System Drivers of IPM for Onion Thrips and Iris Yellow Spot Virus in Onion

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Overview

Onion (*Allium cepa* L.) is attacked by a complex of pests: onion thrips (*Thrips tabaci* Lindeman) and the Tospovirus, Iris yellow spot virus (IYSV), are the most economically important in North America. Overuse of insecticides to suppress thrips, the vector of IYSV, has led to resistance. Analyses of field- and farmscape-scale crop and pest management factors identified key drivers for IPM in Utah onion systems. Using Random Forest Analysis, we identified significant predictors of high IYSV incidence: high thrips densities, high nitrogen (N) content in onion leaves, low soil inorganic N, and low number of insecticide applications. High thrips densities were associated with high onion leaf N, low soil inorganic N, and low soil dehydrogenase, an indicator of microbial activity and soil health. Alternate crop and weed hosts in the farmscape were found to harbor thrips and IYSV, and can serve as a green-bridge between and within growing seasons: alfalfa, common mallow, field bindweed, flixweed, prickly lettuce, and shepherdspurse. Volunteer onions and cull piles can also be significant sources of thrips and virus.

Adult onion thrips feed with a punch-and-suck mode through cone-shaped mouthparts.

Thrips feeding injury to leaves: white to silvery patches and streaks.

We conclude that a systems-based IPM approach for onion pest management is crucial to sustainable and stable crop production with less reliance on insecticides.

Goals

1. Increase knowledge and awareness of how onion production practices affect risk, costs, and returns.
2. Change onion producer attitudes to be more favorable for use of less nitrogen and insecticide inputs.
3. Change onion production management practices to a whole-farm approach that incorporates crop rotation, weed management, and promotes healthy soils.

Necrotic spindle-shaped lesions of Iris yellow spot virus on onion leaves.

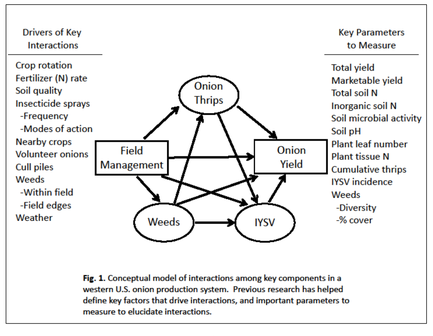


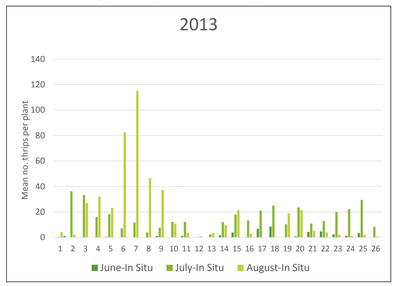
Fig. 1. Conceptual model of interactions among key components in a western U.S. onion production system. Previous research has helped define key factors that drive interactions, and important parameters to measure to elucidate interactions.

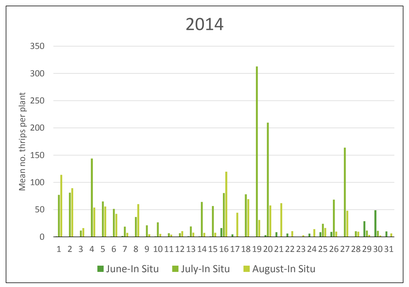
Conceptual model of interactions among key components in an onion production system.

Severe thrips injury reduces onion bulb size.

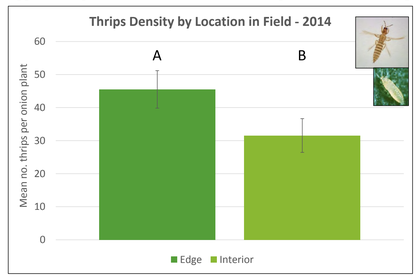
Field-Scale Factors

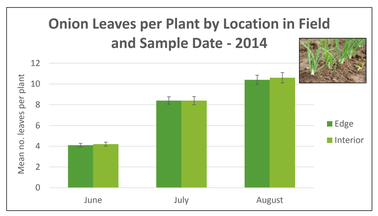
Thrips densities varied greatly among Utah commercial onion fields, months of the year, and years

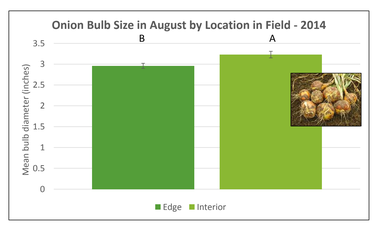




Effect of location within a field on thrips densities and onion growth

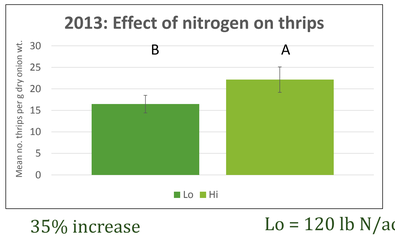


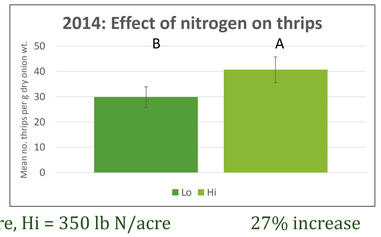




- More thrips were found on onions near the field edge (10 ft from edge) than in the interior (250 ft from edge).
- Onion plants were of similar size between edge and interior locations.
- However, onion bulb diameter was smaller near field edges suggesting that higher onion thrips reduced bulb size.

Effect of nitrogen fertilizer application rate on thrips densities





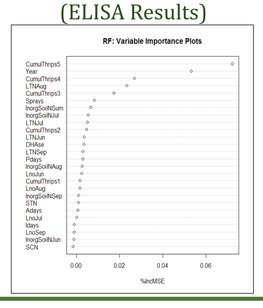
35% increase — Lo = 120 lb N/acre, Hi = 350 lb N/acre — 27% increase

- Onion thrips were consistently more attracted to onions with high rates of N.

Random Forest Classification – search for system drivers

- Random Forest classification analysis identified significant predictors of IYSV incidence and onion thrips densities in onion fields*.

Prediction of IYSV Incidence (ELISA Results)



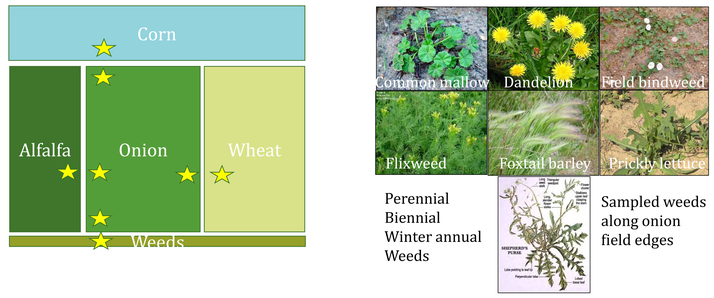
Variable	Relationship	Variable	Relationship
IYSV (season cumulative) 73% of variability explained		Thrips (season cumulative) 78% of variability explained	
Thrips densities	positive	Thrips: Jun & Jul	positive
Onion leaf N: Jul & Aug	positive	Onion leaf N: Jul & Aug	positive
Soil inorganic N	negative	Soil inorganic N	negative
# insecticide sprays	negative	Soil DHase	negative

*Cutler et al., 2007, Ecology 88: 2783-2792.

Farmscape-Scale Factors

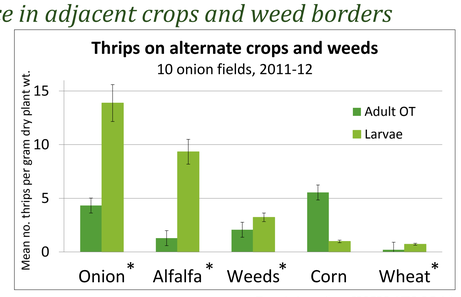
Alternate hosts serve as green-bridges between growing seasons and fields

Thrips sampling on alternate hosts: weeds and adjacent crops

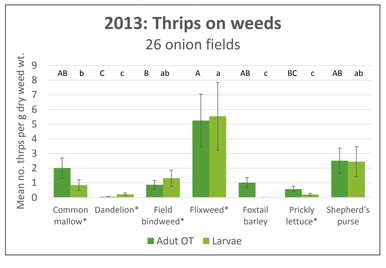


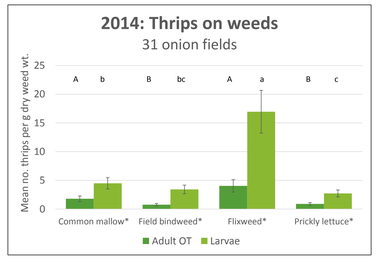
Thrips densities and IYSV incidence in adjacent crops and weed borders

- Onion thrips adults and larvae were abundant on onion, alfalfa, and weeds, but fewer larvae were found on corn and wheat.
- All plant groups were positive for IYSV, except not corn.
- In targeted weed sampling along field edges in May and June of 2013-14, weed species supporting highest densities of onion thrips adults and larvae, and highest incidence of IYSV, included flixweed, field bindweed, common mallow, and prickly lettuce.



*Positive for IYSV (ELISA)





Summary and Implications

Field- & farmscape-scale effects

- Crop management influences thrips & IYSV
  - High N may increase plant apparency, attraction, & digestibility, and reduce 2° compounds.
- IYSV incidence was predicted by
  - High thrips densities & onion leaf N content, and low soil inorganic N & no. of thrips sprays.
- Adjacent crops & weeds function as green-bridges for thrips & IYSV
  - Alfalfa, flixweed, field bindweed, common mallow & prickly lettuce were most important green-bridge hosts across growing seasons & the farmscape.
- Field edge effects on thrips & IYSV
  - Proximity of alternate host crops & weeds, visual attraction, difference in crop management.
- A systems management approach can stabilize & sustain onion production