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Overwintering sites and early spring infestation of onion crops by onion thrips

—TBG milestone 4.2

A report prepared for the

New Zealand Onion Exporters Association

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Contents

1 Executive summary

Between onion harvest in summer and seedling emergence during winter, fields are free of onion crops. Onion thrips must spend this time on other plants or in a non-feeding resting stage. At some point after crops are sown overwintering onion thrips must fly into new crops. Knowledge about overwintering sites and when onion thrips fly into crops will assist development of non-pesticide and pesticide controls.

The objective of this project was to examine when onion thrips infest onion plants during winter and spring.

Yellow sticky traps and onion trap plants were placed by four packhouses from 27 May until 16 September and in four onion fields from 16 September to 28 October. Trap plants were also kept in four other onion fields from 12 August to 21 October.

Onion thrips were flying until the end of June and started again in September. There is evidence that there was a flight of thrips in mid-July which coincided with night temperatures above 10°C and day temperatures above 17°C.

During a typical winter, new crops are unlikely to be invaded by thrips until September.

Thrips were found breeding on self set onions from April onwards.

At present the main source of thrips is most likely to be self set onions.

We have identified some overwintering sites, periods of thrips flight and some aspects of crop colonisation.

1.1 Recommendations

Some of these recommendations are for research projects that may be more appropriately funded by government, but it may be important for the vegetable industry to make its requirements known.

1. Reject onions and onion waste should be disposed of in a way that will not allow onion thrips to escape into the environment (see Section 6.1).
2. All onion bulbs should be removed from fields at harvest.
3. Any self sets should be removed from fields and headlands as soon as they are seen and disposed of in a way that will not allow onion thrips to escape into the environment.
4. Research should be undertaken to determine the conditions that initiate breeding in onion thrips.
5. Research should be undertaken to determine the conditions that stimulate flight by onion thrips.
6. Research should be undertaken to determine the merits of alternative methods for monitoring thrips flights.

Recommendations outline methods for reducing the risk of crop infestation by onion thrips and suggest future research projects.

2 Introduction

Between onion harvest in summer and seedling emergence during winter, fields are free of onion crops. Onion thrips must spend this time on other plants or in a non-feeding resting stage. Onion thrips are believed to overwinter as non-feeding females. It is assumed that some will be associated with onion stores and places where waste onions and debris are dumped. The proximity of crops to these sites may affect the likelihood of early season infestation. In spring 1998 onion thrips were found on sprouting onion bulbs and plants in fields.

At some point after crops are sown overwintering onion thrips fly into new crops. Knowledge about overwintering sites and when onion thrips fly into crops will assist the development of non-pesticide and pesticide controls.

3 Objective

To examine when onion thrips infest onion plants during winter and spring.

4 Methods

4.1 Outline

Group of 10 onion trap plants and one yellow sticky trap were placed close to 4 onion stores/packhouses and then transferred to onion crops after seedling emergence. The traps and onion plants were changed every 2 weeks. When fields were monitored groups of 5 plants were at the field edge and groups of 5 in the middle. Four packhouses and 8 field sites were monitored with trap plants and 4 sites with yellow sticky traps. In addition, self set onion plants and sprouting bulbs in bins were examined for the thrips stages present.

4.2 Sticky traps

One pair of traps was used at each of four sites. The two yellow traps, 205 x 245 mm, were held in position on a flat iron stake by a large metal clip. Additional clips were required at the trap corners to prevent them flapping in strong wind. The top of the traps was approximately 800 mm above the soil.

4.2.1 Trap locations

From 27 May until 16 September the traps were close to four packhouses/onion stores: Flynn Brothers, Attewell Road; Hira Bhana Ltd, Webb Street; Vegmak Produce Ltd, Heights Road; Wilcox Brothers Ltd, Wooten Road.

From 16 September to 28 October the traps were in four onion fields: Hira Bhana Ltd, Harrisville; R C and M D Fulton Ltd, Waiuku Road; Wilcox Brothers Ltd, Wooten Road; Nathu Jivan Ltd, Parker Lane.

4.2.2 *Trap examination*

Used traps were placed in clear plastic bags to prevent them from sticking to anything else. The clear plastic allowed most insects to be identified while on the trap.

The distinction between other Thysanoptera and *Thrips tabaci* was first made by examination under a low power microscope. Those believed to be *Thrips tabaci* were then removed from the trap and mounted on slides for identification under a compound microscope.

When thrips numbers were low, *Thrips tabaci* for slides were removed from the entire area of the trap for examination and counting under the microscope. However, when the numbers of thrips on the traps increased greatly sub-sampling was initiated. A grid consisting of 16 squares was drawn over each trap and sub-samples randomly chosen. When the proportion of Thysanoptera on the trap was high the traps were sub-sampled as follows:

- ¼ (4 of the 16 squares) if there were 150+ thrips of all species on the trap,
- ½ (8 of the 16 squares) if there were 80-149 thrips of all species on the trap.

Thrips thought to be *Thrips tabaci* were prepared and mounted on microscope slides for confirmation of identity. The pieces of traps with the thrips for examination were cut out using a scalpel. Segments of trap were immersed in kerosene for approximately 20 min to dissolve the glue and release the thrips. The pieces of plastic from the trap and plastic bags were carefully removed leaving the thrips in the kerosene. The thrips were then collected on the tip of a paintbrush and transferred to a piece of filter paper and the kerosene allowed to evaporate. A fume hood was used to minimise exposure of staff to kerosene vapour.

The thrips on the filter paper were mounted on glass slides. A drop of PVA mountant type B was placed in the centre of the slide and, depending on numbers, 5-15 thrips were placed on each slide. Under the low power microscope the thrips were arranged so they all faced the top edge of the slide and were in neat rows. This alignment assisted identification under the high power microscope. Once the thrips were in place they were secured by a cover slip and dried at 30°C for approximately 24 h.

The thrips were identified using a high power compound microscope and a key for Terebrantia from the Fauna of New Zealand series. Thrips that were not *Thrips tabaci* were not further identified. Thrips that could not be identified because their distinguishing features were not visible were recorded as "Unidentifiable".

The data were tabulated and examined graphically.

4.3 Onion trap plants

Onion plants grown from bulbs were placed by 4 packhouses or in 4 or 8 onion fields for 2 weeks. At the end of 2 weeks the numbers of thrips on the plants were recorded.

4.3.1 Onion plants

Onion bulbs from Wilcox Brothers Ltd were planted individually in plastic pots (150 mm diameter) in moist growing media. The plants were kept in a heated greenhouse until they had long leaves. Before use the plants were inspected for thrips. Thrips infested plants were thrown out.

Ten pots with onion plants were stood in a metal tray near each of the 4 packhouses with the sticky trap close by. In the onion fields the 5 plants were stood in a tray near the edge of the field and 5 plants in a tray were placed at least 20 m into a field.

4.3.2 Field sites

From 27 May until 16 September the trap plants were close to 4 packhouses/onion stores: Flynn Brothers, Attewell Road; Hira Bhana Ltd, Webb Street; Vegmak Produce Ltd, Heights Road; Wilcox Brothers Ltd, Wooten Road.

From 12 August to 21 October, the trap plants were in four onion fields: Flynn Brothers, Attewell Road; Himemoa Quality Produce, Smeeds Quarry Road; Vegmak Produce Ltd, Gun Club Road; Young Wah Chong Ltd, Aulwyn Road.

From 16 September to 28 October the trap plants were in an additional 4 onion fields: Hira Bhana Ltd, Harrisville; R C and M D Fulton Ltd, Waiuku Road; Wilcox Brothers Ltd, Wooten Road; Nathu Jivan Ltd, Parker Lane.

4.3.3 Assessment of thrips on plants

After 2 weeks the plants were replaced. For the return from the field, groups of 5 plants were placed in bins covered with fine mesh cloth to prevent thrips escaping and cross contamination occurring. Each plant was inspected in the laboratory, and thrips present recorded.

The first batch of plants was kept for 8 weeks in an unheated greenhouse and then examined for the presence of larvae. The plants from each packhouse were kept together and caged in fine netting to prevent movement of thrips between groups of plants.

The data were tabulated and examined graphically.

4.4 Self set onion plants

Self set plants and sprouted onions in bins were examined several times during the autumn, winter and spring. The numbers of adult thrips and larvae were recorded.

4.5 Winter temperatures and thrips development and flights

Temperature records from 1 April to 30 September for the last 11 years from Pukekohe Research Centre were analysed. The daily minimum and maximum temperatures were converted into onion thrips development per day. Temperatures were compared graphically with the 11-year average. In addition, the time for development from egg to mid larval development was calculated for late winter and early spring, and July temperatures were examined graphically for possible relationships with onion thrips flights.

5 Results

5.1 Sticky trap data

Onion thrips were caught on sticky traps during June, September and October (Table 1, Fig. 1).

Table 1: Number of onion thrips caught on yellow sticky traps in two week periods.

Properties	10 Jun[1]	24 Jun	8 Jul	22 Jul	5 Aug	19 Aug	2 Sep	16 Sep[2]	30 Sep	14 Oct	28 Oct
Flynn Brothers/Fulton	7	0	0	0	0	0	0	0	0	0	0
Wilcox Brothers	0	0	0	0	0	0	0	0	9	16	8
Vegemak/Nathu Jivan	4	1	0	0	0	0	0	0	1	1	3
Hira Bhana	1	0	0	0	0	0	0	0	2	3	10
Mean number	3	0.25	0	0	0	0	0	0	3	5	5.25

[1] Dates when traps collected from field. From 27 May to 16 September 1999 the traps were by packhouses.

[2] From 16 September to 28 October 1999 the traps were in onion fields.

5.2 Trap plants

When the trap plants were by packhouses thrips were intercepted during June and the 2 weeks ending 16 September (Table 2, Fig. 2). The low numbers found on plants during July and August were probably contaminants from the bulbs and greenhouse. Onion trap plants in onion fields caught adult thrips in September and October (Tables 3-4, Figs: 3-4). Low catches in the last collections in October may reflect crop spraying. No significant differences were found between the numbers of thrips on trap plants in the field and at the field edge.

Table 2: Mean number of adult onion thrips per plant on onion trap plants left for 2 weeks near packhouses (mean of 10 plants).

Site	10 Jun[1]	24 Jun	8 Jul	22 Jul	5 Aug	19 Aug	2 Sep	16 Sep
Vegemak	1.9	2.0	0.2	0.1	0.1	0.1	0.0	0.4
Wilcox Brothers	0.1	0.3	0.2	0.1	0.1	0.3	0.0	0.5
Hira Bhana Ltd	1.1	0.5	0.1	0.2	0.1	0.2	0.3	1.0
Flynn Brothers	1.7	0.7	0.0	0.0	0.0	0.1	0.0	0.1
Mean	1.2	0.9	0.1	0.1	0.1	0.2	0.1	0.5

[1] Dates in 1999 when plants were collected from field.

Table 3: Mean number of adult thrips per plant on onion trap plants left for 2 weeks in onion fields (mean of 10 plants).

Site	26 Aug[1]	9 Sep	23 Sep	7 Oct	21 Oct
Flynn Brothers	0.0	0.0	0.1	0.1	0.0
Vegmak	0.0	0.0	0.1	0.8	0.1
Himemoa	0.0	0.0	0.2	0.1	0.1
Young	0.0	0.1	0.2	0.1	0.1
Mean	0.0	0.0	0.2	0.3	0.1

[1] Dates in 1999 when plants were collected from field.

Table 4: Mean number of adult thrips per plant on onion trap plants left for 2 weeks in onion fields (mean of 10 plants).

Site	30 Sep	14 Oct	28 Oct
Wilcox Brothers	1.5	13.5	0.0
Nathu Jivan	0.5	0.1	0.0
Hira Bhana	0.5	0.3	0.0
Fulton	0.1	0.2	0.0
Mean	0.7	3.5	0.0

[1] Dates in 1999 when plants were collected from field.

5.3 *Thrips on self set and other onions plants during autumn, winter and spring*

Onion thrips populations on self set plants, sprouted bulbs and crops were examined 5 times.

1. **5 May 1999**

   Well grown self sets were collected from a field near Drury. Seven of the 8 plants dissected had larval thrips. Numbers varied from 1 to numerous. The highest number counted was 25.

2. **10 June 1999**

   Several plants growing on the edge of a field next to a packhouse in Bombay were examined in the field. Plants had many adults and 2 sizes of larvae, showing that the thrips had been breeding on the plants for some weeks.

3. **10 June 1999**

   Sprouting onion bulbs in bins by a second packhouse were examined and only adult thrips were found, suggesting that if egg laying had occurred there had not been time for eggs to hatch.

4. **10 June to 2 August 1999**

   After 8 weeks in an unheated greenhouse onion plants brought back to the laboratory on 10 June had thrips larvae present, both first and second stage larvae.

5. **4 October 1999**

   A South Auckland onion crop was infested with adult thrips and juveniles of 2 sizes. There was a source of thrips on onion self sets growing adjacent to the infested field. The presence of large juvenile thrips implied that the crop was infested immediately after emergence in mid-July.

5.4 *Winter temperatures and thrips biology*

The winters of 1998 and 1999 were warmer than the 11-year average, whereas conditions during 1997 were more typical (Figs 5-7). In addition, 1999 was not as warm as 1998 (Figs 5-6). Table 5 shows that onion thrips can breed on onions throughout the autumn and adult thrips which have developed on self sets could be available to fly onto newly emerged crops if the weather is suitable for flight. The data in Table 5 also show that if newly emerged onion seedlings were colonised between 1 July and 1 August second stage larvae would be found on plants in September in warm winters.

Table 5: Time (in 120 and 200 degree days) from the first of each month for onion thrips to develop from egg to larvae and adult, assuming a developmental threshold of 11.5 °C.

	Time to reach larva 2 (120 degree days)			Time to reach adults (200 degree days)		
Start date	1997	1998	1999	1997	1998	1999
1 Apr	1 May	25 Apr	24 Apr	25 May	23 Jun	15 May
1 May	17 Jun	10 Jun	13 Jun	23 Sep	24 Jul	24 Aug
1 Jun	23 Sep	31 Jul	3 Sep	28 Oct	20 Sep	≈10 Oct
1 Jul	10 Oct	15 Sep	26 Sep	5 Nov	10 Oct	Oct
1 Aug	17 Oct	4 Oct	≈10 Oct	13 Nov	26 Oct	Oct

The weather in the winter of 1999 was warmer than the 11-year average, although the pattern followed the 11-year average (Fig. 5). The warm spell in mid-July is noteworthy. During this period, night temperatures stayed above 10°C and day time temperatures exceeded 17°C (Fig. 8). These conditions are similar to periods earlier and later in the year when onion thrips were flying, and coincide with the emergence of a crop that was subsequently found in early October to be heavily infested with thrips adults and late instar larvae. There were similar high temperatures in July 1998 while July 1997 appears to have had more normal temperatures (Figs 9-10).

6 Discussion

In order to understand the process of crop invasion by an insect it is necessary to know where the insect is between crops and the conditions required for it to invade the crops. Research this winter has identified some overwintering sites, periods of thrips flights and some aspects of crop colonisation.

6.1 Overwintering onion thrips

Onion thrips bred during winter on growing self sets. They were found flying in the vicinity of onion stores and packhouses. It is likely that adult thrips can overwinter in dormant onions either in the field or in store. They are also likely to overwinter in other places such as hedges and wasteland, and they may even breed on other plants.

However, the major source of thrips that subsequently infested fields is likely to be self set onions, onion waste dumps and onion stores. It is recommended that growers regularly remove self sets from fields, and that waste from processing onions and reject onions are disposed of in a manner that will not release thrips into the environment.

6.2 Thrips flights

Thrips flights were monitored by 2 methods, yellow sticky traps and onion trap plants. Both methods showed thrips were flying in June, September and October. The sticky traps are very time consuming and messy to operate, whereas the onion trap plants were easily grown in a heated greenhouse. However, there were always very low numbers of thrips coming from the onion bulbs planted. The use of trap plants is the preferred technique for the winter, although water traps could be useful. Neither method detected thrips flights in mid-July and both methods are dependent on local sources of thrips.

6.3 Colonisation of onion crops

For successful colonisation of a new crop there needs to be a source of thrips, suitable conditions for flying and a new crop for colonisation.

6.3.1 Sources of adult thrips

There were sources of adult thrips throughout the winter around packhouses and presumably near dumps of waste onions and on self sets. This latter is probably the most important source of onions for new crop infestation where fields are replanted. Self sets can be a source of thrips and a place for autumn flying thrips to colonise, creating a population ready to infest emerging seedlings.

6.3.2 Thrips flights

In most years thrips flights can be expected to cease during June and to resume in September. However, when there is a warm winter flights could be expected any time after crop emergence, which means that crops should be carefully monitored in late September or early October. Observations suggest flying thrips are capable of laying eggs. If infested self sets are present in a field then weather suitable for flight is less important for the population of thrips that will later colonise adjacent plants.

6.3.3 New crops

In Auckland, crops emerging after 1 July are unlikely to be invaded by onion thrips until September. However, based on observations of a South Auckland crop that emerged in mid-July, seedlings are vulnerable to colonisation by onion thrips. Onion crops emerging in autumn could support a breeding population of thrips throughout the winter.

6.4 Recommendations

Some of these recommendations are for research projects that may be more appropriately funded by the government, but it may be important for the vegetable industry to make its requirements known.

1. Reject onions and onion waste should be disposed of in a way that will not allow onion thrips to escape into the environment.
2. All onion bulbs should be removed from fields at harvest.
3. Any self sets should be removed from fields and headlands as soon as they are seen and disposed of in a way that will not allow onion thrips to escape into the environment.
4. Research should be undertaken to determine the conditions that initiate breeding in onion thrips.
5. Research should be undertaken to determine the conditions that stimulate flight by onion thrips.
6. Research should be undertaken to determine the merits of alternative methods for monitoring thrips flights.

7 Acknowledgements

Thanks for technical assistance to Helena CadenHead and Rebecca Bush, Crop & Food Research, Richard Wood for facilitating the project, Garth Wilcox for supplying the onions, and the owners of the packhouses and fields for their cooperation.

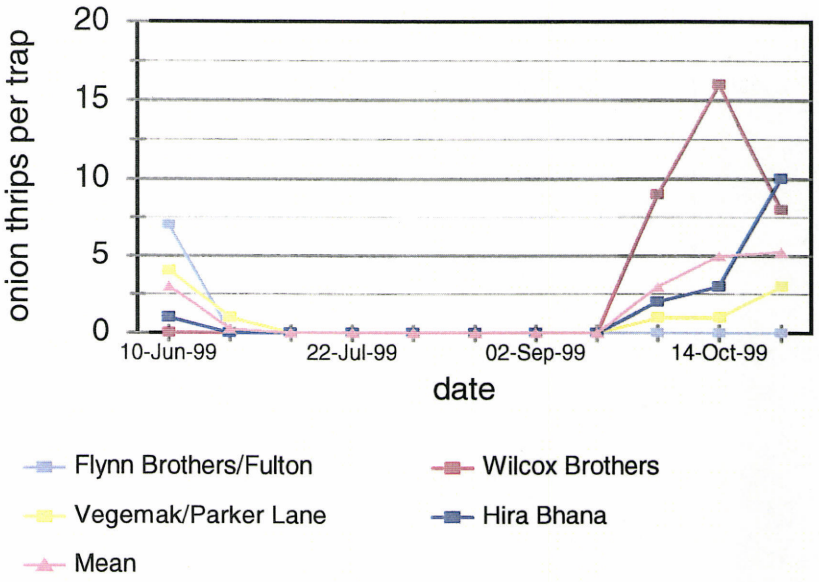


Figure 1: Number of onion thrips caught on yellow sticky traps in 2 weeks. Date when traps collected from field. From 27 May to 16 September 1999 the traps were by packhouses. From 16 September to 28 October 1999 the traps were in onion fields

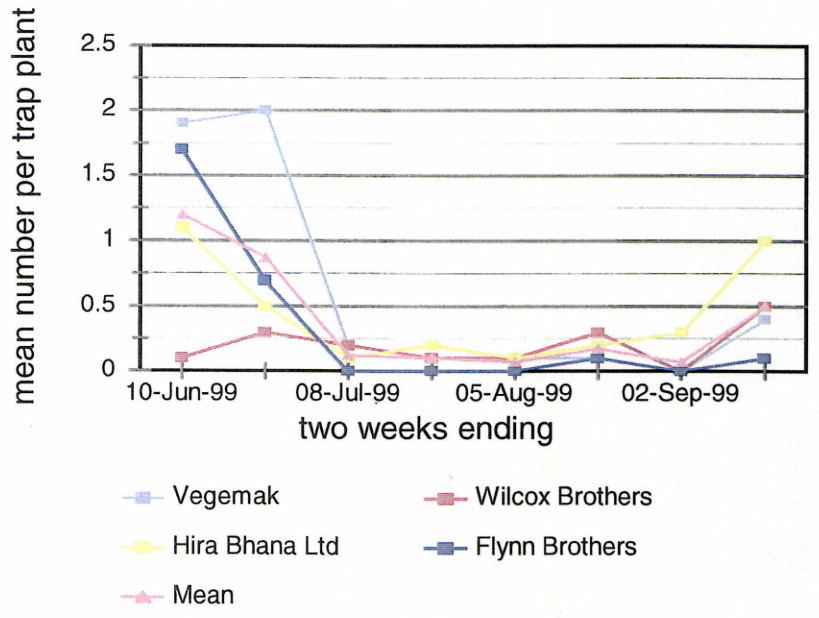


Figure 2: Mean number of adult onion thrips per plant on onion trap plants left for 2 weeks near packhouses. Mean of 10 plants per site.

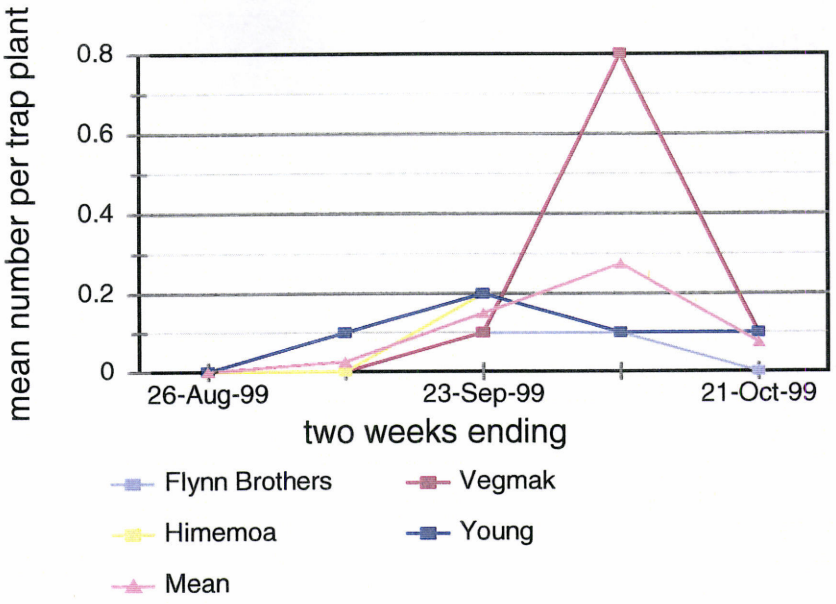
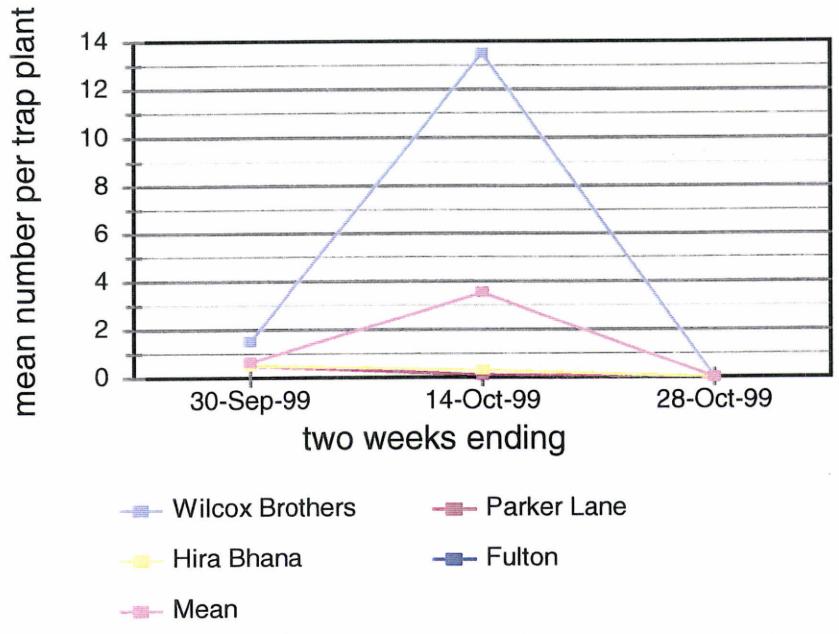


Figure 3: Mean number of adult thrips per plant on onion trap plants left for 2 weeks in onion fields. Mean of 10 plants per site.



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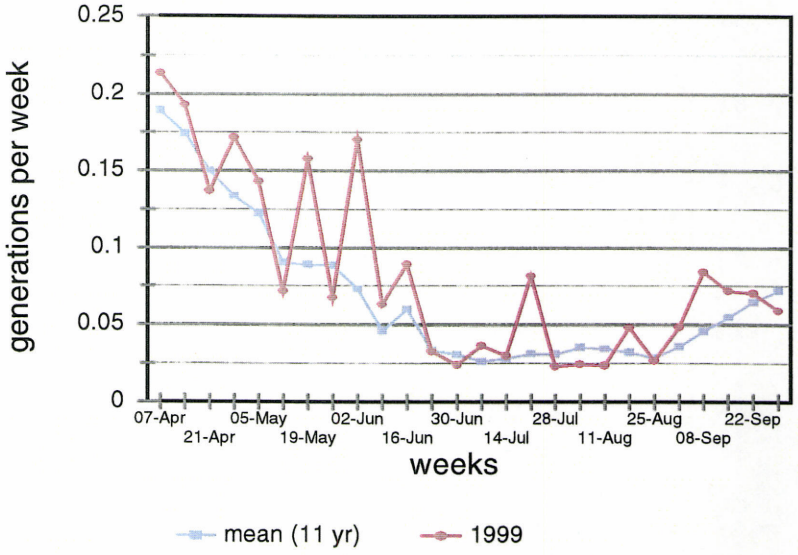

Figure 5: Winter temperatures for 1999 and the 11-year average, expressed as thrips development per week.

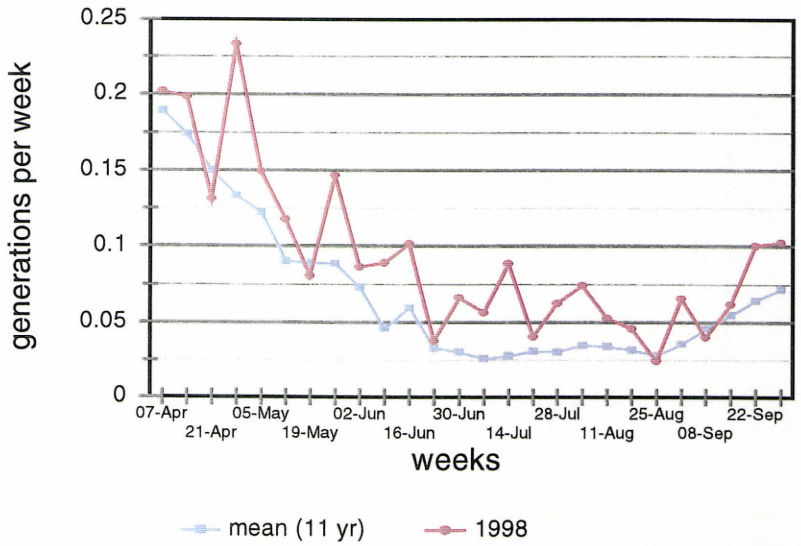

Figure 6: Winter temperatures for 1998 and the 11-year average, expressed as thrips development per week.

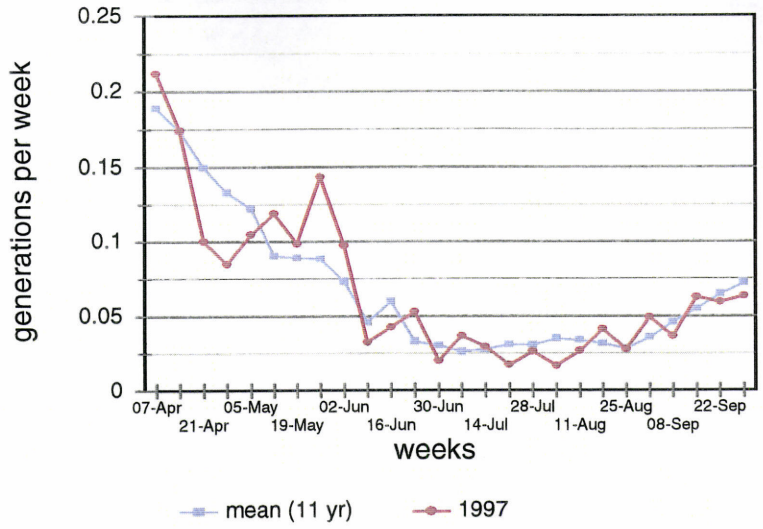

Figure 7: Winter temperatures for 1997 and the 11-year average, expressed as thrips development per week.

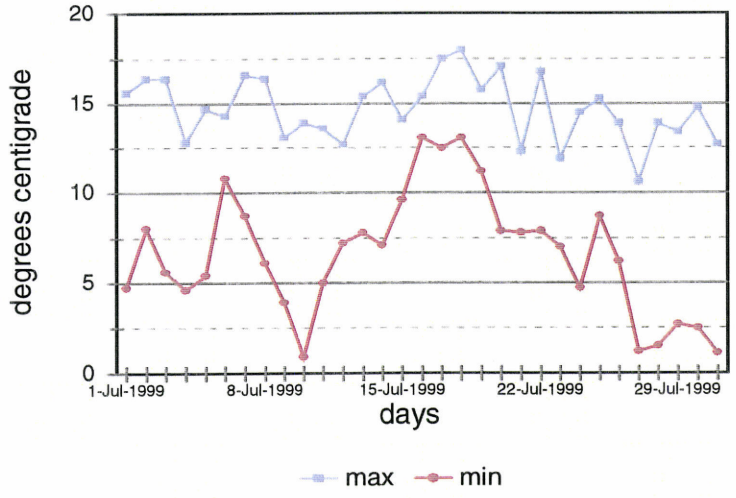

Figure 8: Daily minimum and maximum temperatures for July 1999.

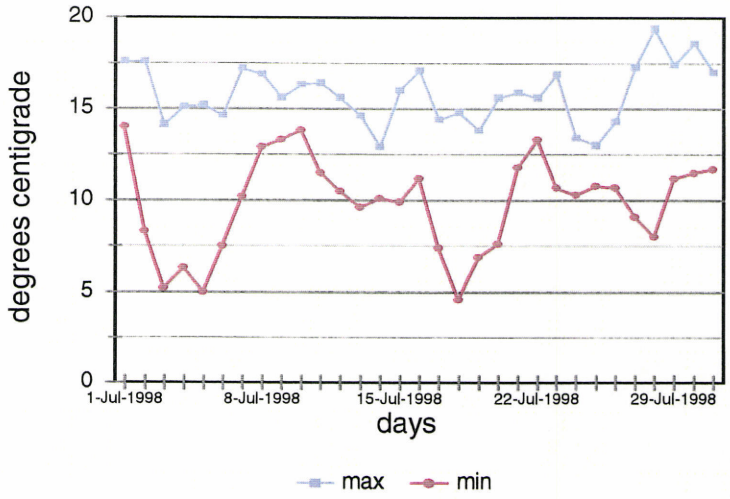

Figure 9: Daily minimum and maximum temperatures for July 1998.

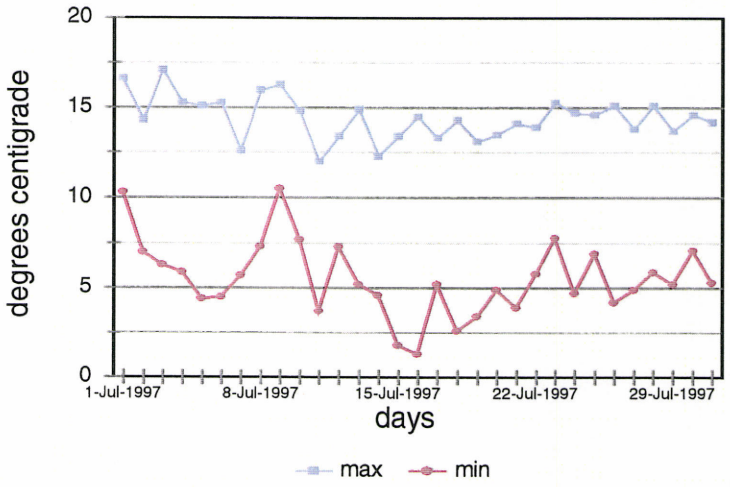

Figure 10: Daily minimum and maximum temperatures for July 1997.