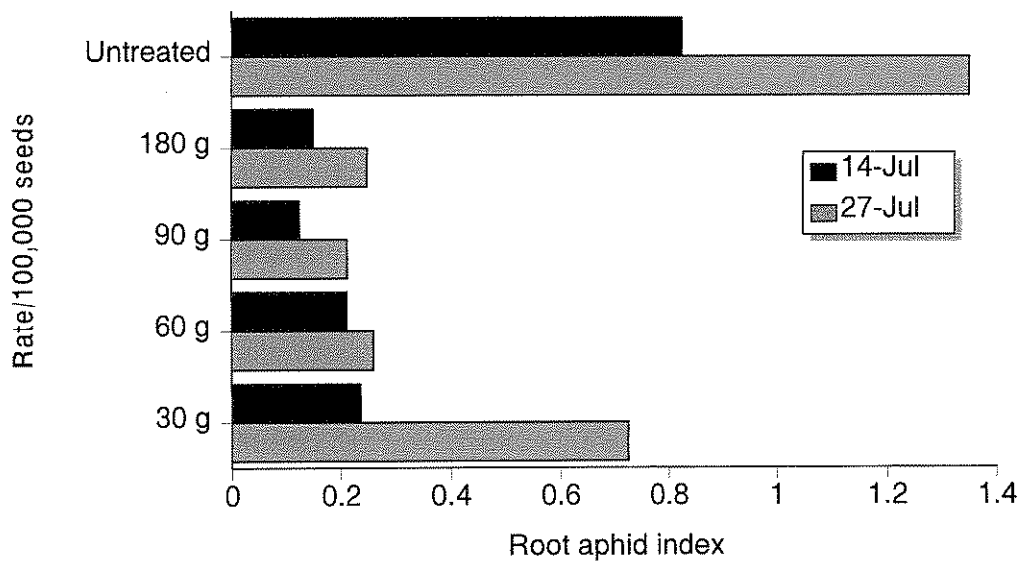
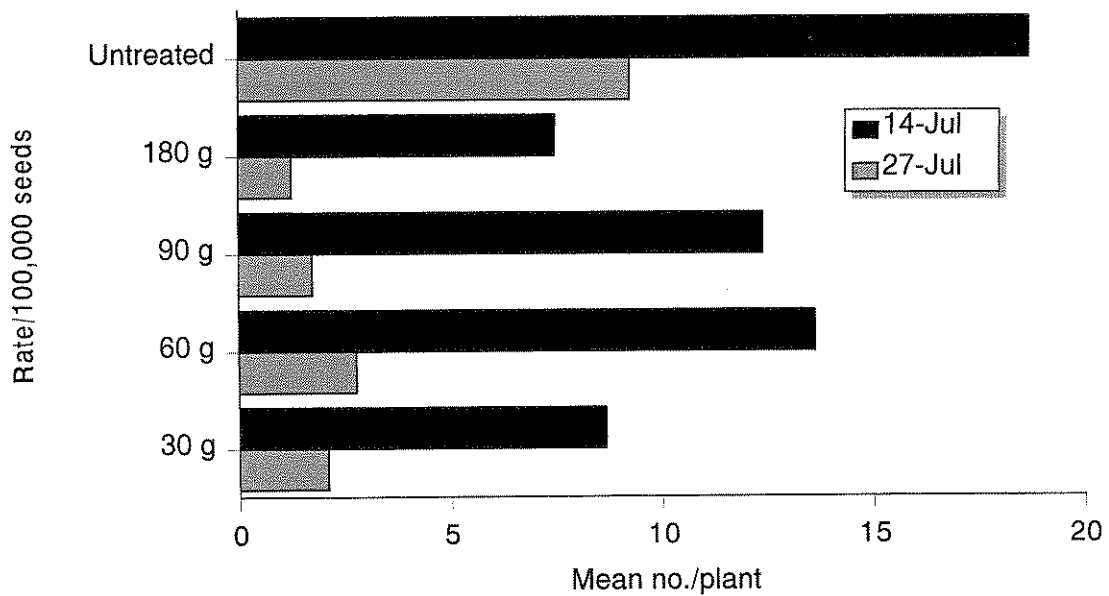


Figure 2. Level of foliar aphid control given by different rates of imidacloprid at Stretham.



Related work

The persistence and efficacy of imidacloprid for foliar and root aphid control on iceberg lettuce has also been tested as part of the LINK-funded project aimed at developing an IPM programme for aphids on outdoor lettuce. The results from two years of work are in line with those in this report. In particular, the level of control of foliar aphids was found to be excellent. It is likely that the LINK project will now address ways of using imidacloprid within an IPM programme. Consideration will be given to ways in which the use of the product can be limited to those situations where it is most needed, thus ensuring that the risks of a rapid development of insecticide resistance can be minimised.

Conclusions

- Imidacloprid at all rates tested suppressed low lettuce root aphid populations, but did not provide complete control. It is likely that the highest permitted rates (currently 125 g a.i./ha/season, equivalent to approximately 180 g/100,000 seeds at conventional outdoor lettuce planting densities) will be required to give effective control of severe lettuce root aphid infestations.
- Foliar aphid control with imidacloprid is satisfactory at rates lower than would be required for effective root aphid control, and is generally better than that provided by existing standards such as pirimicarb. However, depending on the exact rate used and the duration of the crop, it is possible that short-persistence foliar spray treatments may still be required close to harvest to ensure full aphid control.
- Consideration should be given to the best way to use imidacloprid within an IPM programme to ensure that the product has an effective life-span.

Acknowledgments

I am grateful for the assistance of Dr Jennie Blood-Smyth and Jackie Town of ADAS Arthur Rickwood in carrying out the field trials work. G's Fresh Salads generously provided seed and sites in commercial crops for the work. Seed treatments were applied free of charge by Seedcote Systems Ltd.

Contract between ADAS (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research/development project.

1. TITLE OF PROJECT

Contract No: FV 162a
Contract Date: 26.05.95

**OUTDOOR LETTUCE: ASSESSMENT OF THE EFFICACY OF
IMIDACLOPRID FOR THE CONTROL OF LETTUCE ROOT APHID**

2. BACKGROUND

Since the withdrawal of diazinon in 1993, the UK lettuce industry has lacked Approved insecticides with label recommendations for the control of lettuce root aphid on outdoor lettuce. This aphid is probably the most serious pest of outdoor lettuce in the UK and has the potential for causing total crop failures. It is a particular problem in the drier areas of the country such as eastern and south-eastern England. The lack of effective control measures was further demonstrated in 1994 when serious lettuce root aphid attacks occurred in eastern and southern England.

The recent commercial launch of imidacloprid as a seed treatment ('Gaucho') for aphid control on sugar beet has highlighted the potential of this product for use in horticultural crops. As a highly active aphicide, it is particularly appropriate for use in lettuce where controlling aphids is a high priority. Imidacloprid has now been entered into the HDC-funded Specific Off-label Approval (SOLA) programme at HRI Stockbridge House, to generate the necessary residue data to support an application for Off-label Approval as a seed treatment for lettuce root aphid control. However, there is no data from UK based trials on the efficacy of this product against lettuce root aphid, and it is essential that such data is generated to ensure 1) that the product is effective and 2) that if a SOLA is granted, the product can be used at a rate consistent with reliable aphid control.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

There are no recent figures for the percentage of the national outdoor lettuce crop treated for lettuce root aphid; MAFF pesticide usage data suggests that c. 1450 ha were treated with diazinon in 1991, i.e. c. 20% of the total outdoor lettuce area (note that it is not necessary to treat all lettuce plantings as early and late plantings are not at risk). Thus the value of the *total* potential annual yield loss (assuming 3700 dozen lettuce/ha priced at £2.45/dozen) is £13.1 million. Assuming a conservative average actual yield loss of 6% the losses to the industry currently run at c. £788,000/year, not including the costs of any treatments applied. Assuming a successful outcome to the project, yield losses could be reduced to 2%/year. Total annual savings of c. £551,000 should therefore accrue before the cost of treatment (unknown) is taken into account. There would also be a spin-off in terms of reduced costs and losses for foliar aphid control.

4. SCIENTIFIC AND TECHNICAL TARGET OF THE WORK

1. To assess the overall efficacy and persistency of imidacloprid seed treatment for lettuce root aphid control on lettuce.
2. To identify the optimum dose-rate required to achieve a consistent level of lettuce root aphid control.

5. CLOSELY RELATED WORK

HDC is currently providing financial support to the LINK project on developing an IPM programme for aphid control on lettuce. As part of this project, the efficacy of new insecticides for the control of foliar and root aphids on lettuce is being investigated. This work is concentrating primarily on the use of foliar spray treatments, although a single rate of imidacloprid seed treatment is included. However, as these trials are primarily designed to assess the effect of foliar sprays on aphid control, the trial design is inappropriate for including a range of seed treatment doses and assessing the effect of these on lettuce root aphid.

work is also being undertaken in Holland to assess the efficacy of imidacloprid seed treatments for foliar aphid control on lettuce; no data on the efficacy of these treatments on lettuce root aphid are available. Similarly, there is anecdotal evidence from the USA that imidacloprid (as a foliar treatment) will control aphids on lettuce. However, it is very unlikely that a foliar imidacloprid treatment will become available in the UK, and climatic conditions in the USA are very different from the UK.

6. DESCRIPTION OF WORK

The work will be carried out in commercial lettuce crops in East Anglia. Plants (cv. Saladin) will be raised from treated seed at ADAS Arthur Rickwood. Three trials will be planted at different locations but at similar timings (within 10 days of each other). However, full assessments will only be made at the site with the highest level of lettuce root aphid. simple visual damage score assessments will be made at harvest on the remaining two trials.

- Treatments:**
1. Nil (control)
 2. Imidacloprid seed treatment at 180 g/100,000 seeds (125 ga.i./ha equivalent (maximum permitted rate).
 3. Imidacloprid at 90 g/100,000 seeds.
 4. Imidacloprid at 60 g/100,000 seeds.
 5. Imidacloprid at 30 g/100,000 seeds.

Each treatment to be replicated 4 times in a randomised block design.

Assessments: Assessment of the level of root aphid infestation will be made at hearting and at harvest. Plants will also be assessed for the level of infestation by foliar aphids at the same time.

Commercial Trials: Dr J Blood-Smyth of ADAS will also liaise with G's Fresh Salads Ltd to ensure that assessments made by G's technical staff on their own observational trials on imidacloprid on lettuce are compatible with those made on HDC-funded trials.

7. START DATE, DURATION AND REPORTING

Start date; 01.04.95, duration 9 months

The final report detailing the results of the HDC trials together with the observations from the G's Fresh Salads Ltd trials will be produced by 31 December 1995.

8. STAFF RESPONSIBILITIES

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9. LOCATION

The trials will be located on commercial farms in East Anglia. The timing of the trials will aim to coincide with the peak migration period of lettuce root aphid as indicated by HRI forecasts.