Survey of Weeds as Reservoirs of INSV in Yuma County – Results From Two Year Survey



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Impatiens Necrotic Spot Virus in Lettuce

- Major threat to Salinas, CA lettuce industry (Monterrey County).
- INSV cost Salinas growers between \$100+ million in losses annually (INSV and Pythium Wilt task force).
- Causing major disruptions in lettuce supply chain.



Viruses devastate Salinas Valley

plant dises caused by insect feeding and soll-borne pathogens. This led to a short supply of lettuce for U.S. markets and recor high prices.

VEGETABLE GROWERS NEWS



Impatiens Necrotic Spot Virus hits Salinas lettuce

FarmPress Farm Press Blog

Salads will be in short supply for Thanksgiving



INSV and several other plant diseases lead to similar results in lettuce – it destroys the crop. Ine viruses involved make the plants appear to melt as they die. Significant acreage across the Salinas Valley suffered the same fate this summer a farmers lost crops. This led to a significant shortage of lettuce for consumers and record-high lettuce prices.

INSV outbreak in the Salinas Valley could push the price of iceberg lettuce to near \$95 a box. Todd Fitchette | Nov 09, 2022

Impatiens necrotic spot orthotospovirus (INSV)

- Family: Orthotospoviridea
- Order: Bunyaviridae
- Negative-strand RNA virus
- Spread by western flower thrips
- +600 know host plants
- Closely related: to Tomato spotted wilt virus (TSWV), Tomato chlorotic spot virus (TCSV), Soybean vein necrosis virus (SVNaV)



Enveloped, spherical. Diameter from 80 to 120nm.



Western flower thrips (Frankliniella occidentalis)

<u>Biology</u>

- 100s species of host plants (vegetables, ornamentals and fruit crops)
- Adults: 1-2 mm long
- Female can lay 150-300 eggs
- Egg to adult- 13 days or less (25-30° C, most favorable temp)
- Adults live about 28 days
- Poor flyers, rely on wind for dispersal

Vectors of Tospoviruses

- Impatiens necrotic spot virus (INSV)
- Tomato spotted wilt virus (TSWV)



Western Flower Thrips and INSV Acquisition

INSV in Lettuce

- Infection occurs within minutes of feeding.
- Plants become stunted, chlorosis, and leaves with irregular-shaped, tan to dark brown, necrotic spots or ringspots.
- No methods for preventing/treating the virus.
- No genetic resistance in lettuce varieties.



Timeline of INSV in AZ lettuce



1980s: INSV First described in the Netherlands in ornamental crops.





> Plant Dis. 2022 Jan 27. doi: 10.1094/PDIS-09-21-2118-PDN. Online ahead of print.

First Report of Impatiens Necrotic Spot Virus Infecting Lettuce in Arizona and Southern Desert Regions of California

Daniel K Hasegawa ¹, Laura Jenkins Hladky ², William M Wintermantel ³, Alexander I Putman ⁴, Apurba K Barman ⁵, Stephanie Slinski ⁶, John Palumbo ⁷, Bindu Poudel ⁸

2021-Present: Reported in desert lettuce regions in California (Imperial and Riverside Counties) and Arizona.

2006: Reported in

lettuce in Monterey County, CA.

APS Publications

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Published Online: 11 Jul 2008 https://doi.org/10.1094/PDIS-92-8-1248A

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Affiliations \lor

First Report of *Impatiens necrotic spot virus* Infecting Lettuce in California S. T. Kolke, Y.-W. Kuo, M. R. Rojas, and R. L. Gilberson 2019 – Present: Severe outbreaks in Monterey County and other coastal lettuce regions. Up to 100% crop losses, losses = 100's millions US\$.



Ongoing University of Arizona Thrips-INSV Research

Monitoring introduction and movement of INSV infected thrips in Arizona – Palumbo (Entomology Dept), Discua (Entomology Dept), Slinski (UA YCEDA) – Arizona Iceberg Lettuce Research Council (AILRC)

Investigation of Weeds as a Reservoirs for INSV – Palumbo, Discua, Slinski – AILRC, AZDA-SCBGP

Insecticide Efficacy Studies and Areawide Thrips Monitoring – Palumbo AILRC, AZDA-SCBGP, Industry

Virus transmission studies – Poudel-Ward (UA Yuma Cooperative Extension) - AZDA-SCBGP

Development of Monitoring Tool for Managing Tospovirus Damage to Lettuce – Carrière (Entomology Dept) - AZDA-SCBGP



Transplants as source of INSV infected thrips in Arizona

First INSV infected thrips observed in late-Aug-early Sep, collected Brassica transplants 2021-2022

Fields with lettuce transplants were INSV first detected mid Oct (2021-2022).

By the end of lettuce season (Apr 2022) INSV was widespread, yet INSV incidence observed (2021-2022) has been low, less than 2%.





Weeds and crops can support large thrips populations



Thrips abundance highest Oct/Nov and Apr. Cotton, Alfalfa, Cantaloupes, major reservoirs for thrips (likely non INSV hosts).



Beat pan sampling

Weeds as a reservoirs for INSV

- INSV has a wide range of weed hosts: sow thistle, shepherd's purse, common purslane, lambsquarter, nettleleaf goosefoot, hedge mustard etc.
- Weeds can play a role in transferring virus when lettuce is not produced into the next produce season.
- Weed control during off season may help reduce virus incidence onto next produce season.



Weeds as reservoirs of INSV

- Research from Dr. Daniel Hasegawa (USDA ARS) has identified role of weeds as reservoirs of INSV in Coastal, CA.
- Several weeds have been identified as important hosts of the virus allowing them to act as a 'green-bridges' between growing season.



Diagram by Daniel Hasegawa

Arizona INSV host weed survey

- Determine whether INSV can persist around fields when lettuce is not produced in Yuma Region (May-Aug).
- Document the most important INSV host weeds in Arizona.





Weed collecting

- March 2021 ongoing
- 100+ collecting locations Tacna San Luis, AZ
- Weed and thrips sampling weekly



Site Selection

Based on:

- INSV Incidence in lettuce
- Weed abundance





INSV Testing

- TAS ELISA
- Agdia Immunostrips
- PCR



Results - Weeds and Thrips Collected

- 10000+ weeds and volunteer crops
- <3000 weeds in 2021, 6000+ weeds in 2022
- 31 INSV positive weeds in 2021, 43 in 2022, and 8 in 2023
- 50+ weed species
- 1500+ thrips collected from 250+ weed vacuum samples

15 INSV host weeds collected 2021-2023 in Arizona



1. Nettleleaf goosefoot (Chenopodiastrum murale)



4. Tumble amaranth (*Amaranthus albus*)



2. Common Purslane (*Portulaca oleracea*)



5. Groundcherry (*Physalis sp.*)



3. Lambsquarters (*Chenopodium album*)



6. Desert Horsepurslane (Trianthema portulacastrum)

Photo credits: http://southwestdesertflora.com

15 INSV host weeds collected 2021-2023 in Arizona



7. Common sowthistle (Sonchus sp.)



10. Lesser Sea Spurrey (Spergularia salina) Sisymbrium officinale Photo © Biopix: JC Schou



8. Cheeseweed mallow (*Malva parviflora*)



11. Prickly lettuce (*Lactuca serriola*) Spergularia salina © Bobby Hattaway

9. Hedge mustard (Sisymbrium sp.)

12. Burclover (*Medicago polymorpha*) Photo credits: <u>http://southwestdesertflora.com</u>

15 INSV host weeds collected 2021-2023 in Arizona

13. Yellow sweetclover (*Melilotus officinalis*)

14. Sheperd's purse (*Capsella bursa-pastoris*)

15. Nuttall's Povertyweed (*Blitum nuttallianum*)

INSV positivity rates 2021-2023

weeds

*Started surveying weeds Mar 2021

Weed INSV positivity rates 2021-2023

Thrips collected from weeds 2021-2023

Weed abundance declines over summer

One week after harvest - 1/18/22

After disking - 2/2/22

Positive INSV goosefoot - 4/13/22

Positive INSV goosefoot -5/17/22

No subsequent positive weeds found after wheat harvest -7/19/22

Results so far

- Low incidence of INSV in weeds in AZ compared to Salinas.
- For the last two summers INSV likely disappeared from weed population.
- Number of thrips, and INSV incidence peaked in April and declined thereafter.
- Weeds don't seem to play an important role in maintaining/spreading INSV in the desert.

Thrips and INSV Management in lettuce

- Season-long sanitation. *Disk crop residue, weed management.*
- Scouting for thrips. *Dot let populations built up.*
- Focus on minimizing Secondary spread.
- Early and aggressive spray timing in High-risk areas. *Fields adjacent to transplants.*
- Using Insecticides Differently. *Rotate insecticides, use of products that provide suppression when populations are low.*
- Test symptomatic plants promptly.

Figure 5. Trends in insecticide use for control of Western Flower Thrips in Spring lettuce, 2005-2022.

John Palumbo

Future directions

- Weed survey will continue until September 2023.
- Greater focus on thrips sampling.
- Transmission studies.
- *Tomato spotted wilt virus* (TSWV).
- Thrips DNA, INSV RNA Samples.

THE UNIVERSITY OF ARIZONA Yuma Center of Excellence for Desert Agriculture

Thank you!

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