Thresholds for Plague Thrips in the Victorian strawberry industry

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Final Report

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HAL Project BS12003 - : Thresholds for Plague Thrips in the Victorian strawberry industry

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Purpose of the Report:

The aim of this project was to help strawberry growers in Victoria, and other States, to know what level of plague thrips causes damage, so that they can minimise insecticide use and improve sustainability.

Funding Sources: This project has been funded by HAL using voluntary contributions from the Victorian Strawberry Industry Development Committee with matched funds from the Australian Government.

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Contents

Media Summary

The aim of this project was to determine whether or not large numbers of plague thrips (up to and more than 50), either alone or in combination with onion thrips, cause damage to strawberry flowers and berries. This project was conducted over two consecutive growing seasons and the conclusion from the first seasons work was that up to 50 plague thrips in a flower caused no damage to the subsequent berry. The results of the second seasons work suggest that even more than 100 thrips per flower caused no damage to subsequent fruit.

Data on populations of plague thrips were collected from strawberry farms in Wandin, (Yarra Valley, Victoria). The data were collected using sticky traps to find out the number of plague thrips flying as well as from flowers to find out how many were actually in the crop. The numbers of thrips detected in the 2013-14 season were very low when compared to previous seasons.

Because the number of plague thrips was so low in the strawberry crops, it was necessary to field collect plague thrips and onion thrips from other sources (such as weeds in the Werribee South agricultural area).

These thrips were then caged on flowers of potted strawberry plants to assess subsequent levels of damage. The variety of strawberry grown was *Albion*, which is one of the most common varieties currently grown in Victoria. Fifty plus adult thrips were placed on each flower; more thrips were added to the same flower over three days to replicate a flight of thrips.

The cages were removed at petal drops and each flower was tagged and continued to grow until the berry was fully formed and ripe. Then the ripe berry was photographed and scored for damage. Even up to 150 thrips per flower caused no observable damage to berries when compared to untreated controls.

Technical Summary

The aim of this project was to determine whether or not large numbers of plague thrips (*Thrips imaginis*) alone or in combination with other thrips such as onion thrips (*Thrips tabaci*) can cause damage to strawberry flowers and the subsequent berries.

This project was conducted over two consecutive growing seasons (2012 - 2013 and 2013 – 2014) and the conclusion from the first seasons work was that up to 50 plague thrips in a flower caused no damage to the subsequent berry. The results of the second seasons work suggest that even more than 100 thrips (around 150 thrips in total over 3 days) per flower caused no damage to subsequent fruit.

Data on populations of plague thrips were collected from strawberry farms in Wandin, (Yarra Valley, Victoria). The data were collected using sticky traps, to find out the number of plague thrips flying, as well as from flowers to find out how many were actually in the crop. The numbers of thrips detected in the 2013-14 season were very low when compared to previous seasons. In 2009 – 2010 numbers of plague thrips were orders of magnitude higher than during this study. Such seasonal variation is not unusual.

Because the number of plague thrips was so low in the strawberry crops, it was necessary to field collect plague thrips and onion thrips from other sources (such as weeds in the Werribee South agricultural area).

These thrips were then caged on flowers of potted strawberry plants to assess subsequent levels of damage. The variety of strawberry grown was *Albion*, which is one of the most common varieties currently grown in Victoria. Fifty plus adult thrips were placed on each flower; more thrips were added to the same flower over three days to replicate a flight of thrips.

Cages were removed at petal drop and then each flower was tagged and continued to grow until the berry was fully formed and ripe. Then the ripe berry was photographed and scored for damage. Even up to 150 thrips per flower caused no observable damage to berries when compared to untreated controls.

The conclusion of this project is that, at least on the variety Albion, it is not worth applying insecticides to target plague or onion thrips in flowers. Such applications are likely to disrupt the biological control of insects and mites that actually do cause damage to strawberries.

Introduction

Plague thrips (*Thrips imaginis*) are an annual occurrence in Victorian strawberry crops. As their name suggests they often arrive in overwhelming numbers when the bush and surrounding vegetation dries out and the thrips disperse in search of other habitats. Their timing often coincides with peak strawberry production. Victorian strawberry growers would often spray an insecticide for thrips every few days during this time of year for fear of losing their crop leading up to Christmas. The insecticide used for plague thrips, Success Neo, is expensive and could also have an impact on some beneficial species important in an IPM program if overused.

The damage caused by plague thrips is not clearly understood. Western flower thrips are certainly severe pests of strawberries and this is the same in Europe and North America (Hancock; University of California). Rightly or wrongly, plague thrips have been associated with distortion to the berries, aborting flowers and scarring fruit. However, in addition to plague thrips, onion thrips (*Thrips tabaci*) is also a common occurrence alongside plague thrips in strawberry flowers. Unlike western flower thrips, which certainly breeds in flowers and so juveniles are present, plague and onion thrips do not establish ongoing populations after their initial invasion and so it is winged adults that are present. Growers can easily distinguish the yellow juveniles of western flower thrips from the brown adults of plague and onion thrips and so usually have a good idea of the type of thrips present. This differentiation has been made even more straightforward in the past when insecticides targeting thrips were applied, as insecticide resistant western flower thrips would be the only individuals remaining (plague thrips and onion thrips are not resistant to sprays such as *Success* (spinosad) at this stage).

This project was conducted over two seasons and in the first year's trials it was demonstrated that 50 plus plague thrips did not cause damage to strawberry flowers. The industry however felt that more information was needed on the damage caused by a prolonged flight of very high numbers of thrips, and so the project went to Year 2 where the sole aim was to look at higher levels of thrips per flower. Plague thrips are usually far more abundant for a few weeks in summer than onion thrips but in the last season (2013-2014)

the numbers of plague thrips were so low that onion thrips were a significant part of the species composition and so the tests used both species, not just plague thrips.

Due to insecticide use on commercial strawberry farms it was decided that the best way to conduct this trial in the second season was by using potted strawberry plants. So all of the results reported here for year two relate to the use of these plants, but in year one the trials were on a commercial farm.

The aim of this project was to clarify the type of damage, if any, that plague thrips cause and also how many plague thrips per flower can be tolerated before any damage occurs. Knowing that would allow us to advise on whether or not insecticide applications targeting plague thrips are worthwhile in reducing damage to berries.

Materials and Methods

Trials were carried out over two growing seasons (2012 - 2013 and 2013 - 2014).

2012 -2013 Season Trials

In the first season of trials, the impact of different numbers of thrips on strawberry formation was assessed in two ways. The first involved using the naturally occurring levels of plague thrips (as measured by the average number of thrips per flower) and the second method involved caging flowers with known numbers of thrips.

Our aim for conducting the second part of the trial was to cage individual flowers with either a known number of thrips, or to cage flowers and count the number of thrips that were in them naturally when the cages were removed, and assess the fruit at harvest. This was conducted at a commercial strawberry farm and involved first using naturally occurring levels of plague thrips and then using higher levels of thrips which were added to the caged flowers.

It was very important that the caged flowers were not sprayed with any insecticides during the trial, and that marked flowers that were tagged were left intact until ripe. For this to be achieved we needed the collaboration of the growers and also the casual labourers. Plague thrips are generally only found in high numbers for a few weeks around December and we used the sticky trap data to get the timing right. Unfortunately the traps placed on the medium to large farms did not provide continuous sets of data as the traps were damaged. We placed traps each week but they were not useable when we came to assess them. Also many of our tags were removed and placed on other plants making any assessment impossible. There are high numbers of casual labourers on the larger farms and communication is difficult. For this reason we conducted our caged flower trial on one commercial farm only, Santo and Maria Faella's (referred to as Site 1). This was the smallest of the farms where we attempted trials and so was much easier to ensure that the traps, cages and tagged berries were left untouched and also that the trial was not sprayed. Santo and Maria Faella were very helpful and very keen to be involved.

Counts of thrips were made using sticky traps and these were compared to data from other recent years. Thrips numbers were also estimated using counts from 10 flowers. Table 1 indicates the levels of thrips tested the first set of cage trials at Site 1.

Table 1: Average numbers of plague thrips per flower at different sampling times

Low	Medium			High	Very High
2.7	8.1	9.7	10.9	14.3	50.0

We conducted two trials at site 1, using naturally occurring levels of plague thrips in the first trial and then caging set numbers of plague thrips in a subsequent trial. We used 10 flowers on ten different plants for each treatment and also 10 controls which were caged to exclude plague thrips.

2013 – 2014 Season Trials

In the second season, all trials were conducted using potted plants. Fifty strawberry plants (var. *Albion*) were grown in pots and, when required their flowers were caged with fine mesh bags (Figure 1). The plants were not covered, and so were exposed to sun, wind and rain in order to be as similar as possible to field grown strawberry plants on commercial farms. For these trials the fifty potted plants were checked twice a week when we had numbers of thrips available, in order to find the appropriate stage of flowers (just open). We aimed for a minimum of 10 flowers at a time, but this was not always possible as the plants have flushes of growth and flowering. Sometimes there were two suitable flowers on one plant, but usually just one flower per plant was available. Different numbers of thrips, from low (approx 10) to high (50 or 100 plus), were added to each bag. In the first season of trials the maximum number of thrips added was 50 per flower. In the second season of trials the maximum number was 150 thrips per flower, with 50 thrips added each day for three days. In all cases these were winged adults. Controls consisted of flowers caged with no thrips added (and in effect thrips and all insects were excluded).

Figure 1: A flower caged and a berry tagged using our method.

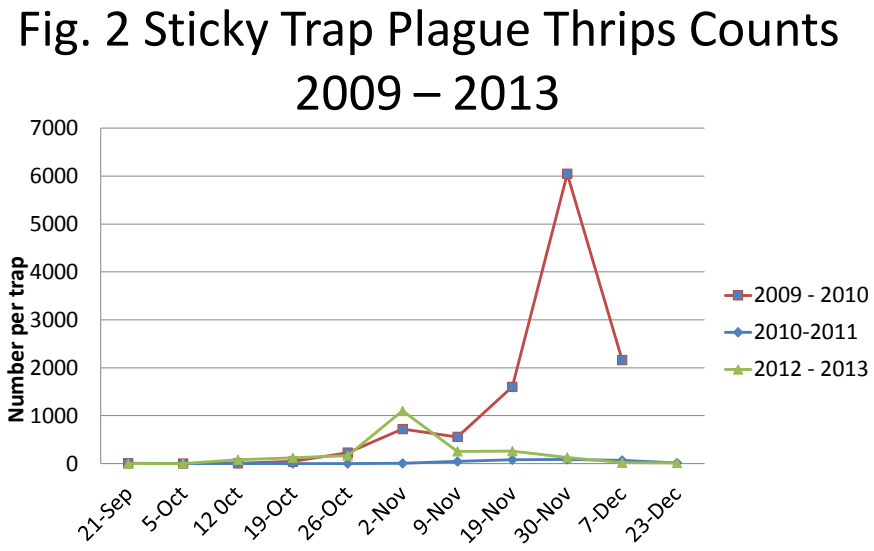
Each flower that was caged was individually identified and tagged with surveyors flagging tape. When the cage containing the flower was removed (after petal drop) each developing berry was followed until it ripened. Then a photograph was taken of each berry when it was ripe. The berry was then scored for damage, and rated as either "No Distortion", "Some Distortion", "Severe Distortion" or "Aborted Flower".

Extreme temperatures meant that some of the trials had to be repeated because of the high number of damaged or aborted flowers in the controls. This damage was caused by the extreme heat that occurred in the summer of 2013-14. As the trials relied on the flower progressing through to ripe fruit for a result to be made, anything that affected the progress would disrupt the assessment of that particular fruit.

Plague thrips numbers were very low in the second summer of this project (2013-14), so to conduct the trials thrips were collected from weeds in Werribee South. To make sure enough thrips could be added to the bags it was necessary to use a combination of both plague and onion thrips. The proportion of plague to onion thrips was approximately equal in field samples and then in each replicate.

Results

Figure 2: Numbers of thrips on yellow sticky cards



No sticky traps were placed in the 2013-2014 season as the project was not field-based, but the number of thrips per flower in field samples was less than the "Low" category listed in Table 1. That is, the number of plague thrips in that latest season was extremely low when compared to other years.

The levels of thrips found in flowers at Site 1 and used in the first series of trials indicated that there was no distortion or damage of any kind caused by plague thrips, at least in the variety "*Albion*" (see Figure 3).

Figure 3: Strawberries harvested after having 50 thrips per flower, compared to a control with none per flower.

The results of all of the trials needed to be compared using a standard assessment. This assessment was made using a score of relative damage . The damage that occurred was rated as either “No Distortion”, “Some Distortion”, “Severe Distortion” or “Aborted Flower”.

Figure 4: Damage Ratings

Note: These photos depict damage or distorted strawberries, but the damage is not necessarily caused by insects. They are simply to provide a reference for our assessments.

No Distortion

Some Distortion

Severe Distortion

Aborted Flower

There was an extremely high level of aborted flowers in both the plants with thrips and those where thrips were not present in some of the early trials. Later trials did not have this problem.

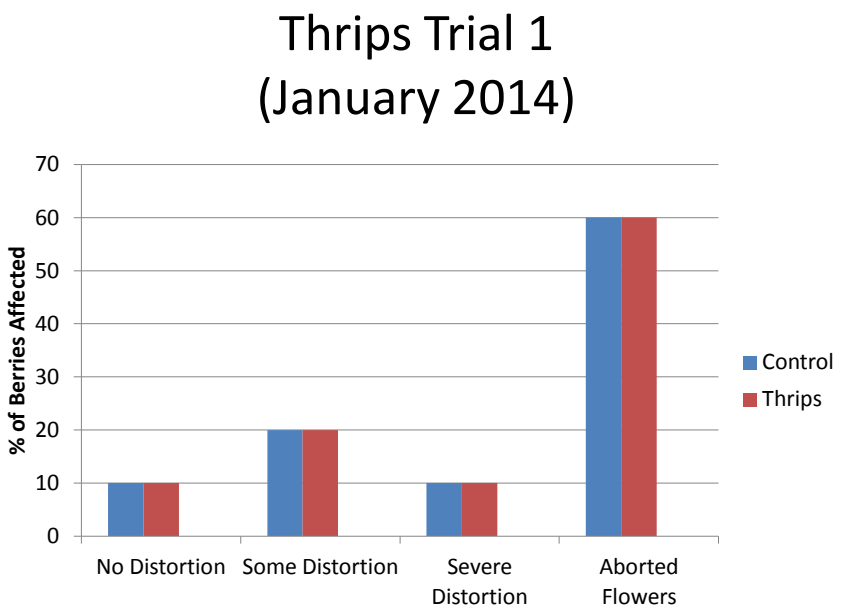


Figure 5: Berries distorted or aborted, with and without 150 plague and onion thrips per flower (January 2014), 10 flowers on 10 plants.

There is no significant difference between the control and thrips treated sequence (Chi-test probability value = 1).

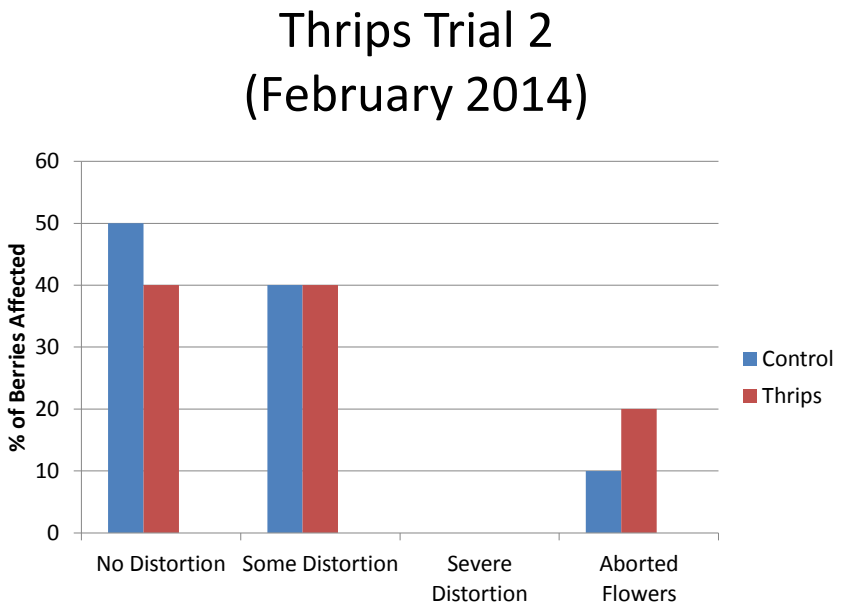


Figure 6: Berries distorted or aborted, with and without 150 plague and onion thrips per flower (February 2014), 10 flowers on 10 plants.

There is no significant difference between the control and thrips treated sequence (Chi-test probability value = 0.694).

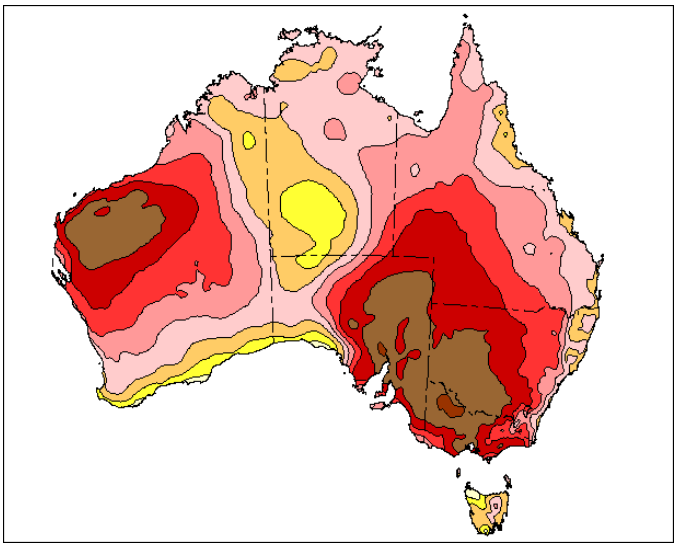
The trials conducted in January 2014 coincided with one of the hottest periods of weather ever in Victoria (see Figure 5).

"One of the most significant multi-day heatwaves on record affected southeast Australia over the period from 13 to 18 January 2014. A dome of very hot air developed over Western Australia in the second week of January, setting a number of records in that state, before moving eastwards to be over the southeast of the continent. A high-pressure system remained near-stationary over the Tasman Sea from the 13th onwards, directing mainly northerly winds over southeast Australia (including Tasmania), before a trough moved across the region on the 17th and 18th, bringing cooler air and ending the heatwave there.

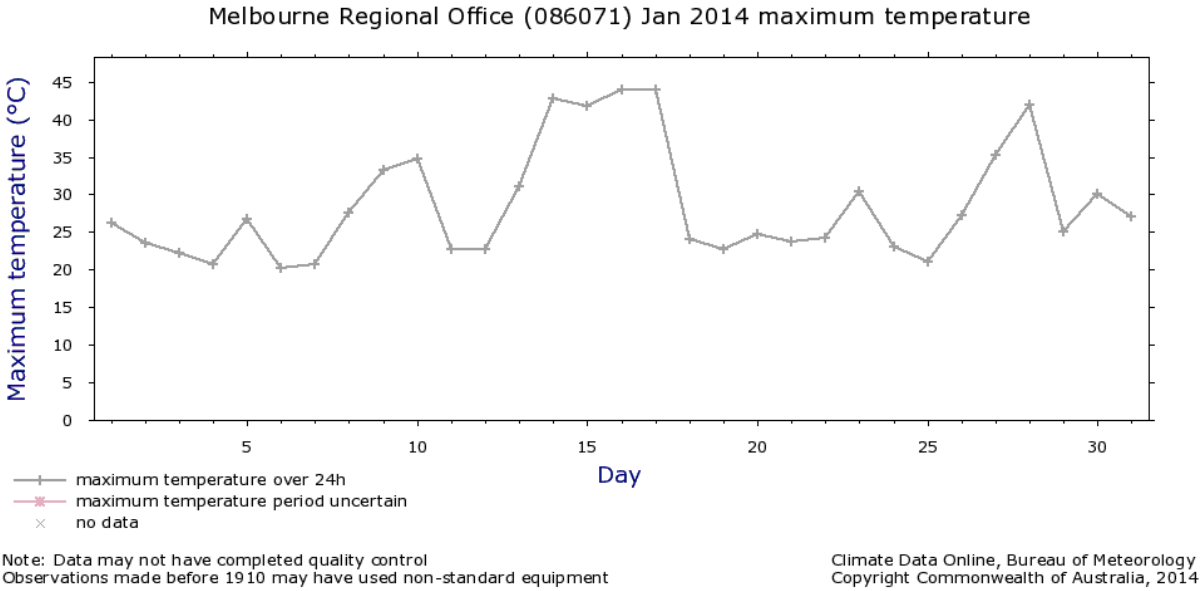
The major area affected by the heatwave consisted of Victoria, Tasmania (particularly the western half), southern New South Wales away from the coast, and the southern

*half of South Australia. Over most parts of this region, it ranked alongside the heatwaves of January-February 2009, January 1939 and (from the limited information available) January 1908 as the most significant multi-day heatwaves on record". (**Australian Government, Bureau of Meteorology, January 22 2014**)*

Figure 6: Temperature Map in Australia on January 17 and in Melbourne (daily) throughout January 2014



Red and brown areas on the map indicate maximum temperatures of 40 - 45°C.



Discussion

The trials from year 1 indicated that up to 50 thrips per flower caused no damage to the berries in "Albion" variety. That is, there is no threshold that could be established at that point, other than to say it is more than 50 thrips per flower, and this is unlikely to occur in most years.

The results from the second year's trials were similar to those of the first year. There was no significant difference between the control and the flowers exposed to thrips. There were similar levels of aborted flowers and distortion in both.

Many more berries were caged, and thrips added than are shown in these results. The problem in many of the experiments that we conducted is that to assess a trial we had to keep the berries until they were fully formed and ripe. The variety used is badly affected by rainfall or moisture and so many berries could not be assessed as they were badly damaged by rain (both treated and controls). So we could only use berries that ripened without rotting for assessment. Conducting large fully replicated trials of using 150 thrips per flower would have required immense numbers of thrips (at least 1,500), coinciding with having flowers of the right stage all at the same time on the same day and this was difficult given the last season's thrips numbers and climatic conditions. This trial was established more than once but weather conditions meant that not all trial results could be used due to rain affected berries or similar. Our observations were that we could see no difference whatsoever between flowers with extremely high numbers (150) thrips and those with none, in any of the trials that were conducted.

So the conclusion from this project is that it is not worth spraying insecticides to target thrips (particularly plague or onion thrips) in flowers in order to try and protect subsequent berries. This can only apply to the variety we tested (Albion) with certainty but it is a strong indication that growers should be very cautious about spraying insecticides for thrips in other varieties as well.

In addition to not being economically viable to spray insecticides for thrips to prevent potential damage, there is a certain down-side to the use of any such insecticide sprays in terms of detrimental impact on beneficial species that are biological control agents for other

real pests in strawberries (such as western flower thrips, two-spotted mites, aphids and caterpillars).

Plague thrips tend to occur in large numbers in late November to late December in most years, and arrive in areas such as the Yarra Valley when there are hot, northerly winds. So they coincide with sudden hot conditions. The data presented here indicates that the hot weather alone is sufficient to abort flowers, and anything that upsets pollination will affect the shape of the berries that are subsequently produced. So it is reasonable to think that growers may associate berry damage, or flower abortion with thrips (because they are visible) when in actual fact it is likely to be the climatic conditions that coincide with thrips activity.

Due to the low number of thrips over the last two seasons it is difficult to compare the results from these trials to the effect of an extremely large flight of thrips. However, we can conclude that moderate flights of thrips are insignificant in terms of the economic loss that they cause. The decision to use an insecticide needs to take into account the cost of spraying, the impact that spraying may have on biological control, and the effectiveness of the spray in terms of reducing damage, particularly if the damage is not caused by thrips.

In years when plague thrips numbers reach extremely high levels (such as in 2009-2010) then it is possible that they could cause damage, but research into this needs to be conducted at that time. Caging 50 thrips per day for the flowering period of a strawberry caused no damage greater than controls and so numbers would need to be greater than this before any economic damage occurs.

Technology Transfer

The results of the project will be disseminated to the Victorian Strawberry Industry by presentations to growers at meetings organised by the strawberry IDO and via the VSIDC.

Recommendations

The simple recommendation to growers is that they stop spraying insecticides for plague or onion thrips, as this is likely to cause more problems than it solves. If varieties other than *Albion* appear to be susceptible then these should be tested as soon as possible.

Acknowledgments

We gratefully acknowledge the VSIDC and Victorian strawberry growers in general for their support of this project. However, our particular thanks goes to Santo and Maria Faella who gave us their enthusiastic support and allowed us access to their farm for any trials that we needed to conduct. They also gave us valuable discussions about many aspects of controlling insect and mite pests in strawberry production. We also acknowledge the contribution of Angelica Cameron who assisted us in the first year's field trials.

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University of California (2008). Integrated Pest Management for Strawberries (2nd Edition). Agriculture and Natural Resources Publication 3351

Commercialization & Intellectual Property Issues

There are no issues

Communication/Extension Activities

The results will be presented to the industry when the IDO can arrange a suitable meeting, and via the industry newsletter.

Next Steps

The only next step that we suggest is to survey growers to see if they think any other varieties are particularly susceptible to plague thrips.

Other Issues

Distortion of berries can be caused by many other factors and if berry distortion is a problem, and it is not due to insects, then efforts should be made to identify what exactly is causing the problems.