Annual Research Report

California Leafy Greens Research Board

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Project title: Monitoring seasonal thrips population dynamics and identification of reservoir hosts of *Impatiens Necrotic Spot Virus* (INSV) in Imperial Valley lettuce production landscape

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Summary:

This project was initiated to address the potential concern for INSV incidences in lettuce production in Imperial Valley following the initial reports of this virus in multiple fields during March 2021. During the same time, there were also report of INSV in multiple lettuce fields from Yuma region of Arizona. Since there has not been any significant report of this virus in desert production region, we initiated a similar research program that has been continuing in the Salinas Valley. A network of yellow sticky traps was placed in 30 different locations to cover most of the production areas of the Imperial County. Monitoring of thrips populations on the basis of trap capture was recorded from May 2021 and continuing to date. The trap capture did not indicate high level of thrips populations or activities during 2021. There were two primary thrips species captured on the traps. Dominance of the two thrips species were also confirmed from our field collected thrips populations in lettuce research trial plots. We collected plant samples from available weed species within and around multiple lettuce fields where incidence of INSV was reported early in the year (March 2021). Among the several weed species collected and tested for the presence of the virus (INSV) using ELISA or PCR tests, highest percent positive samples were recorded in curly dock followed by annual sowthistle, prickly lettuce, little mallow and nettleleaf goosefoot. However, there were no detection of INSV positive samples from collections made during the summer and late fall of 2021. Evaluation of several insecticide

products were conducted in lettuce field where plots were randomized and replicated under field conditions to document the efficacy of these products to thrips populations. Initial thrips population was dominated by bean thrips (*Caliothrips fasciatus*) and later on western flower thrips (*Frankliniella occidentalis*) dominated the overall species complex. We found that Radiant® is the most efficacious product for thrips population management followed by Beleaf® and Exirel®. Efficacy of either Torac® or Movento® was not at par with the industry standard treatment of Radiant®.

Objective 1: To monitor seasonal thrips density and species composition in the Imperial Valley. Results from this objective will provide real-time information on thrips activity in the landscape of Imperial Valley to help in thrips management decision making.

Procedure: Monitoring of thrips populations was conducted using yellow sticky cards (7.6 x 10.2 cm, BASF, Inc.) in 30 different locations across the Imperial County (Fig. 1). At each location, one double sided, yellow sticky card was placed near field margin by suspending the card on a metal loop. Based on our experience the traps were slightly modified (additional metal net enclosure) to prevent trapping the unwanted alfalfa butterfly, which is highly abundant in the region and interfere with the efficiency of thrips capture on sticky cards. These sticky cards were replaced and retrieved on a weekly basis and collected traps were examined under a stereoscope to count the number of adult thrips present on both sides of the card. To identify the specie complex of thrips, we used a few gross morphological features of commonly abundant thrips in this region. Average number of thrips per trap per week is reported per trap location and general area.

Fig. 1. Trap sites for capturing thrips population in Imperial County

Results: A total of 30 traps were placed across the crop production areas in Imperial County to monitor the thrips population abundance and activities throughout the year. After initial establishment of traps in various selected sites, it was observed that these traps attracted many alfalfa caterpillar (*Colias eurytheme*), which is highly abundant due to extensive alfalfa production in this region. Interference from these butterflies in capturing the thrips population on the sticky traps, we modified the sticky traps by putting a wire enclosure to prevent the unintentional capture of the butterfly (Fig. 2). Although we initiated the trapping effort from May-2021, most of the trap data was unusable due to this issue of butterflies captured on the stick card surface until we put out our modified traps during mid-August.

Fig. 2. Yellow sticky trap, interference from alfalfa butterfly and modified trap

The following graph shows the average number of western flower thrips captured per trap on a weekly basis. Overall, western flower thrips (WFT) populations seem to be very low until early November, when population reached to a peak of 17 thrips per trap per week. The number of thrips gradually declined during mid-December probably in response to the ambient temperature and remained low for the rest of the growing season. It is noteworthy to mention that although the overall WFT population was low, there were significantly high numbers (>100 per trap/week) of bean thrips captured during early part of the lettuce growing season (Sep-Oct) in Imperial County. This observation, presence of comparatively large bean thrips population, was also confirmed from our field trial at Holtville location.

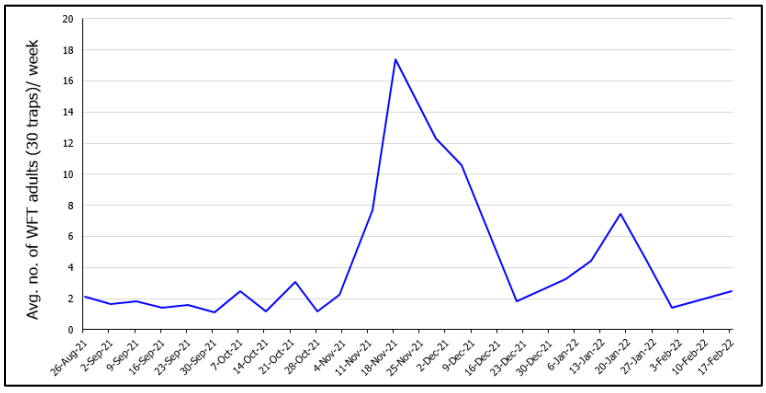

Fig. 3. Average number of WFT captured on sticky traps, Imperial County, 2021-22.

Objective 2: To document prevalent weed species that are hosts of both thrips and INSV (Impatiens necrotic spot virus) in the Imperial Valley. Identification of weed hosts that support either thrips or the virus, or both, is critical to best manage directed-weed management in lettuce crops, which would minimize future incidences of INSV.

Procedure: Westerns flower thrips has more than 600 host plants which include many weeds as well as crops grown in the Imperial Valley. However, many of these host plants may not be the host of the INSV and therefore it is important to recognize and identify those host plants which are likely to support both insect vector (thrips) as well as the virus. Plant samples from lettuce during the growing seasons and weed species present in and around the lettuce fields were collected at three different times of the year for detection of INSV. Lettuce plants showing symptoms of the virus were tested using ImmunoStrip® (Agdia Inc., Elkhart, IN) and fields where infection has been confirmed will be closely monitored. This work provides a framework for monitoring and detecting the spread of INSV in the lettuce growing region of Imperial County and can be applied to other lettuce growing regions where thrips-transmitted viruses remain a threat.

Results: The time of weed sample collection was during June-2021, Nov-2021 and March-2022. In each sampling effort between 50-150 plant samples were collected from available weed species in and around the fields where lettuce crops were present or previously reported. Interestingly, we were able to detect INSV on a number of plant samples, which were collected during June-2021 (Fig. 4). However, after testing over 200 samples collected during Nov-2021 and March-2022, no INSV positive samples were detected. Nonetheless, our survey of weed hosts of INSV in Imperial valley documented several weed species which are potential hosts of INSV and should be a matter of concern when it comes to the management of this virus on lettuce production. Following graph shows the various weed hosts and positivity rate of the samples collected from these weed species.

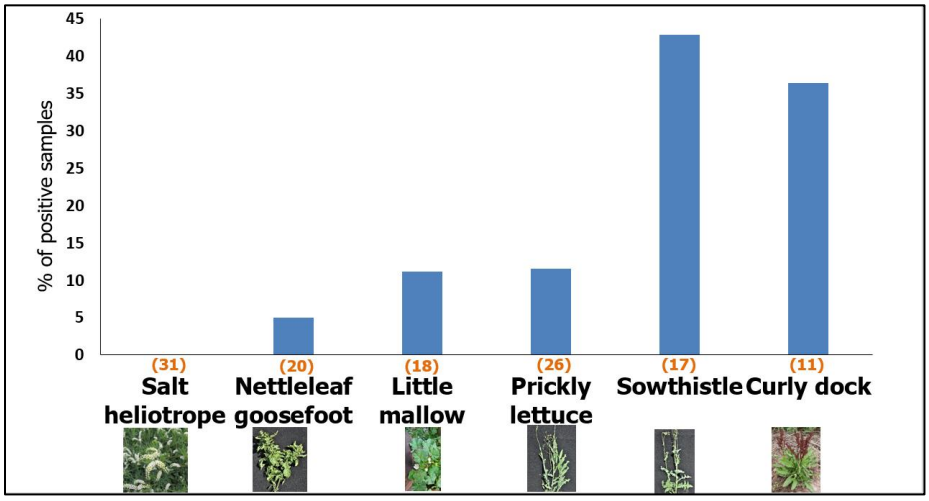

Fig. 4. Weed samples and their positivity rate for INSV collected from Imperial Co., June 2021.

Based on our results, it is evident that curly dock, which is usually present mostly in ditches or canal beds are one of the key weed hosts of INSV. Similarly, sowthistle, prickly lettuce, little mallow and nettleleaf goosefoot are reservoir hosts of INSV. Given the ability of western flower thrips to utilize these weed species as their host, there is greater risk of spreading INSV in our

lettuce production. These results and their implications in INSV management have been discussed in various Extension meetings in the region.

Objective 3: To evaluate the efficacy of different insecticide products on thrips populations infesting the lettuce crop. In order to manage thrips population on lettuce and other leafy vegetables, effective and safer chemistries need to be identified and utilized in evolving integrated pest management (IPM) programs.

Procedure: This experiment was conducted at the Desert Research and Extension Center at Holtville, CA during the growing season. Romaine 'Valley Heart' was transplanted on two-row, 40-inch beds during late October following grower's management practices except the application of insecticides. Each plot was four rows by 35-ft; 5-ft border margin and 1 row buffer was maintained between each plot. Five different insecticide treatment programs and one untreated control were randomly assigned to a total of 24 plots, based on randomized complete block design (RCBD) with 4 replications. The insecticide products and their rate are: Radiant® (7.0 oz/A), Beleaf® (2.85 oz/A), Torac® (21.0 oz/A), Movento® (5.0 oz/A), and Exirel® (20.0 oz/A). Foliar applications of the selected insecticides were made with a CO_2 pressurized boom sprayer, set to deliver 22.5 gal/A through 2 TXVS-18 ConeJet® nozzles per bed. An adjuvant, Dyne-Amic® (Helena Chemical Co.), was added at 0.25% to all treatments. Numbers of thrips from three plants per replicate was recorded at various sampling dates following each application. Adult and larval thrips count data was subjected to ANOVA and mean separation using Turkey's HSD test ($P \leq 0.05$). Thrips collection was done by whole plant washing method to record total number of individuals infesting each plant.

Fig. 5. Heavy infestation of bean thrips on lettuce plants observed on trial plots

Results: The overall thrips population collected during the sampling of lettuce plants at the research plots were composed two species: western flower thrips (*Frankliniella occidentalis*) and bean thrips (*Caliothrips fasciatus*). In contrary to our expectation, the bean thrips population was much greater on the lettuce plants compare to the western flower thrips at the trial plots during

early lettuce growing season in the low desert (Fig. 5). The efficacy results are shown separately by thrips species and altogether for immatures.

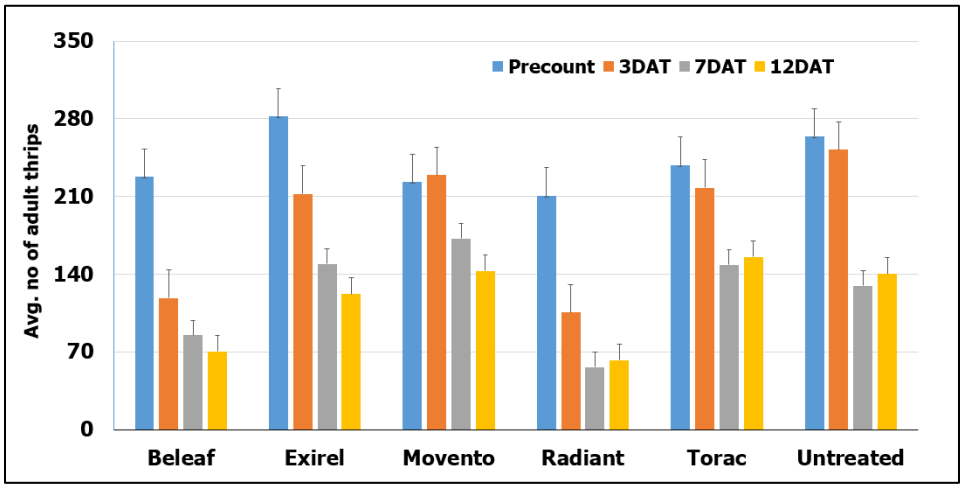

Fig. 6. Efficacy of insecticide products on adult bean thrips population, Holtville, CA, 2021

The bean thrips population prior to the insecticide application on the trial plots ranged between 210-280 adults per plant. Number of adult bean thrips 3 days after treatment (3DAT) was significantly lower on Radiant® and Beleaf® treatment compared to untreated control (Fig. 6). However, the efficacy of Exirel®, Movento® and Torac® was less compared to Radiant and Beleaf. Similar trend in reduction of thrips population was observed when population was evaluated at 7 days after treatment (7DAT). The final evaluation of efficacy was conducted at 12 days after treatment (12DAT), which indicated that Radiant and Beleaf were able to reduce the thrips population significantly compared to untreated and other three insecticide products.

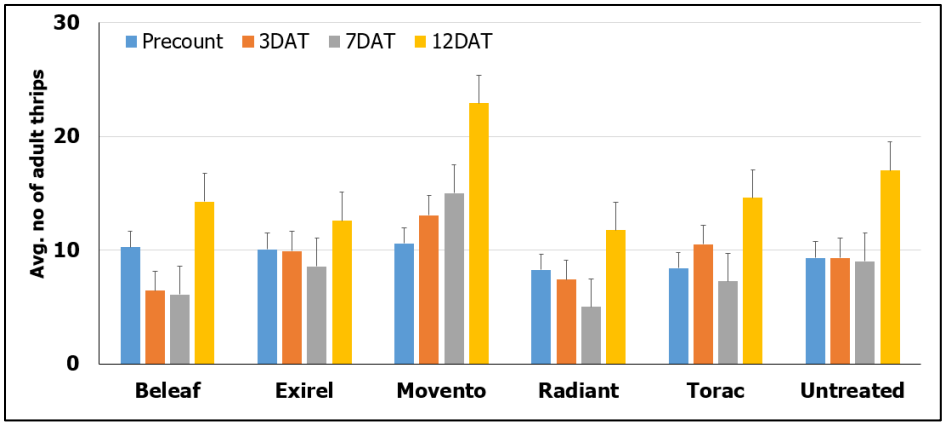

Fig. 7. Efficacy of insecticide products on western flower thrips adults, Holtville, CA, 2021

The western flower thrips is a serious concern for lettuce growers as it is a vector of INSV disease. However, we did not record high numbers of WFT in the trial plots and due to the low pressure of the pest, effect of insecticide application was less prominent (Fig. 7). Nonetheless, Radiant® and Beleaf® were two insecticide products, which were efficacious to reduce the population by half compared to the pre-treatment WFT population. It appears that the thrips number during 12 DAT

was much higher, which indicate an influx of dispersing thrips from nearby fields and lack of residual activities of the products at that time period on adult thrips.

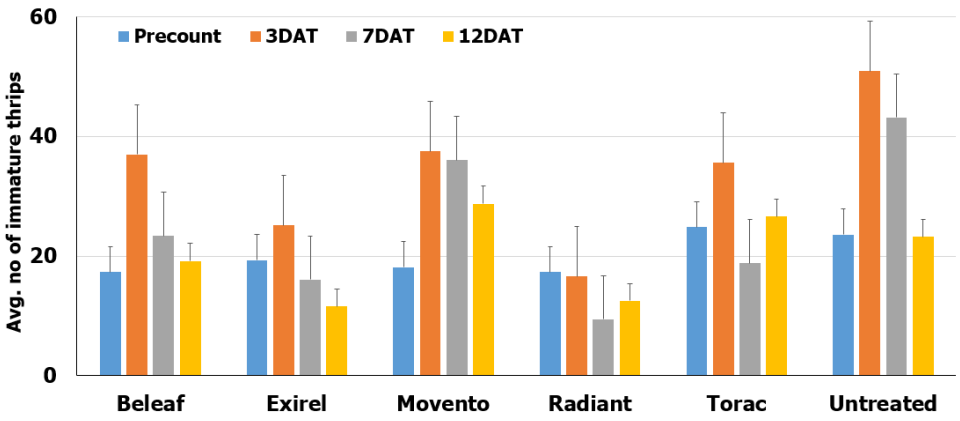

Fig. 8. Efficacy of insecticide products on immature thrips population, Holtville, CA, 2021

Evaluation of immature thrips population indicated that Radiant® and Exirel® were two products, which were able to exhibit efficacy on reducing the numbers at both 7 DAT and 12 DAT and this reduction is significant compared to the untreated control (Fig. 8). Both Movento and Torac, did not show significant efficacy on immature populations in this trial.

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