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Capture of onion thrips in onion storage facilities  
using sticky traps with or without thrips lure

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# 1 Executive summary

LUREM-TR is a commercial thrips attractant product that has been developed by Crop & Food Research and Plant Research International. It is currently manufactured and distributed by European partners as a tool for monitoring thrips in greenhouses.

While this tool is effective in greenhouses, the question now arises as to whether this technology can be adapted for use in the field and in onion stores. This report investigates the efficacy of thrips attractant chemicals in onion stores. Key operational issues include:

- Will environmental conditions in the stores allow the attractant and sticky trap to function effectively (**examined in this project**)?
  - sticky traps are made from coloured plastic covered in insect glue and provide a visual cue that draws thrips to the trap so lighting conditions are likely to be important
  - the chemical attractant requires air movement to diffuse odour away from the trap so air flow in stores may be a factor
- Will the strong onion odour present in onion stores interfere with the activity of the attractant chemical (**beyond the scope** of this project)? and
- Have thrips trapped on the sticky boards flown into the stores or come from the onions stored in the bins (**beyond the scope of this project**)?

## **This project**

The current project examined the conditions within a variety of onion storage facilities, and tested LUREM-TR lures with sticky traps inside these stores for their ability to increase capture of onion thrips relative to traps without the lure.

Three onion stores in Pukekohe (Balle Brothers, Master and Sons, Jivan Lakhu) and four onion stores in Canterbury (Tucker, Pye, Turley, and Howey), plus 1 pack house (Southern Packers Ltd, Canterbury) were selected for this study.

The conditions (light, temperature, air flow) within each facility during March–May 2008 were documented.

Sticky traps with or without LUREM-TR were placed on fixed structures within onion stores (usually on support beams) or outside (along the walls or fence lines). Traps were not placed on or in the bins themselves since these are frequently moved.

Three to four traps were placed within each store, and two to four outside (as a positive control, since the lure should 'work' outside). Traps were replaced weekly and the species and numbers of thrips were recorded. The trapping period was determined by numbers of onion thrips caught on traps, so no further traps were set up when thrips numbers were low, or when onions were no longer being stored (Canterbury: Pye, Turley). The trapping period was 3–5 weeks in Canterbury and 8–9 weeks at Pukekohe.

## **Results**

Conditions within onion stores varied considerably among the stores used in this study. The onion stores varied from partially open structures (open on one or two sides) to completely enclosed, with temperature controlled environments. They also ranged in size, with floor areas ranging from <500 to >2000 m<sup>2</sup>.

Inside onion stores where there was little or no light, with ambient temperature (5–20°C) very few thrips were caught on any sticky traps.

Where thrips were caught on sticky traps within the onion stores, there was no increase in thrips numbers on traps with LUREM-TR compared to on traps without the lure.

However, sticky traps with LUREM-TR hung along fences outside onion stores generally caught more onion thrips than traps without the lure.

### **Conclusions**

Factors that may have contributed to **low thrips numbers on all traps** within some onion stores, regardless of the presence or absence of LUREM-TR, may include:

- the lack of light or poor lighting (affecting the visual response of thrips to traps)
- the position of the traps within the stores (affecting the ability of thrips to detect traps).

Factors that may have contributed to **a lack of increase in capture of thrips on traps with LUREM-TR** compared with traps without LUREM-TR in onion stores may include:

- odours from the onions may have interfered with the ability of thrips to detect the odour from the lure
- the LUREM-TR system was developed for use in greenhouses. The environment in an onion store is vastly different so the delivery system (i.e. the way the chemical attractant is packaged then released once it is attached to a trap) may need to be altered to function effectively in an onion store. When tested outside onion stores, LUREM-TR did not increase the numbers of onion thrips caught to the same extent as it has in greenhouses, suggesting an alternative delivery system may also improve onion thrips capture in the field.

### **Recommendations**

Increasing the attractiveness of the lure odour to onion thrips compared with odours from onions may be the key to developing a more efficacious trapping system for onion stores.

We could then develop (i) an improved trap (e.g. including a light source with the coloured sticky boards), and (ii) optimal systems for arranging traps within a storage facility (e.g. suspending traps over the top of bins).

Once the best odour delivery system (how the chemical attractant is packaged, then released near/on a trap) and trap design have been developed we can then investigate the relationship between trap capture and numbers of onion thrips in stored onion bulbs, which will in turn help to determine the optimal number and location of traps within a storage facility.

## 2 Introduction

LUREM-TR is a commercial thrips attractant product that has been developed by Crop & Food Research and Plant Research International. It is currently manufactured and distributed by European partners as a tool for monitoring thrips in greenhouses.

Previous research has shown that onion thrips are highly attracted by the thrips attractant chemical either:

- Using a prototype lure (containing the same chemical attractant as LUREM-TR)
  - in grass fields, traps with a prototype lure caught 24–84 times more onion thrips than traps without (Teulon et al. 2007; Davidson et al. in press)
  - in an onion crop, the prototype lure caught on average 18 times more onion thrips over a 24-hour period than traps without the lure (Davidson et al. in press)
- Using LUREM-TR
  - traps in greenhouses with the commercial lure caught up to 15 times more onion thrips than traps without the lure (Teulon unpublished data).

While LUREM-TR is effective in greenhouses, the question now arises as to whether this technology can be adapted for use in the field and in onion stores. This report investigates the efficacy of thrips attractant chemicals in onion stores. Key operational issues include:

- Will environmental conditions in the stores allow the attractant and sticky trap to function effectively (**examined in this project**)?
  - sticky traps are made from coloured plastic covered in insect glue and provide a visual cue that draws thrips to the trap so lighting conditions are likely to be important
  - the chemical attractant requires air movement to diffuse odour away from the trap so air flow in stores may be a factor
- Will the strong onion odour present in onion stores interfere with the activity of the attractant chemical (**beyond the scope of this project**)? and
- Have thrips trapped on the sticky boards flown into the stores or come from the onions stored in the bins (**beyond the scope of this project**)?

A previous study has shown that yellow sticky traps may be used to monitor thrips in stored onions in bins, although the light conditions under which traps caught thrips were not reported (Martin & Workman 2001). Unlike the study described in this report, the sticky traps in Martin & Workman's study were positioned in or on top of bins that were not moved during their eight-week study. Also, their study did not determine if the numbers of onion thrips on the sticky traps were related to the numbers in the stored onions. A further study by Tomkins (2002) also did not find a strong relationship between onion thrips numbers on traps and numbers in stored onions, but the position of the traps in relation to the bins and light conditions were not reported.

The combination of a volatile chemical lure and a coloured sticky trap may improve monitoring of onion thrips in stored onions. The study described here was a preliminary evaluation of the potential application of the thrips lure using the commercial delivery system, LUREM-TR developed for greenhouses combined with coloured sticky traps, for capturing onion thrips in onion storage facilities.

### 3 Methods

Three onion stores in the Pukekohe area and four in Canterbury, plus a pack house in Canterbury were selected for this study (Table 1). The number of traps hung along permanent structures within, just outside, or well away from (at least 20 m) the onion stores (to sample thrips in the outdoor environment) are given in Table 2 (see Appendix I for photos of stores, with arrows indicating approximate locations of traps). Traps at least 20 m away from the stores were hung along fences or hedges as a positive control, since the lure should ‘work’ outside. For all stores except Turley’s, sticky traps at a given location either all had no lure or all had 1 or 4 lures hung from each trap. In Turley’s store traps could be placed far enough apart (at least 15 m to avoid traps with a lure contaminating traps without a lure) to compare the numbers of thrips captured on a trap with a lure to the numbers captured on a trap without (paired test) within a given week. The conditions inside each facility (temperature, light, air flow) were documented (Table 3).

Table 1: Onion stores used as study sites for thrips attractant trials.

Region, onion store	Type and size	Sample dates
<b>Pukekohe</b>		
Balle Brothers	Partially open, >2000 m <sup>2</sup>	6 March to 8 May 2008
Master and Sons	Two partially open, each 500–1000 m <sup>2</sup>	6 March to 8 May 2008
Jivan Lakhu	Partially open 1500–2000 m <sup>2</sup>	6 March to 8 May 2008
<b>Canterbury</b>		
Tucker	<500 m <sup>2</sup>	19 March to 16 April 2008
Pye	Enclosed <500 m <sup>2</sup>	4 March to 1 April 2008
Turley	Enclosed, 1000–1500 m <sup>2</sup>	4 March to 8 April 2008
Howey	Enclosed, <500 m <sup>2</sup>	11 March to 1 April 2008
Southern Packers	Pack house, partially open, 1500–2000 m <sup>2</sup>	11 March to 1 April 2008

Blue sticky traps, 10 x 20 cm (Pherobank traps, purchased from Horticulture), were hung 1.5–2 m above the ground, from permanent structures within the stores or, in the case of Master and Sons, between two adjacent stores (Appendix I). The sticky traps were not attached to the bins because these were frequently moved during the week for grading or were repositioned within the store as more onions were harvested.

We used LUREM-TR as the delivery system for the thrips attractant because (1) it is already commercially available, and (2) is reported to work for up to four weeks, whereas our prototype lure has only been shown to work for up to 3 days (Teulon unpublished data).

Sticky traps and lures were replaced each week. The presence or absence of lures on sticky traps was altered each week within or just outside the onion stores, except inside Turley’s store where two traps had lures and two traps had no lures in any given week, alternating lures between the traps each week. Likewise along fences or hedges, the traps with or without lures were swapped each week.

Table 2: The number of traps hung along permanent structures within, just outside, or well away (at least 20 m) from the onion stores. At each location (except for



Turley's store) all of the traps had either no lure or all had one or, from early April, four lures hanging from them.

Region, onion store	Number of traps inside	Number of traps along exterior wall(s)	Number of traps along fence or hedge (positive control) <sup>1</sup>
<b>Pukekohe</b>			
Balle Brothers	4	3 (north wall), 4 (south wall)	4
Master and Sons	4	4	0
Jivan Lakhu	4	4	0
<b>Canterbury</b>			
Tucker	2	0	2
Pye	4 (2 along railing, 1 in each of 2 windows)	0	2
Turley <sup>1</sup>	4	0	4
Howey	4	0	0
Southern Packers	5	0	4

<sup>1</sup>Paired traps (one or two traps with the lure and one or two without the lure) to determine if LUREM-TR could increase trap capture of onion thrips relative to traps without the lure.

All of the support beams at Master and Sons that could be used to hang traps from were around the outside of the onion stores buildings. There were no other structures within the stores at Master and Sons from which traps could be hung. Consequently the traps were hung from support beams along the exterior of one of the stores, with a neighbouring store within 0.5 m (Appendix I).

When traps and lures had been hanging up for a week they were collected by placing one or two sticky traps from the same store and location within a labelled A4 plastic sheet protector and taken or sent to the entomology laboratory at Crop & Food Research, Lincoln, where onion thrips were identified and counted on each sticky trap using a stereo microscope (up to 100x magnification).

## 4 Results

### 4.1 Conditions within onion stores

The light conditions, temperature and air flow within onion stores are described in Table 3 (see Appendix I for photos of stores).

Conditions amongst the onion stores varied considerably, from partially open structures (open on one or two sides) to completely enclosed, temperature controlled environments. Light conditions within the stores ranged from no to very little light (e.g. Balle Brothers, Tucker) to some artificial lighting. They also ranged in size, with floor areas ranging from <500 to >2000 m<sup>2</sup>.

Table 3: The light, temperature and air flow conditions within the different onion stores. Ambient temperatures at the Pukekohe stores ranged from 10 to 20°C, and at the Canterbury stores without controlled temperatures from 5 to 18°C.

Region, onion store	Type and size	Light	Temperature	Air flow
<b>Pukekohe</b>				
Balle Brothers	Partially open, >2000 m <sup>2</sup>	Ambient light very low intensity within middle of store, i.e. no to very little light	Ambient temperature	Very low within middle of store; no visible movement of sticky traps
Master and Sons	Two partially open, each 500–1000 m <sup>2</sup>	Ambient light levels high between stores where traps were positioned, i.e. full daylight	Ambient temperature	Moderate to high; visible movement of sticky traps
Jivan Lakhu	Partially open 1500–2000 m <sup>2</sup>	Ambient light levels moderate to low within the store	Ambient temperature	Low to moderate; occasional movement of sticky traps
<b>Canterbury</b>				
Tucker	<500 m <sup>2</sup>	Ambient light very low intensity within (tarp used to cover onion bins removing all ambient light)	Ambient temperature	Fan on; high air flow, when fan is off; very low air flow within middle of store
Pye	Enclosed <500 m <sup>2</sup>	Ambient light very low intensity within, unless doors open or artificial lighting on	Controlled temperature (28°C)	Fan on; moderate to high at railing. High at openings (windows) in wall dividing store in half
Turley	Enclosed, 1000–1500 m <sup>2</sup>	Ambient light very low intensity within, unless doors open or artificial lighting on	Controlled temperature (28°C)	Fan on; moderate to high
Howey	Enclosed, <500 m <sup>2</sup>	Ambient light very low intensity within, unless doors open	Ambient temperature	Low to high depending if doors were open
Southern Packers	Pack house, partially open, 1500–2000 m <sup>2</sup>	Ambient light moderate due to artificial lighting and open doorways	Ambient temperature	Low to moderate

It was not possible to determine how often and for how long artificial lighting was turned on within Pye and Turley's stores, or how often or for how long the doors on Howey's store were open.

## 4.2 Onion thrips trap capture

Most traps were left in, around or near onion stores for seven days, except during the first sample week at Pye (Canterbury) where initially traps were replaced after 2 days, then every 7 days. The total numbers of onion thrips caught on each trap with or without lures hung within or just outside along the walls of onion stores are presented in Figures 1–5 for the following stores: Pye, Turley, Balle Brothers, Jivan Lakhu, and Master and Sons. No onion thrips were caught on sticky traps hung within the pack house (Southern Packers), or Tucker's onion store, and only 2 onion thrips were caught on any of the 12 traps hung within Howey's onion store over the 3-week trapping period. The total numbers of onion thrips caught on traps hung outside Southern Packers (two traps on a fence and two traps near a gorse hedge) and near a hedge at Tuckers are presented in Figures 6 and 7.

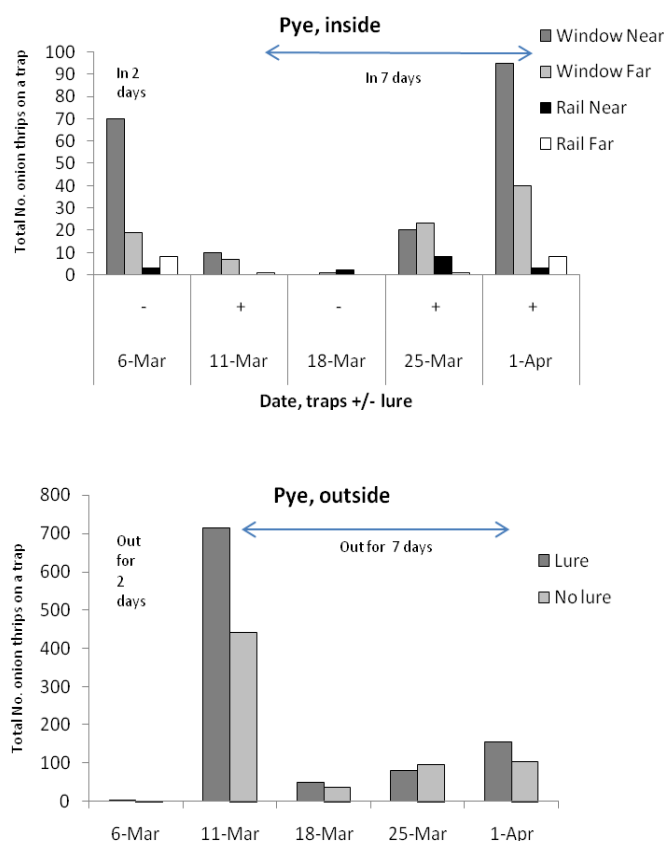


Figure 1: Total numbers of onion thrips caught on traps hung inside Pye's onion store, or along the fence, outside

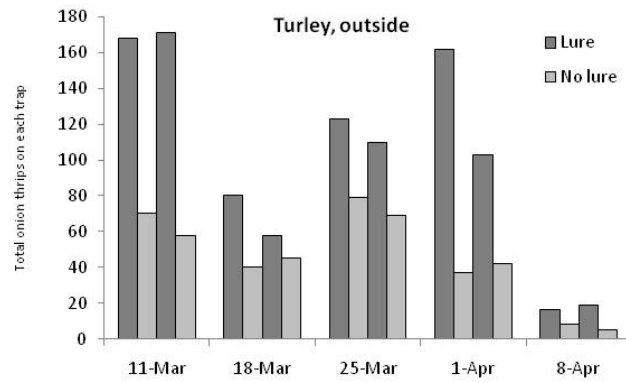
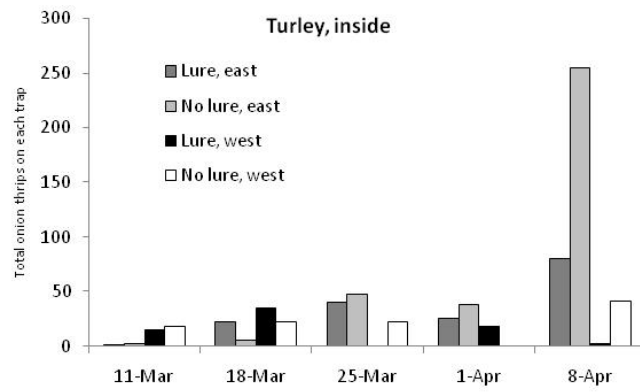


Figure 2: Total number of onion thrips caught on traps hung inside Turley's onion store, or along the fence, approximately 50 m north of the onion store.

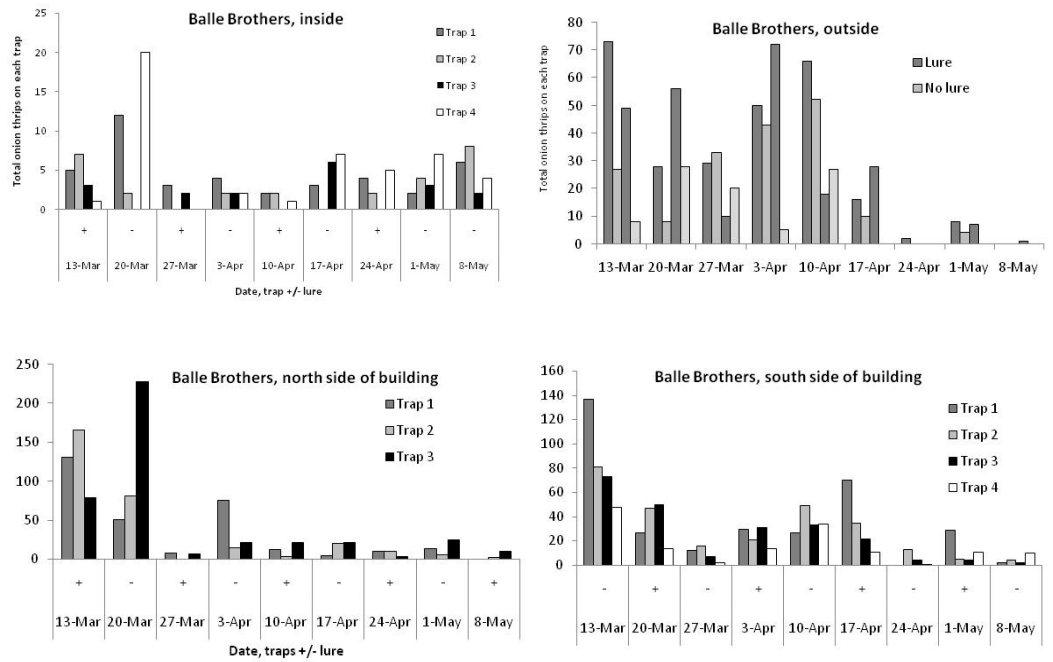


Figure 3: Total number of onion thrips caught on traps hung inside Balle Brother's onion store, or along the fence, outside, or along the northern or southern exterior sides.

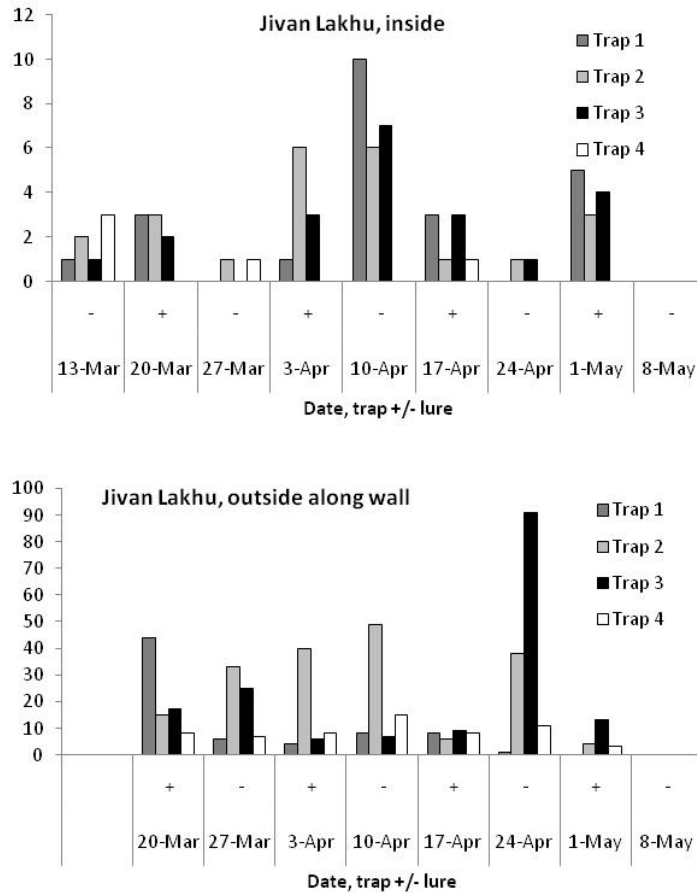


Figure 4: Total number of onion thrips caught on traps hung inside Jivan Lakhu's onion store, or along the exterior side.

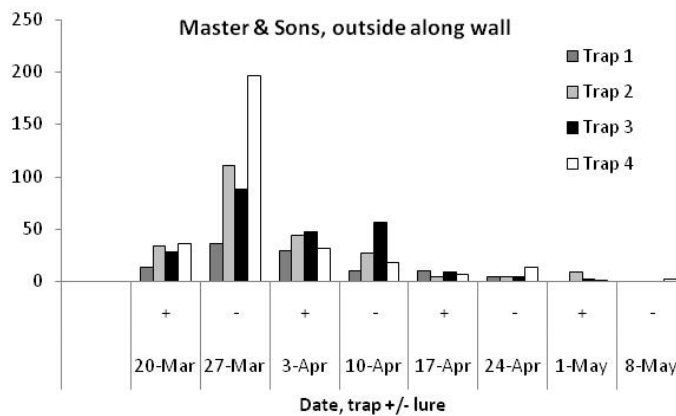


Figure 5: Total number of onion thrips caught on traps hung inside Master and Son's onion store, or along the exterior side.

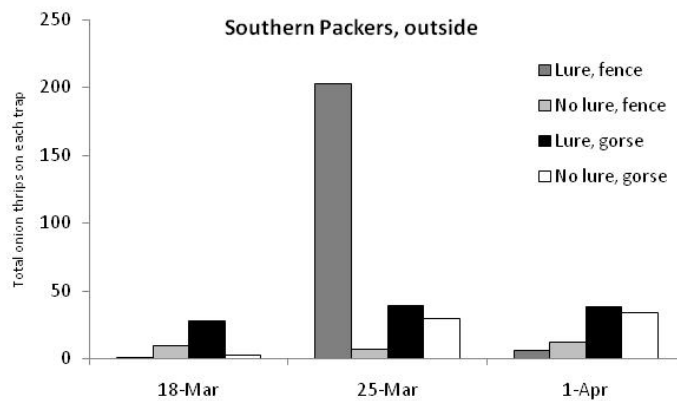


Figure 6: Total number of onion thrips caught on traps hung outside Southern Packers along a fence or gorse hedge.

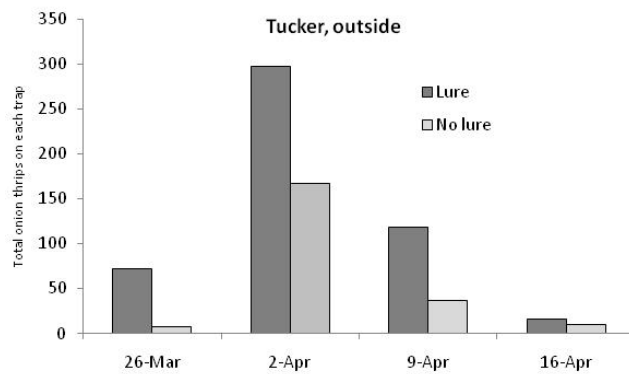


Figure 7: Total number of onion thrips caught on traps hung outside Tucker's onion store along a hedge.

Inside onion stores where there was little or no light, very few thrips were caught on any sticky traps (<20 thrips, Figures 3–4). More thrips were captured on sticky traps in stores that had artificial lighting (up to 95 inside Pye's and 255 inside Turley's stores, Figures 1–2). However, surprisingly few thrips were caught on traps hung between stores at Master and Sons (Figure 5) despite these traps being in higher ambient light conditions (i.e. receiving almost full daylight) compared to those within the stores at Balle Bros or Jivan Lakhu.

Where thrips were caught on sticky traps within the onion stores, there was no clear increase in thrips numbers on traps with LUREM-TR compared to on traps without the lure (Figures 1–5).

There was no increase in the number of onion thrips on traps with lures compared to on traps without lures hung along walls just outside onion stores (Figures 3–5).

However, sticky traps with LUREM-TR hung along fences outside onion stores generally caught more onion thrips than traps without the lure (Figures 1–3, 6–7). Traps with LUREM-TR caught 0.8–1.6 times more onion thrips than traps without along the fence approximately 20 m east of Pye's storage facility (Figure 1); 1.3–4.4 times along the fence line approximately 50 m north of Turley's storage facility (Figure 2); 0.1–29.0 times more along the fence line approximately 50 m north of Southern Packers facility (Figure 6); and 0.5–6.1 times more along the fence line approximately 30 m east of Balle Bros. storage facility (Figure 3).

## 5 Conclusions

This study was a preliminary evaluation of the use of a commercially available thrips lure, LUREM-TR, with coloured sticky traps in onion stores for onion thrips capture. The traps were set up within stores with the aim of minimising the impact on operations within the stores.

In contrast to catches obtained in greenhouse crops on these lure and sticky traps, low numbers of thrips were caught on traps within some onion stores, regardless of the presence or absence of LUREM-TR. Reasons for this may include:

- the lack of light or poor lighting, affecting the visual response of thrips to traps
- the position of the traps within the stores, affecting the ability of thrips to locate traps.

Factors that may explain why traps with the lure did not catch more thrips than traps without the lure in onion stores may include:

- odours from the onions may have interfered with the ability of thrips to detect odour from the lure
- the LUREM-TR system was developed for use in greenhouses, an environment that is vastly different to that in onion stores. Even when tested outside onion stores, LUREM-TR did not increase onion thrips capture to the same extent as it has in greenhouses, or as has the prototype lure. This suggests that the current LUREM-TR delivery system needs adaptation for use inside onion stores or outside in the field.



## 6 Recommendations

If we can demonstrate that the odour can be more attractive to onion thrips than odours from onions, then this would help us to develop a delivery system better suited to onion stores.

With an improved delivery system (the way the chemical attractant is packaged then released once attached to a trap) we could then develop (i) an improved trap (e.g. including a light source with the coloured sticky boards), and (ii) optimal systems for arranging traps within a storage facility (e.g. suspending traps over the top of bins).

Once the best trap design and lure delivery system have been developed we can then investigate the relationship between trap capture and numbers of onion thrips in stored onion bulbs.

## 7 Acknowledgements

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# Appendix I

Photos of onion stores indicating the location of traps.

## Pukekohe onion stores



Balle Bros Ltd, Pukekohe. Arrows indicate general location where sticky traps were hung along the northern and southern sides of the onion store and from a fence approximately 40 m from the store.



One of the entrances to Balle Bros store, and general location of traps positioned inside the store (indicated by arrow).



Jivan Bahku. Arrow points to a sticky trap hanging on the wall. Three other traps were hung approximately 4 m apart further along the wall away from the entrance.



Sticky traps hung inside Jivan Bahku onion store, approximately 15 m from the entrance shown in the picture above.



Onion store (showing about two-thirds of one of the two such structures) at Master and Sons.



Sticky traps hung between stores at Master and Sons. Traps could not be hung within the stores because there were no structures available to hang them on.

## Canterbury onion stores



Temperature controlled onion store, Pye.



Inside Pye onion store, showing 'window' between wall separating store where sticky traps were hung (top), and in the foreground of the bottom picture, the railing where two other traps were hung.





Southern Packers, course grading. Position of one of the traps indicated with arrow. The second trap was positioned at a similar height (about 2 m above the ground) and location relative to the grading machinery on the opposite wall.



Southern Packers, finer grading machinery for domestic market or export grading. Position of sticky traps indicated with arrows.



Howey's store at Southern Packers. Four sticky traps were positioned approximately 5 m apart inside, along the wall indicated with the arrow.



Tucker's onion store (open half of shed) indicated by arrow.



Turley's temperature controlled onion store.



Inside western half of Turley's store. Railing in the foreground was used to hang sticky traps. Other half divided by a wall is similar, where a further two traps were hung along a similar railing as that shown.