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Onion thrips breeding and damage to onion bulbs: laboratory studies Milestone 2, projects 1.2.1 and 1.2.2

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A report prepared for the
New Zealand Onion Exporters Association

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1 Executive summary

Experiments were conducted in order to determine the ability of thrips to reproduce on different plant types (red onions, brown onions and leeks), to establish on different parts of onion bulbs, and to determine the amount of damage to onions caused by known numbers of thrips during a known period of time.

In one experiment, windows were cut in the outer dead skins of the onion bulbs to provide free access of thrips to the onion bulb tissue. The onions and leeks were infested with 20 adult thrips and the number of progeny recorded after 8-10 days and after 18-20 days. The rate of reproduction of thrips on brown onions was extremely slow. The rate of reproduction on red onions was higher, but still very low compared with leeks.

In a second experiment, thrips-free onions were infested with known numbers of thrips into short cut necks, onto the root bases or onto windows cut in the dead outer skins. Onions were infested with adult or larval thrips. Cages were placed over the thrips. The numbers of live and dead thrips were assessed three times (1 week, 3-4 weeks and 5-10 weeks) after infestation. Onions were infested five times. There was poor survival of thrips on the onion bulbs and very little feeding damage within the onion bulb.

Pukekohe Long Keeper onion bulbs were not a good host for onion thrips. The amount of damage caused by thrips caged over short-necked onions was negligible and unlikely to be detected by a consumer.

The window bioassay method developed for this study may be a useful tool for onion breeders to assess different onion breeding lines for vulnerability to thrips.

2 Introduction

It is well known that onion thrips can breed successfully and multiply rapidly on onion leaves. However, the current problem with thrips damage to export onion bulbs has revealed that little is known about thrips behaviour and their ability to reproduce on bulbs. Thrips naturally infest onion bulbs through the necks of the onions or through cracks in dry skins. There have been reports that onion thrips can feed and lay eggs in various parts of onion bulbs, but no information is available about the importance of various sites for feeding, survival and reproduction of thrips on these sites.

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Feeding by onion thrips is reported to damage the live onion scales and this feeding damage lowers the quality of onions in overseas markets. However, it is not known how much damage an individual thrips can do over a known period of time. It is also not known how well onion thrips reproduce on brown onion bulbs compared to other types of onions or to green *Allium* leaves.

Two trials were designed to investigate these issues. The first trial compared the rate of reproduction of onion thrips on the flesh of brown onions compared with red onions and leek leaves. The second laboratory study was designed to examine the ability of adult and larval thrips to establish, feed and breed on different parts of onion bulbs and to measure the damage done over known periods of time.

3 Methods

3.1 Ability of thrips to breed on brown (PLK) onions, red onions and leeks

Brown onions (cv. Pukekohe Long Keeper) were grown at Pukekohe Research station (see trial diary in Appendix I). Red onions were commercially grown and sourced from Young Wah Chong Ltd Pukekohe (experiment 1) and from Ian Croft Produce Ltd (experiments 2 and 3). The leeks were bought from a local retailer.

In order to expose the fresh onion scale on each bulb a 20 mm x 20 mm window was cut through the outer dry skin and the first fleshy scale of the bulb. The cuts for the window were only made on three sides so a flap of skin and scale was retained to provide shelter for the thrips. The necks of the onions were cut short and sealed with wax to prevent the thrips inoculated into the container from having access to the centre of the bulbs and to prevent contamination with thrips that may have been in the interior of the onions. Each onion was placed in a plastic jar (130 mm tall, 90 mm diameter). Segments of leeks (2 –3 rings, 30 mm long) were also placed in individual jars.

Twenty adult female thrips from colonies reared on leeks were added to each of half the jars with onions. The jars without added thrips (control onions) provided a measure of the numbers of thrips already in the onions. After adding thrips, the tops of the jars were covered with a paper tissue and a lid with a 35 mm hole. Because the leek rings rapidly dried, fresh segments were added three times per week. The jars were kept at 25°C and in 16 h light and 8 h dark. Each treatment was replicated 10 times (Appendix I).

Half of the containers were examined after 8 to 10 days when the number of larvae produced in the first generation were counted. The remaining containers were examined after 18 to 20 days and the total numbers of thrips larvae, pupae and adults in each container were assessed. The trial was repeated three times at different dates. The data were summarised using a spreadsheet before being, tabulated and graphed.

3.2 *Thrips establishment and damage to brown onions*

Onions (Pukekohe Long Keeper) were grown in Range 12 at Pukekeho Research Station as part of a Government Funded (FRST) project. The trial diary in Appendix I contains details of crop management. At top fall (30 January 2001) one bed of onions was uprooted and the necks bent tightly to reduce the chance of thrips entering the bulbs. When the bulbs were dry they were put in onion sacks and stored in ambient conditions at Mount Albert Research Centre. Onion bulbs at top fall were collected from the same bed of onions.

Experiments were set up at intervals from top fall onwards (Table 3). Known numbers of adult or larval thrips were caged over the necks of the onions and the root bases or 'windows' 20 x 20 mm cut in the dry skin (see 3.1 above). The neck of the onion was cut off close to the bulb to improve access to the space between the onion scales. The cage consisted of a plastic vial 60 mm long and 45 mm diameter with a ring of 'Bluetac' around the rim to attach it to the onion (Fig. 1). The onion and cage were placed in a plastic jar (130 mm tall, 90 mm diameter). The top was covered with paper tissue and a lid with a 35 mm diameter hole (Figs 2-3) to prevent condensation and high humidity. Each treatment was replicated fifteen times. The jars were kept at 25°C and in 16 h light 8 h dark. One-third of the containers were examined after 1 week to assess establishment, one-third after 3-4 weeks to measure the progeny from the first generation of eggs, and the last third after 5-10 weeks.

The numbers of live and dead thrips of each life stage in the jar, cage, and different parts of the bulb were recorded. Damage within the bulb was also recorded. The data were summarised using a spreadsheet and tabulated. No further analysis was undertaken.

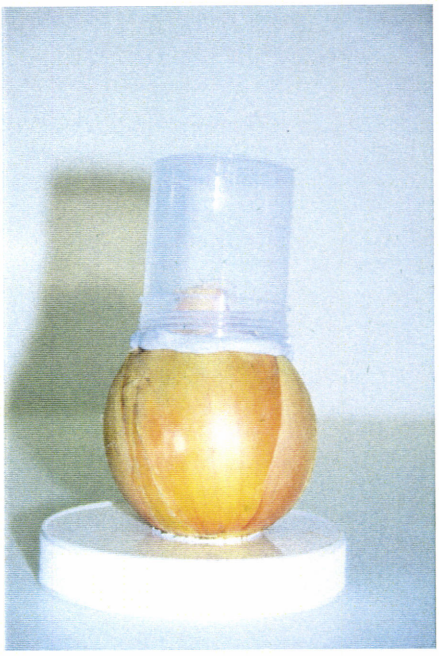

Figure 1: Cage with thrips over onion bulb with a short cut neck.

Figure 2: Onion and cage over neck in a jar covered with paper tissue.

Figure 3: Onion and cage over root base before and after placing in jar which is covered with paper tissue.

4 Results and discussion

4.1 Ability of thrips to reproduce on brown onions, red onions and leeks

Compared with leek leaves, very few thrips were produced on freshly exposed onion bulb tissue (Tables 1-2, Figs 4-5). After 8-10 days 100 adult females produced only 3-12 larvae on the brown onions and 65-128 on red onions compared to 984-1817 on the leeks (Table 1, Fig. 4). After 18-20 days the 100 female thrips produced 19-47 thrips on brown onions, 34-246 on red onions and 3174-3763 on leeks (Table 2, Fig. 5)). Even though there was only limited thrips reproduction on red onions, they caused unacceptable levels of damage to these bulbs.

The brown, control onions showed no or minimal contamination by natural infestations of thrips, while the high numbers of thrips found on the control red onions indicated that there was a significant natural infestation. This natural infestation and the variability between experiments suggest that the bioassay needs to be modified to minimise natural infestations and more onions used in each test.

Table 1: Total numbers of progeny from 100 adult female thrips on brown onions (Pukekohe Long Keeper), red onions and leeks after 8-12 days.

Date set up	Date examined	Brown onion	Brown onion control	Red onion	Red onion control	Leek
8 Mar	16 May	12	0	65	4	1814
19 Apr	30 Apr	3	0	70	14	984
10 May	18 May	7	0	128	13	1817

Table 2: Total numbers of progeny from 100 adult female thrips on brown onions (Pukekohe Long Keeper), red onions and leeks after 18-20 days.

Date set up	Date examined	Brown onion	Brown onion control	Red onion	Red onion control	Leek
3 Mar	26 May	19	0	76	21	3174
19 Apr	8 May	76	1	246	95	3763
10 May	30 May	47	0	34	83	3267

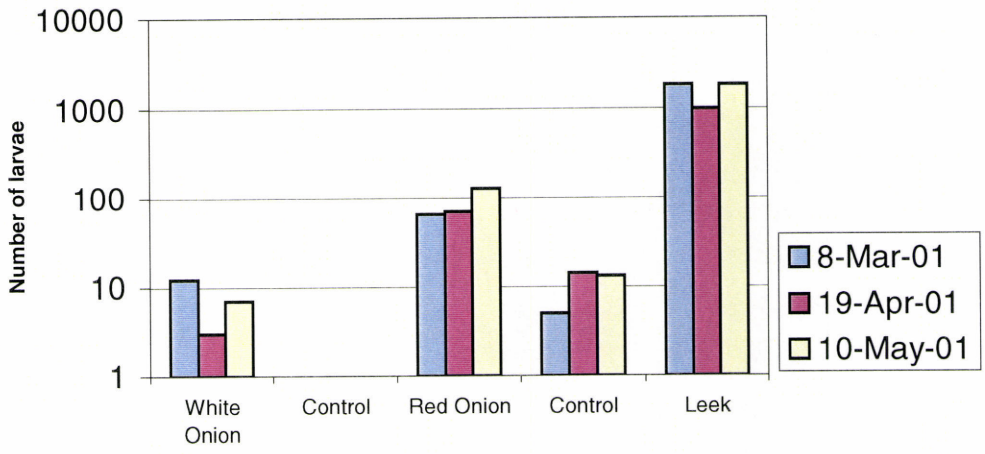

Figure 4: Larvae produced by 100 adult females after 8 days.

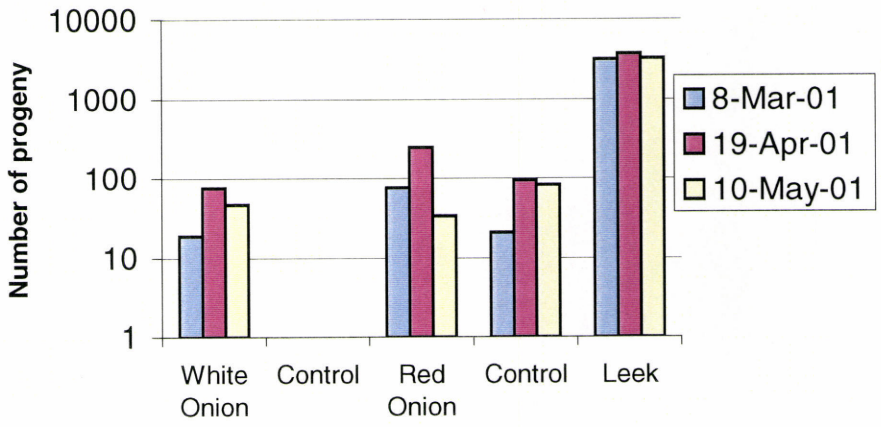

Figure 5: Progeny produced by 100 females after 18-20 days.

4.2 *Thrips establishment and damage to brown onions*

Experiments were established when bulbs were at top fall, leaves 50% dry, and at three intervals after harvest (Table 3). There was poor establishment and survival of thrips on the onion bulbs (Tables 4-8). The thrips were able to reproduce on the bulbs and some thrips were present after 10 weeks, but survival was very poor. Neither the numbers of thrips in the original inocula nor the life stage of the thrips strongly influenced the thrips populations in the bulbs.

The thrips caged over the necks of onion bulbs caused very little feeding damage in the bulbs. A consumer is unlikely to detect the damage we saw.

Table 3: Dates onions were inoculated with thrips, age of the onions and dates when the onions were examined.

Date set up	Onion condition and weeks after harvest	Date examined			Examination time after infesting (weeks)		
26 Jan 2001	Top fall	2 Feb	23 Feb	6 Apr	1	4	10
9 Feb 2001	50% dry	16 Feb	9 Mar	23 Apr	1	4	10
19 Mar 2001	2	26 Mar	9 Apr	26 Apr	1	3	5
17 Apr 2001	6	23 Apr	10 May	31 May	1	3	6
15 May 2001	10	22 May			1		

Table 4: Mean numbers of thrips surviving after caging on onions on 26 January 2001. Five bulbs per treatment.

Date examined	Weeks after infestion	5 adults in top	20 adults in top	5 adults caged over root base
2 Feb	1	6.4	6.4	1.0
23 Feb	4	2.4	0.2	0.2
6 Apr	10	0.6	0.6	0.0

Table 5: Mean numbers of thrips surviving after caging on onions on 9 February 2001. Five bulbs per treatment.

Date examined	Weeks after infestion	Caged over top of onion				Caged over root base		
		5 adults	20 adults	5 larvae	20 larvae	5 adults	20 adults	5 larvae
16 Feb	1	9.4	3.4	4.2	5.4	0.2	0.8	0.2
9 Mar	4	0.6	1.0	2.2	2.6	0.2	0.2	0.0
23 Apr	10	0.0	0.8	0.0	0.0	0.0	0.0	0.0

Table 6: Mean numbers of thrips surviving after caging on onions on 19 March 2001. Five bulbs per treatment except 10 per window treatment on 26 March.

Date examined	Weeks after infestion	Caged over top of onion				Caged over window in dry skin	
		5 adults	20 adults	5 larvae	20 larvae	20 adults	20 larvae
26 Mar	1	0.6	2.6	2.0	nd	2.3	1.7
9 Apr	3	1.0	2.0	0.6	2.8	0.4	0.4
24 Apr	5	0.2	1.6	0.6	0.8	nd	1.2

Table 7: Mean numbers of thrips surviving after caging on onions on 17 April 2001. Five bulbs per treatment.

Date examined	Weeks after infestion	Caged over top of onion				Caged over window in dry skin	
		5 adults	20 adults	5 larvae	20 larvae	20 adults	20 larvae
23 Apr	1	1.0	0.4	1.0	4.0	0.0	4.8
10 May	3	0.8	0.6	0.4	0.8	3.8	1.4
31 May	6	4.2	3.8	1.6	2.6	1.0	0.2

Table 8: Mean numbers of thrips surviving after caging on onions on 15 May 2001. Five bulbs per treatment. (NB data still to come).

Date examined	Weeks after infestion	Caged over top of onion				Caged over window in dry skin	
		5 adults	20 adults	5 larvae	20 larvae	5 adults	20 adults
22 May	1	3.6	2.8	1.0	4.8	0.4	0.6

5 Conclusions

While green onion leaves and leek leaves provide excellent substrates on which thrips can reproduce the tissue of bulbs is less satisfactory, allowing very limited reproduction. Pukekohe Long Keeper onion bulbs do not appear to be a good host for onion thrips. When thrips were caged over the necks of onion bulbs, the amount of damage caused by thrips was negligible and unlikely to be detected by consumers.

The red onions used in these trials were more susceptible to thrips than the brown Pukekohe Long Keeper onions. Not only do red onions have thin skins that are susceptible to splitting, but thrips are able to reproduce more successfully on live red onion bulb tissue than on brown onions. Even

though the rate of reproduction on the red onions was very low compared to that on leeks, thrips caused significant levels of damage to red onion bulbs.

The bioassay using windows cut in the sides of onion bulbs may be a useful tool for onion breeders to compare the vulnerability to thrips of onion bulbs from different breeding lines.

6 Acknowledgements

We thank John Thacker for organising the supply of red onions, Richard Wood for providing advice on the growing of the onions, Barry Childes for managing the crops and spraying, Lydia Huggard and Jan Elliot for technical assistance.