Onion

Where: Gallery Overlook (upper level) Room C & D
MI Recertification credits: 2 (1B, COMM CORE, PRIV CORE)
OH Recertification credits: 1.5 (presentations as marked)
CCA Credits: PM(2.0)
Moderator: Bruce Klamer, Byron Center, MI

9:00 am — Managing Onion Insect Pests and Associated Diseases (OH: 2B, 0.5 hr)
- Brian Nault, Entomology Dept., Cornell Univ., Geneva, NY

9:40 am — Managing Bacterial Diseases of Onion (OH: 2B, 0.5 hr)
- Bhabesh Dutta, Plant Pathology Dept., Univ. of Georgia

10:20 am — Pink Root and Mycorrhizal Inoculants in Onion Production in the Pacific Northwest (OH: 2B, 0.5 hr)
- Lindsey du Toit, Northwestern Washington Research & Extension Center, Washington State University, Mount Vernon, WA

11:00 am — Session Ends

Managing onion insect pests and associated diseases

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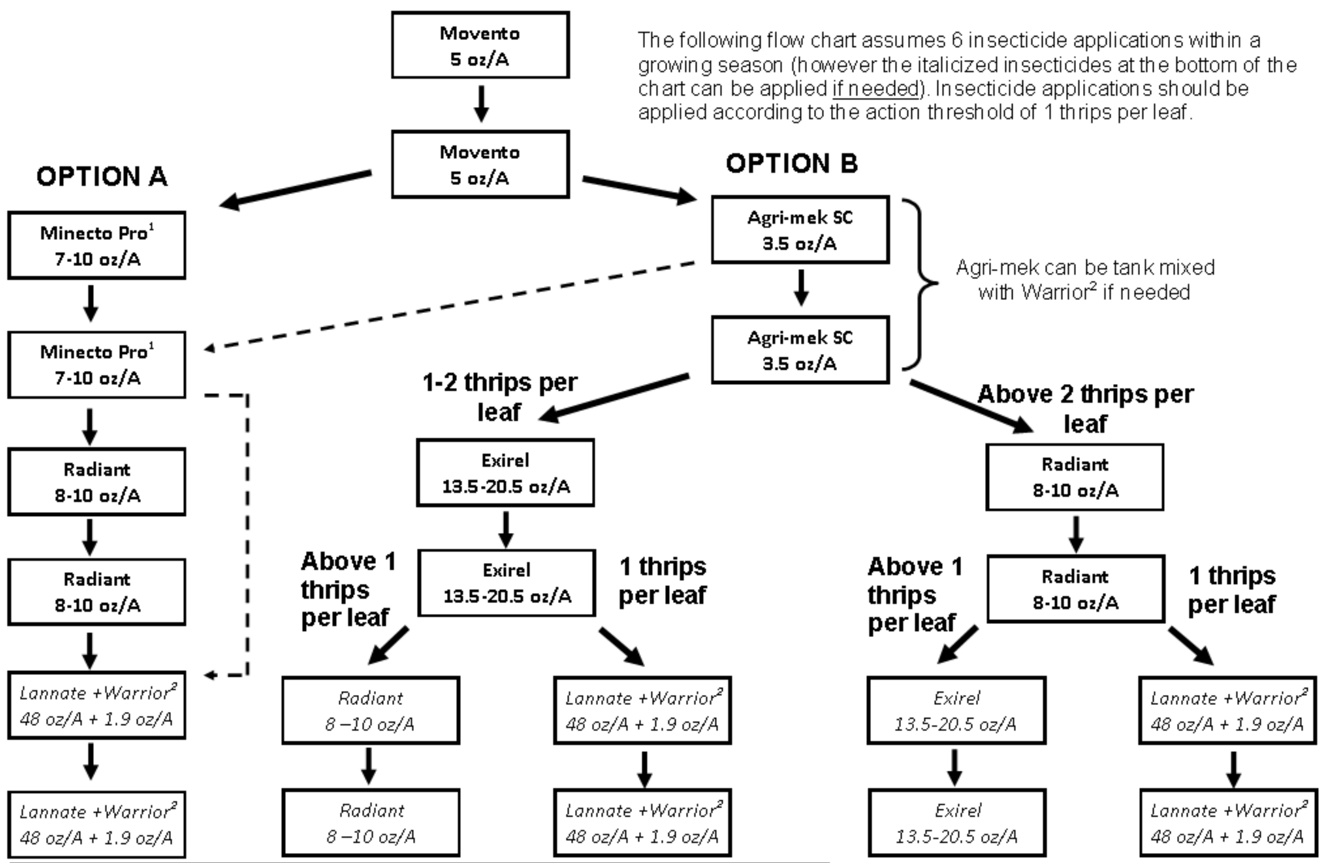
Onion Thrips Management Using Insecticide Programs

Based on multiple years of field studies in New York, the best products for managing onion thrips in onion have been Agri-Mek SC, Exirel, Minecto Pro, Movento and Radiant SC (**see Chart below**). Using these products in a particular sequence will provide season-long control of thrips infestations and should slow down insecticide resistance development and reduce pesticide and input costs. Past research in NY also showed that the best season-long sequences start with two applications of Movento and finish with one or two applications of either Radiant or Exirel. Whether or not Agri-Mek or Minecto Pro should be used in between these products may depend on the level of thrips pressure. The chart below offers some options to consider when pressure is high (Option A) and when it is low to moderate (Option B). If more than six applications are needed, consider the additional products listed. The decision to either make or not make an application should be determined using an action threshold of 1 thrips per onion leaf.

Guidelines for Managing Onion Thrips in 2018



[1] Agri-mek and Exirel should not be used in sequence with Minecto Pro
[2] Warrior II w/ Zeon technology

Impact of Onion Thrips Management and Fertilization on Bulb Decay

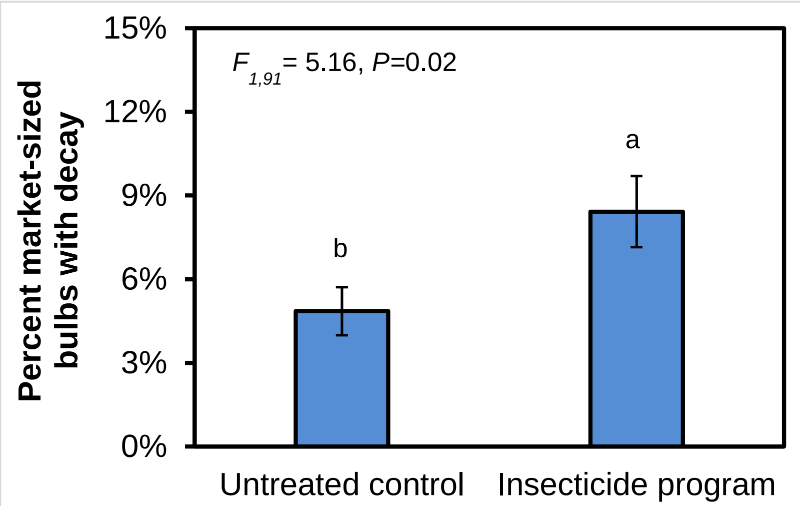


Figure 1. Percent market-sized bulbs with internal decay at harvest. A subsample of bulbs ('Standard' and 'Jumbo' size grades) were longitudinally cut open at harvest to determine if the bulb was decaying. Insecticide applications were applied using an action threshold of one thrips larva per leaf, and untreated controls were never applied with insecticide. Means followed by the same letter are not significantly different (P>0.05).

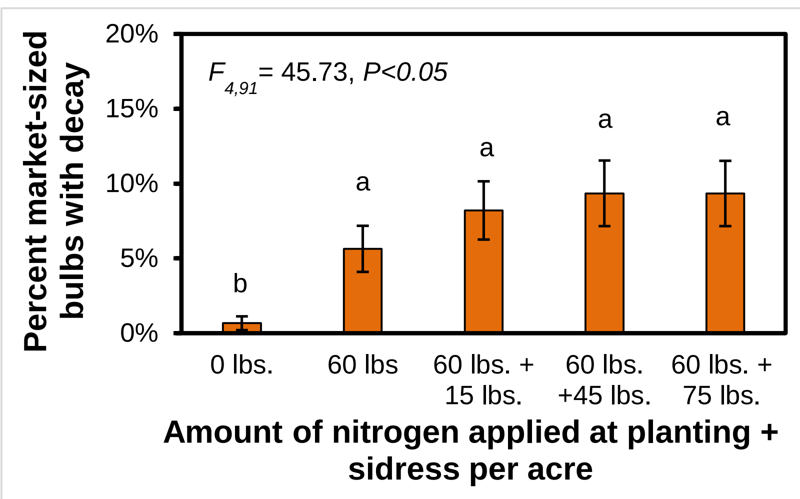


Figure 2. Percent market-sized bulbs with internal decay at harvest. A subsample of ('Standard' and 'Jumbo' size grades) were longitudinally cut open at harvest to determine if the bulb was decaying. Nitrogen applications and rates were split into two times. All fertilized treatments received 60 lbs of urea per acre at planting, and a split application of either 15 lbs, 45 lbs, or 75 lbs of urea per acre applied when onions had between 3-5 leaves. An unfertilized treatment was included as a control. Means followed by the same letter are not significantly different (P>0.05).

In New York in 2017, thrips control using an action-threshold based insecticide program was evaluated. While thrips were effectively controlled using insecticides (results not shown), we were surprised that market-sized bulbs in the insecticide-treatment had significantly more internal decay (e.g., bacterial pathogens) compared with the control (**Fig. 1**). A subsample of symptomatic bulbs revealed over 8 species of bacterial pathogens, including those that cause center rot (*Pantoea spp.*) and sour skin (*Burkholderia cepacia*). Premature lodging in the untreated control may have been responsible for the greater levels of rot.

Also in New York in 2017, we examined the impact of varying levels of urea applied to onion on onion thrips abundance. While we did not detect differences in onion thrips densities among the four urea treatments, we observed significantly greater levels of internal bulb decay in treatments receiving nitrogen (regardless of rate) compared with the control that received no nitrogen (**Fig. 2**).

These studies will be repeated in 2018 to determine if these trends continue to occur.

Relationship Between Onion Thrips Damage and Stemphylium Leaf Blight

In New York this fall, we were interested to know if previous onion thrips damage would exacerbate Stemphylium leaf blight (SLB), caused by *Stemphylium vesicarium*, in onion cultivars that vary in leaf waxiness. To examine this question, a wide range of thrips damage was created (high, low and no; **see Fig. 3**) on two onion cultivars: a waxy cultivar, 'Alisa Craig', and one that has semi-glossy wax, 'Avalon'. Onion leaves were then treated with similar numbers of *S. vesicarium* spores and later examined for the length of the leaf with SLB.

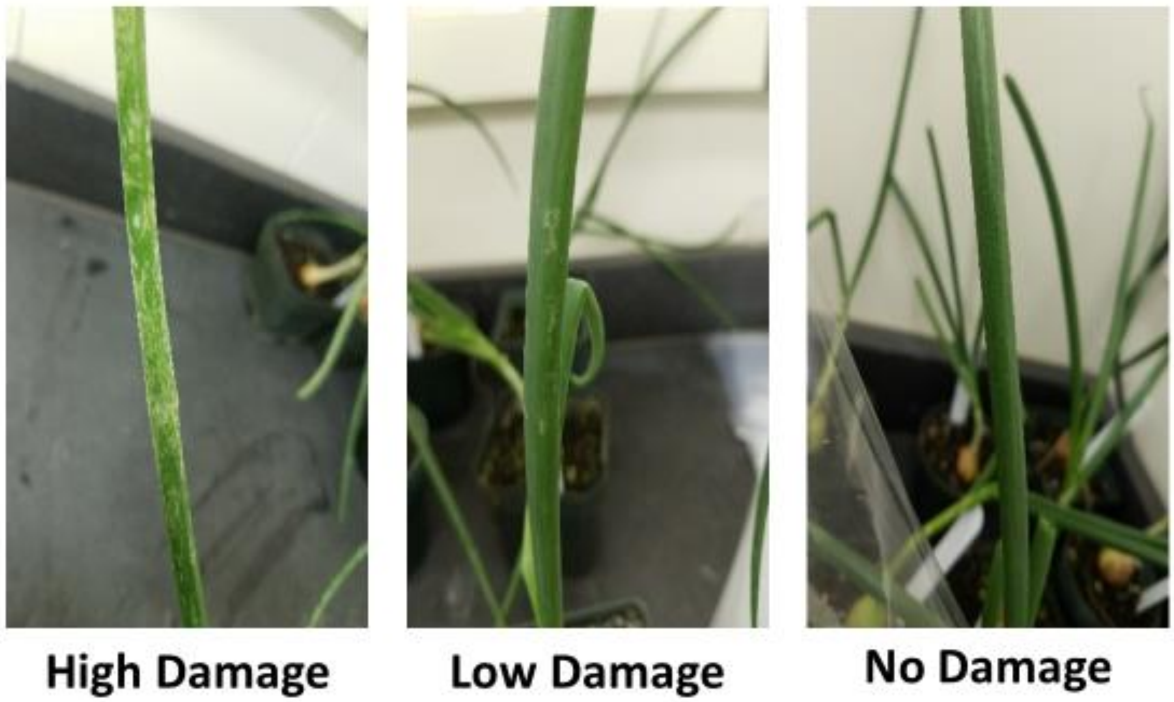


Figure 3. Onion leaves that had high, low and no damage from thrips feeding prior to inoculation with *Stemphylium vesicarium* spores in a greenhouse study in New York in 2017.

Results indicated that SLB occurrence on the waxy cultivar increased as previous damage by thrips increased (**Fig. 4a**). SLB occurrence on the semi-glossy cultivar with previous high and low thrips damage were similar and significantly greater than SLB in the non-damaged control (**Fig. 4b**). Surprisingly, SLB was grater in the higher wax cultivar. The percentage of each leaf that had dieback symptoms also will be analyzed to determine if that factor may explain why SLB differed between the treatments. Studies will continue to understand the relationship between onion thrips, damage caused by thrips an SLB.

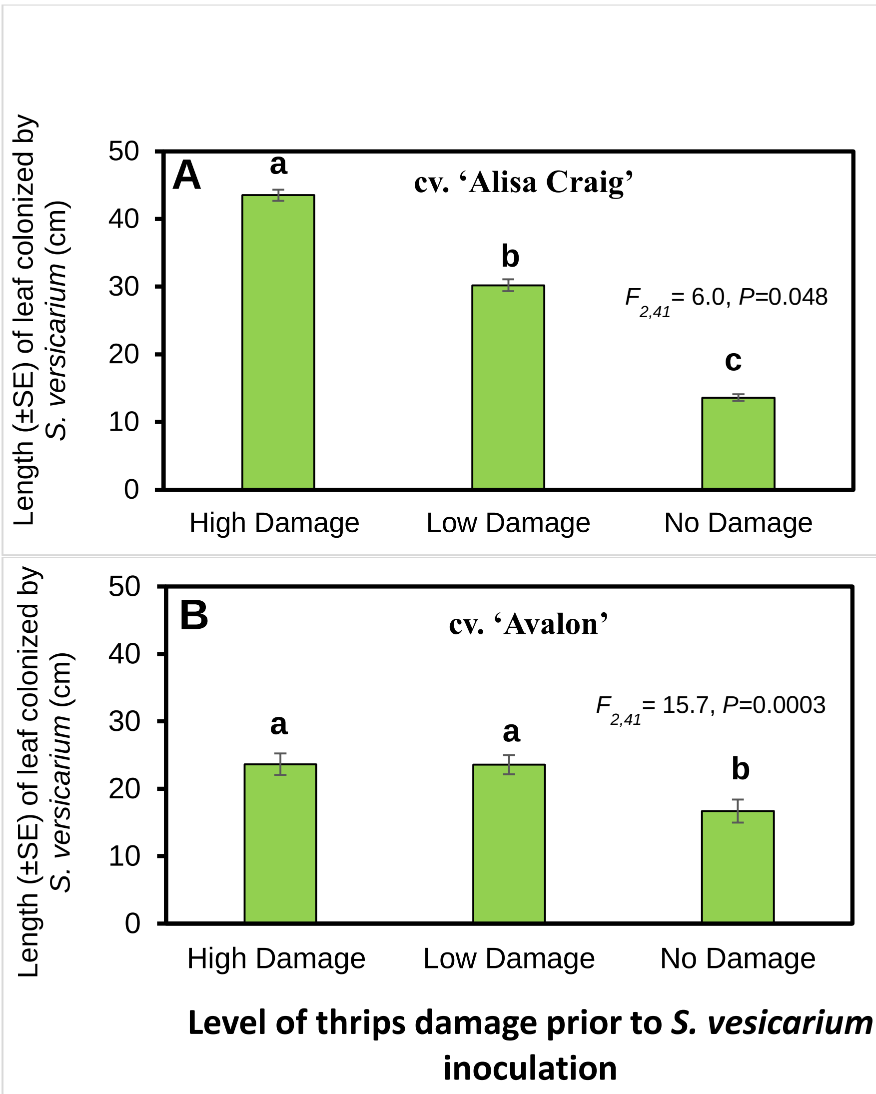


Figure 4. Length of leaf colonized by *S. vesicarium* in three different levels of thrips damage, 'No damage', 'Low Damage', and 'High Damage' (n=15 for all treatments). Means within a cultivar followed by the same letter are not significantly different (P>0.05).

Relationship Between Onion Thrips Control and Iris Yellow Spot Disease

In New York in 2016, we were interested to determine if onion thrips control using insecticides would reduce the incidence and severity of *Iris yellow spot* (IYS) disease in onion in a commercial field. Onion thrips and IYSV pressure was very high at this test site. Two insecticide programs were evaluated: weekly insecticide sprays and an action-threshold based program that had fewer sprays. Regardless of the insecticide program evaluated, thrips control was identical (results not shown). However, the incidence of IYS was significantly lower in the insecticide programs than in the untreated control through late July (**Fig. 5a**). In early August, the incidence of IYS eventually reached 100% in the insecticide treatments at the same time as the untreated control. The severity of IYS at the end of the season when the crop was mature was evaluated using a scale of 0-4 (0 having no lesions and 4 having many lesions). Results indicated that IYS severity was significantly lower in insecticide treatments compared with the untreated control (**Fig. 5b**). Damage by thrips and IYS in the untreated control caused mean marketable yields to be significantly lower than yields in insecticide-treated plots (**Fig. 5c**). Implications of these results are that insecticides can be used to delay the incidence of high levels of IYS and reduce the severity of the disease. However, insecticide use will not protect onions from IYS and other management tactics are desperately needed.

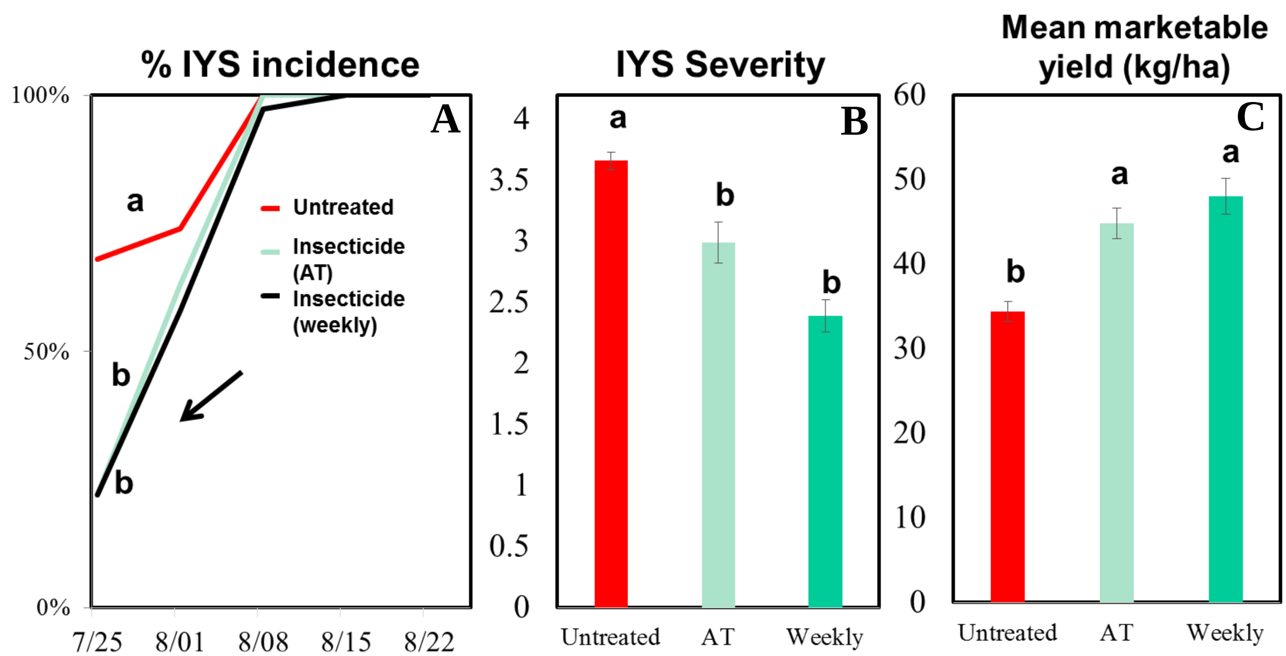


Figure 5. Percent incidence of Iris yellow spot (IYS) disease, IYS severity and mean marketable yield in onions treated either weekly with insecticides (weekly) or treated only when thrips densities reached an action threshold of 1 per leaf (AT) or left untreated. Means followed by the same letter are not significantly different (P>0.05).

Allium Leafminer Threatens Allium Production in Eastern US

A new invasive insect pest known as the Allium leafminer (ALM), *Phytomyza gymnostoma* Loew, has recently arrived in the eastern US (**Fig 6a**). ALM attacks crops in the *Allium* genus (e.g., onion, garlic, leek, scallions, shallots and chives) and is considered a major threat to producing these crops. This insect has two generations per year (spring and fall) separated by a "hibernation" period during the summer. Originally from Europe, ALM was first detected in Pennsylvania in December of 2015 and in New Jersey and New York in 2016. In spring of 2017, ALM was commonly found throughout eastern Pennsylvania (>21 counties), eastern New York (5 counties) and potentially some mid-Atlantic States. There is serious concern that this pest will continue to migrate and threaten Allium production areas in the mid-western and western US and Canada.

The damaging stage of ALM is a maggot (**Fig. 6b**), which initially feeds within leaves creating mines downward until it completes its development as a pupa near the bottom of the plant (e.g., bulb) (**Fig. 6c**). Feeding causes extensive damage and renders the crop unmarketable. Moreover, feeding by larvae create entry routes for bacterial and fungal pathogens to establish, which causes plants to rot. High ALM infestations have occurred in onion and leek fields with as many as 20 to 100 pupae per plant, and 100% of plants infested.

Insecticide evaluation studies were conducted in NY and PA this fall and results are forthcoming.

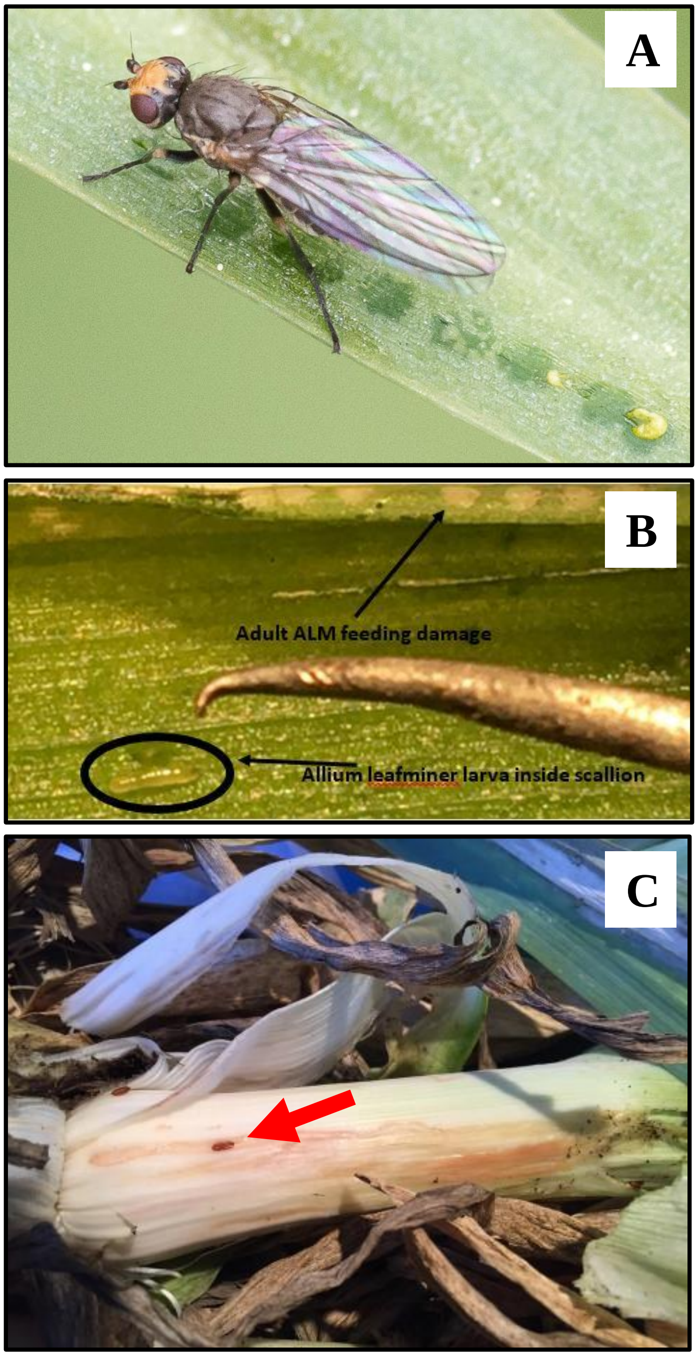


Fig. 6. (**a**) Allium leafminer adult with circular marks where she punctured the leaf surface to either feed on secretions and/or lay eggs. (**b**) Allium leafminer larva. (**c**) Allium leafminer pupa near the base of a leek; bacterial rot also present, presumably initiated from wound created by maggot feeding.

Insight into the Diversity, Epidemiology, and Management of *Pantoea Ananatis*, Causal Agent of Center Rot of Onion in Georgia

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Annually, Georgia plants over 12,000 acres of sweet onions (National Agricultural Statistical Service, USDA). Center rot of onion (*Allium cepa* L.) is caused by a Gram-negative bacterium, *Pantoea ananatis* (Serrano) Mergaert. The pathogen was first associated with center rot in Georgia (1997) on Vidalia onions. Since then, it has been spreading to different onion growing regions in the United States. The symptoms of center rot start with water soaking lesions on foliage which run along the length of the leaf. The lesions may gradually turn necrotic and produce blighted appearance with disease progression. In severe cases, infected plants may wilt and exhibit bleached appearance of the foliage (Gitaitis and Gay, 1997; Dutta et al., 2014). *P. ananatis* can also invade into the bulb tissue and cause bulb discoloration. The bacterial invasion can pre-dispose bulb to post-harvest rot caused by the secondary microbes in storage. Under favorable conditions, yield losses to this disease may be as high as 100% (Gitaitis and Gay, 1997).

Multiple sources of *P. ananatis* inoculum have been associated with center rot epidemic (Gitaitis et al., 2002; Walcott et al., 2002; Dutta et al., 2014). Infested onion seeds can introduce inoculum to onion field. *P. ananatis* is both seed-borne and seed-transmitted in onions and under favorable conditions, the bacterium can cause considerable economic losses (Walcott et al., 2002; Goszczynska et al., 2006). *P. ananatis* can also be transmitted to onion by two known insect vectors, *Frankliniella fusca* (tobacco thrips) and *Thrips tabaci* (onion thrips) (Gitaitis et al., 2003; Dutta et al., 2014, 2016). The mode of bacterial transmission was reported to be passive through contaminated thrips feces (Dutta et al., 2014, 2016). *P. ananatis* has also been reported to survive as an epiphyte on weeds in the farmscapes of Georgia (Gitaitis et al., 2002). Furthermore, onion pathogenic *P. ananatis* strains have been found to survive on over 20 weed species near onion production sites in the state of Georgia. Weeds may provide local sources of inoculum during the season and harbor the pathogen from one growing season to the next (Gitaitis et al. 2002). Currently, genetic resistance to center rot in commercially available cultivars has not been identified. The genetic diversity of the pathogen must be elucidated to successfully breed for genetic resistance. Therefore, we investigated 1) the genetic diversity of *P. ananatis* strains endemic to Georgia, 2) test commercially available cultivars for reduced center rot incidence at various growth stages, and 3) examine the efficacy of protective chemical foliar treatments at two growth stages and the role thrips presence had on effectiveness of applications.

We assessed a collection of fifty *P. ananatis* strains collected from Georgia over three decades to determine genetic factors that correlated with onion pathogenic potential. Strains varied greatly in their pathogenic potential and aggressiveness on different cultivated *Allium* species like onion, leek, shallot and chive. Using multi-locus sequence analysis (MLSA) and repetitive extragenic palindrome (rep)-PCR techniques, we did not observe any correlation between onion pathogenic potential and core genome genetic diversity.

Further we evaluated that at what growth stage the plant is most susceptible to bulb infection and if there are differences in susceptibility to bulb infection among sweet onion cultivars. The results indicate that total bulb center rot incidence was significantly higher for Granex YPRR (84%) compared to other cultivars. Also, cultivars 1518 (49%) and 1407 (33%) had significantly lower incidence of bulb infection compared to other tested cultivars. Onions were significantly more susceptible to bulb infection when inoculated during first leaf senescence (62%) as compared to bulb initiation (37%) and bulb swelling

(31%) stages in pre-cured bulbs (*P*=0.041). Significant higher incidence of center rot was observed for bulbs whose foliage were inoculated during first leaf senescence stage (64%) compared to bulb initiation (55%) and bulb swelling (52%) stages (*P*=0.048). Interactions between onion cultivar and inoculation stage on center rot bulb incidence was not significant ($P \geq 0.218$), when evaluated at different assessment periods. However, different cultivars displayed significant variability in susceptibility to bulb infection. The outcomes of this study may have implications in devising management strategies aimed at protecting most susceptible onion growth stages against *P. ananatis*.

Further we evaluated if better disease management with chemical protection can be achieved with targeted chemical protection at susceptible onion growth stages. Foliar treatments of acibenzolar-S-methyl (Actigard 50WG), copper hydroxide (Kocide 3000), and Actigard + Kocide were evaluated for their effectiveness at two critical onion-growth stages; bulb initiation and bulb swelling. In addition, it was also evaluated if thrips feeding can result in reduced efficacy of protective treatments against *P. ananatis*. The results indicate that there was a significant effect of protective applications at two onion-growth stages on the bulb incidence of center rot ($P<0.05$), in absence of thrips. However, response of protective chemical application was not significantly different between two growth stages ($P>0.05$). At bulb initiation, treatments of Kocide 3000 (12.4%) and Kocide 3000 + Actigard (14.8%) application had significantly lower center rot incidence in onion bulbs than Actigard alone (38.2%) treatment. Similar results were observed for the protective treatments at the bulb swelling stage with disease incidence of 40.2% for Actigard, while incidence levels for the Kocide 3000 and Kocide 3000 + Actigard treatments were 20.5% and 17.4%, respectively. In contrast, applications of Kocide 3000, Actigard, or Kocide 3000 + Actigard at two growth-stages did not significantly reduce center rot bulb incidence ($P>0.05$) after onion seedlings were exposed to thrips. The results indicate that thrips infestation can reduce the efficacy of protective chemical treatments against *P. ananatis*. Hence, it is critical to implement an effective management strategy including thrips management and protective chemical treatments against *P. ananatis* at susceptible growth stages of onion.

Overall, the results from this research findings shed important insights into the diversity, epidemiology, and management of center rot on onion, which can be incorporated into the integrated disease management for center rot.

Literature Cited.

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