Relationship between *Stemphylium vesicarium* and onion thrips (*Thrips tabaci)* in the development of Stemphylium leaf blight disease

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Introduction

- Stemphylium leaf blight, caused by the fungal pathogen *Stemphylium vesicarium*, is an emerging foliar disease of onion in northeastern North America, and can cause yield reductions upwards of 85% (Fig. 1a)[1-3]
- Onion thrips (*Thrips tabaci*) is a significant insect pest of onion and feeds directly on onion leaf tissue which reduces bulb yield and causes premature leaf senescence (Fig. 1b)[4-5].
- Onion thrips have previously been shown to interact with certain plant pathogens to exacerbate plant disease, notably the foliar plant pathogen, *Alternaria porri,* which causes purple blotch in onions[6].
- The potential relationship between onion thrips and Stemphylium leaf blight is unknown and may provide insight into managing the disease in the field.

Figure 1: a) Onion plant infected with *Stemphylium versicarium* and displaying typical disease symptoms including excessive leaf dieback and sporulating lesions. B) Onion plant infested with onion thrips (*Thrips tabaci*).

Objectives

1) Determine impact of thrips feeding on the severity of Stemphylium leaf blight disease
1) Determine if *Thrips tabaci* can passively transfer *Stemphylium vesicarium* condiospores to onion

Materials and Methods

Effect of thrips feeding on the colonization of Stemphylium vesicarium and severity of Stemphylium leaf blight. Onions (cv. 'Alisa Craig') were grown free of thrips and *S. vesicarium* in a controlled greenhouse and infested with onion thrips when onions had 5 leaves. After one week, **thrips feeding damage was quantified into three groups, "no damage (all leaves without thrips feeding)", "low damage (leaves have 10-20% feeding damage) ", and "high damage (leaves have >80% damage)" (Fig 2).** Plants from each damage group were inoculated with *S. vesicarium* condiospores. Inoculating spore suspension was 300 ml with a mean conidial count of 19,000/ml. Plants from each damage class were also inoculated with Type 2 water as a negative control. The amount of dead tissue was measured (cm) on every leaf weekly for two weeks. After two weeks, plants were individually incubated for 48 hours in plastic bags, and the total area colonized by *S. vesicarium* measured (cm^2) using a dissecting microscope. Trials consisted of 15 plants per treatment, and trials were replicated 3 times for a total of 45 plants per treatment.

Capacity of an individual onion thrips to physically transfer Stemphylium vesicarium to onion plants. Onion thrips were placed on an agar plate with *S. vesicarium* for 30 minutes, individually placed into 10µl tubes, and transferred singly to thrips-proof cages containing one healthy onion plant. Negative controls containing thrips exposed to only V8 agar were also transferred onto healthy onion plants in thrips-proof cages. After two weeks, all plants were removed, incubated for 48 hours in plastic bags, and examined under a dissecting microscope to determine if *S. vesicarium* colonized the tissue. Trials consisted of 30 plants per treatment, and were replicated 2 times for a total of 60 plants per treatment.

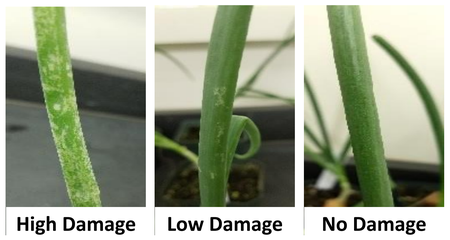

Figure 2: Onion plants with different levels of thrips feeding damage, including 'high damage', 'low damage', and 'no damage' were inoculated with S. versicarium.

Results

Effect of thrips feeding on the severity of Stemphylium leaf blight disease

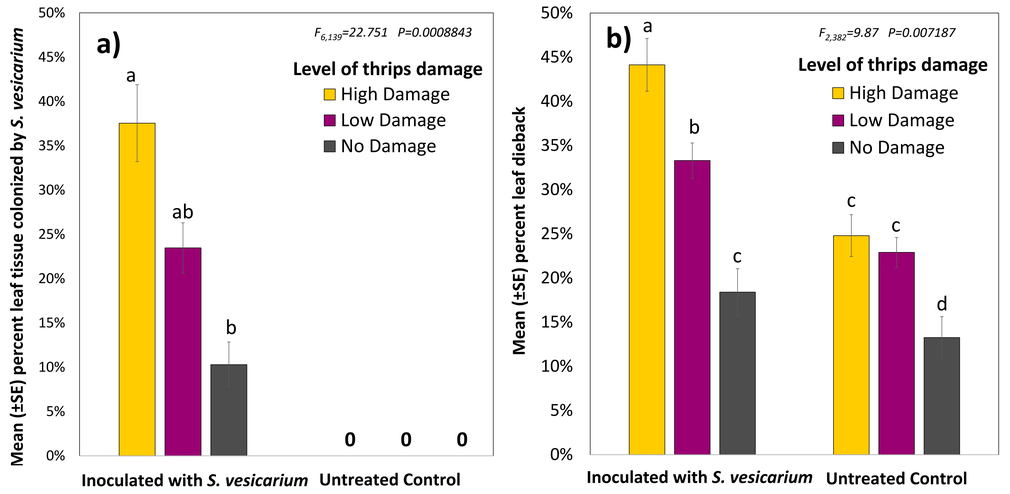

Figure 3: a) Mean (±SE) percent of leaf colonized by *S. vesicarium* in onions inoculated with *S. vesicarium* and in an untreated control within three different levels of thrips damage, 'No damage', 'Low Damage', and 'High Damage'. b) Mean (±SE) percent leaf dieback in onions inoculated with *S. vesicarium* and in an untreated control within three different levels of thrips damage, 'No damage', 'Low Damage', and 'High Damage'.

Capacity for onion thrips to passively transfer *S. vesicarium* condiospores

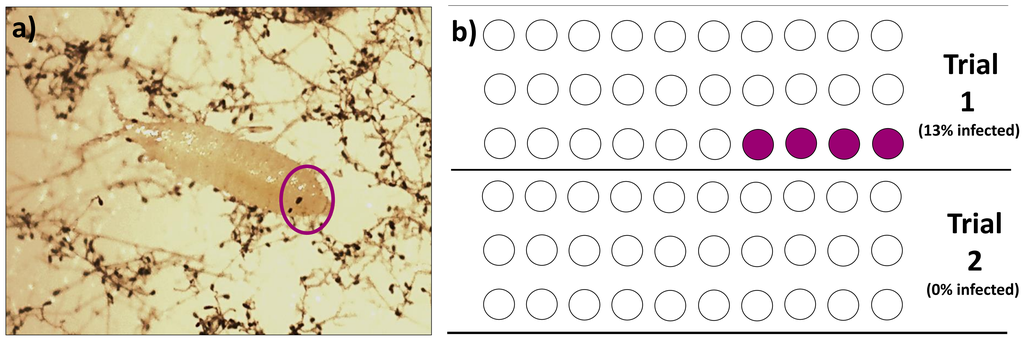

Figure 4: a) Onion thrips larva on petri plate containing *S. vesicarium,* conidiospore attached to abdomen of onion thrips larva (indicated by the purple circle). b) Number of plants infected with *S. vesicarium* after being exposed to a single thrips with condiospores in two trials (indicated by the purple circles).

- Stemphylium leaf blight disease was significantly impacted by the amount of thrips feeding present prior to inoculation. Plants with higher levels of thrips feeding had greater percent *S. vesicarium* colonization on onion leaves. **Plants with 'high' levels of thrips damage had approximately 1-3 times more S. *vesicarium* colonization as compared to the onion plants with 'no damage' or 'low damage'** (Fig 3a).
- Additionally, **plants with greater thrips feeding damage had 2-3 times more leaf dieback as compared to those plants without thrips feeding damage** (Fig 3b).
- Conidiospores successfully attached to the bodies of both onion thrips larvae and adults (Fig. 4a).
- While conidispores were observed on the bodies of thrips, **a low percentage of onion thrips effectively transferred *S. vesicarium***. Over the two trials, only 4 of 60 plants (6.6%) were infected with *S. vesicarium* after being exposed to an onion thrips containing *S. vesicarium* conidia (Fig 4b).

Conclusions

1) Stemphylium colonization and Stemphylium leaf blight disease were significantly impacted by onion thrips feeding. Greater disease and colonization of *S. vesicarium* was recorded in treatments with thrips feeding. Effective onion thrips control throughout the season may significantly reduce levels of Stemphylium leaf blight.
2) In laboratory assays, only 6.6% of total plants were infected with *S. vesicarium* after being exposed to thrips with *S. vesicarium,* which indicates that thrips may be an insignificant factor in transferring *S. vesicarium* . However, this study only examined the effect of a single thrips, and greater densities of thrips may increase the likelihood of *S. vesicarium* infection.
3) Further study is underway to better understand how thrips control could reduce Stemphylium leaf blight disease in commercial onion fields.

References

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