Insecticide resistance development in chilli thrips in Florida strawberries

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Summary

Insecticide resistance development in chilli thrips was evident in this study. Insectides that provided maximum chilli thrips control were Radiant®SC, followed by Exirel, and Assail 30 SG. Brigade was not effective. However, the effective insecticides should be rotated in a season and label restrictions followed.

Objectives

The objectives for this project are to determine, 1) the resistance status in early season and late season chilli thrips to commonly used conventional insecticides in Florida: spinetoram (Radiant SC), acetamiprid (Assail 30 SG), cyantraniliprole (Exirel), and bifenthrin (Brigade), and 2) to calculate the lethal concentrations, LC50 and LC90, for chilli thrips to spinetoram.

Methods

Resistance of chilli thrips to critical doses of four commonly used insecticides

Sampling of chilli thrips populations were conducted in seven to ten strawberry fields (Fig. 1), twice during the strawberry field season of 2019 – 2020. Early season populations were collected in November 2019 and late season populations were collected in February-March 2020.

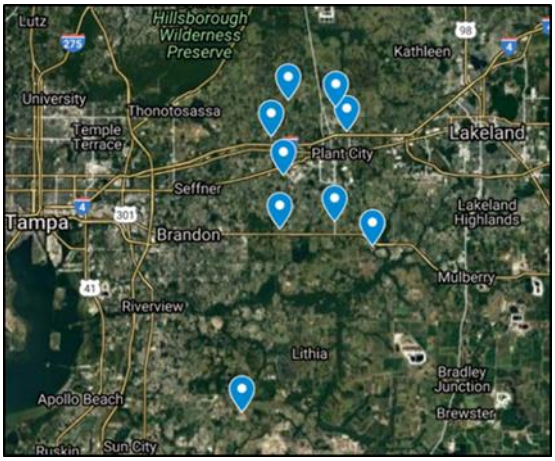


Figure 1. Field locations sampled in 2019-20.

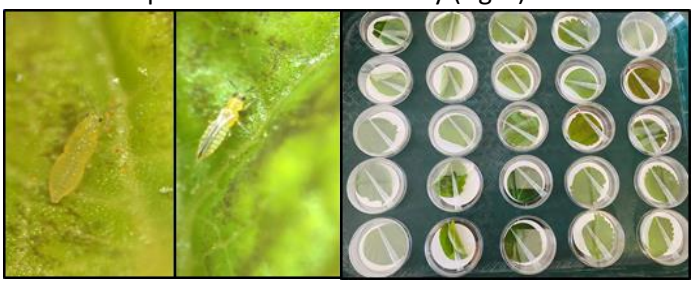
The experimental arenas were prepared by spraying strawberry leaf discs (4-cm dia.) with insecticide solution prepared at critical dose (manufacturer label rate) with potter spray tower and drying them for 30 min (Fig. 2). A control leaf disc was prepared by dipping in deionized water and drying for 30 min. A single treated or control leaf disc was placed in a petri-dish with moist filter paper followed by releasing ten adult thrips in growth chamber set at 27 ± 5 °C and 60 ± 5% relative humidity (R.H.) at 12 h photophase. After 24 hours the petri-dishes were examined for dead and moribund adults. The percentage of mortality was recorded.

LC50 and LC90 of chilli thrips to spinetoram

Serial dilutions of spinetoram were prepared and strawberry leaf discs (4-cm dia.) sprayed with insecticide formulations using potter spray towers and allowed to dry for 30 min. Next, the treated leaf disc was introduced into a petri-dish with moist filter paper. Ten adult chilli thrips from each field collected

populations and 2-year-old, susceptible laboratory

Figure 2. Chilli thrips larvae and adult (left) and strawberry leaf discs in pertri dishes for bioassay (right).



populations were introduced in the petri-dish and checked for mortality after 24 hours. The experimental design was replicated four times and thrips collected from the ten fields were tested separately.

Results

Resistance of chilli thrips to critical doses of four commonly used insecticides

Chilli thrips populations collected from seven out of ten sampled fields, for both early and late seasons in 2019-20, were viable for experimentation. Mortality rates were 29.5 % higher in the early season populations as compared to late season populations (Fig. 3).

Thrips collected earlier in the season represent a population that migrated from elsewhere, with unknown insecticide exposure, into the strawberry fields. Whereas, thrips collected later in the season belong to populations that have been exposed to known insecticide rotations. Therefore, low mortality rates in the late season populations could be attributed to repeated applications of the insecticides which increases the thrips' exposure time to these insecticides, hence the selection pressure increased, causing the resistance development.

Therefore, to sustain the susceptibility of thrips, it is very important to adopt integrated pest management strategies for thrips management. Furthermore, spinetoram and cyantraniliprole showed 10% higher mortality rate for all chilli thrips populations and for both seasons followed by acetamiprid and bifenthrin. Out of all four insecticides tested, chilli thrips showed the least susceptibility to bifenthrin in late season such that early season mortality from the critical dose of bifenthrin was 3.3 times higher than late season mortality.

LC50 and LC90 of chilli thrips to spinetoram

The laboratory population, SS-Lab, was highly susceptible to spinetoram in bioassays. The calculated LC50 and LC90 value of spinetoram for SS-Lab was 0.026 ppm and 8.64 ppm respectively (Table 1). In contrast, susceptibility to spinetoram varied greatly among the 8 field populations collected in 2019. Three out of the eight populations collected from Plant City, FL (Field B, Field F, and Field H) appeared to be highly resistant to spinetoram. Moreover, the LC90 values of all eight field populations were more than the highest concentration used for the bioassay, i.e. 200 ppm. These results suggest that even though spinetoram is the most effective insecticide against chilli thrips currently, there is a decrease in susceptibility to spinetoram in chilli thrips populations, which points to resistance development.

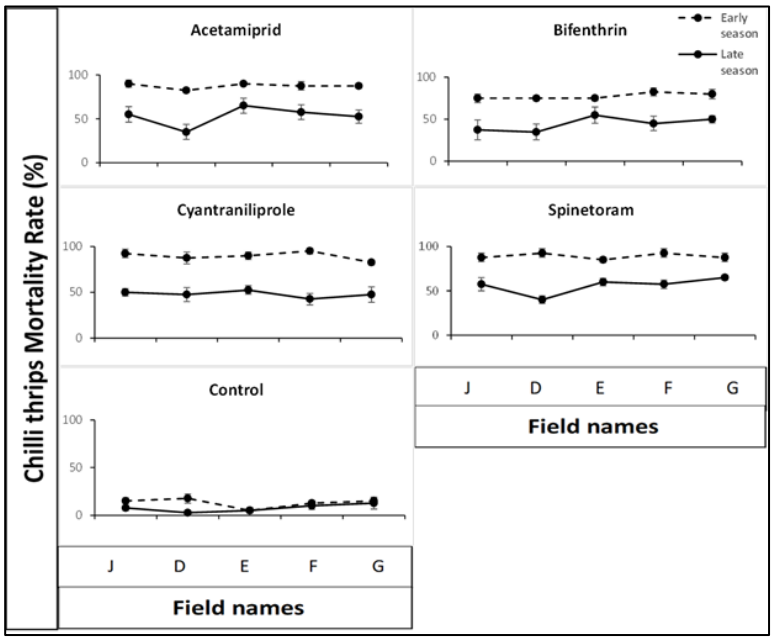


Figure 3: Mortality rate (%) of chilli thrips populations collected from five different fields in Plant City, FL during 2019-20 strawberry season to critical doses of four commonly used insecticides.

Table 1. LC50 and LC90 values of chilli thrips populations collected from eight different fields from Plant City, FL in 2019-20 strawberry season to spinetoram.

Colony Source	LC50 value in ppm	Resistance ratio	LC90 Value in ppm
Lab	**0.026**	**_**	**8.64**
Field B	2.057	78	>200
Field C	1.542	59	>200
Field D	0.585	22	>200
Field E	0.227	9	>200
Field F	7.076	269	>200
Field G	0.159	6	>200
Field H	2.74	103	>200
Field I	1.38	52	>200

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