Digging Deeper: Towards understanding the Stemphylium leaf blight pathogen of onion in New York

Sarah Pethybridge[a], Frank Hay[a], Elizabeth Maloney[a] and Christy Hoepting[b]

[a]Cornell University, School of Integrative Plant Science, Section of Plant Pathology & Plant-Microbe Biology, Geneva, NY 14456; and [b]Cornell Cooperative Extension Regional Vegetable Program, 12690 State Route 31, Albion NY 14411

Introduction

Fungal foliar diseases are a major constraint to onion production, causing premature senescence of plants, undersized and immature bulbs, and collectively they may reduce yields and necessitate a rigorous fungicide program for control. Historically, the main foliar diseases of onion in New York have been Botrytis leaf blight (*Botrytis squamosa*), purple blotch (*Alternaria porri*), Stemphylium leaf blight (*Stemphylium vesicarium*), and sporadic epidemics of downy mildew (*Peronospora destructor*. In recent years, Stemphylium leaf blight has emerged as a more aggressive disease. Collectively, these diseases cause defoliation and death of the leaves due to girdling prior to lodging. Moreover, the symptoms of Stemphylium leaf and blight and purple blotch may be easily confused. The loss associated with this complex of diseases has been estimated to range from 40 to 75% in the absence of fungicides (L. Stivers, http://pmep.cce.cornell.edu/fqpa/crop-profiles/onion.html). .

This project was initiated due to concerns of the increasing prevalence and severity of foliar diseases, especially Stemphylium leaf blight, in conventional onion production. The primary objective of this study was to identify the most commonly occurring foliar fungal diseases.

Materials and Methods

Isolations. Diseased leaves were collected from conventional (*n*, total number of leaves = 846) and organic (*n* = 283) onion fields during 2015 to characterize the fungi associated with onion plants affected by foliar disease. Fields were representative of the range of growing regions within New York State, ranging from production on muck (Potter (Yates Co.), Orange County, Phoenix, Oswego and Fulton (Oswego Co.), Sodus (Wayne Co.), and Elba (Genesee/Orleans Cos.) to upland (Elba and Batavia (Genesee Co.), Phelps (Ontario Co.), Penn Yan (Yates Co.), Hector (Schuyler Co.), Allegany (Cattaraugus Co.) and Plattsburgh (Clinton Co.). Leaf samples were collected between 16 July and 28 August. In each field, one diseased leaf was collected from each of 8 to 73 randomly selected visually diseased plants per field. Samples were collected from different types of lesions, for example, tan-, purple- or black-colored, small and large-sized. Leaves were stored at 4°C for no longer than 4 days following collection.

Diseased leaves were placed in individual glass dishes and placed on fiber glass mesh suspended within sealed plastic trays containing damp tissue to maintain high humidity. Trays were incubated at room temperature and observed for fungal growth after 3 days. Emerging fungal mycelia were

transferred to potato-dextrose agar. Fungi were identified to genus and species based on morphological characteristics.

The incidence of fungi associated with the diseased onion leaves was summarized as prevalence (number of fields where a species was detected compared to the total number of fields sampled × 100) and as isolation frequency (number of diseased leaves from which a species was isolated compared to the total number of leaves incubated × 100).

The effect of organic and conventional production practices on the distribution of fungal incidence was tested using a *t*-test. The effect of location within selected conventional production fields on the isolation frequency of *S. vesicarium* and *A. porri* was also tested.

Results

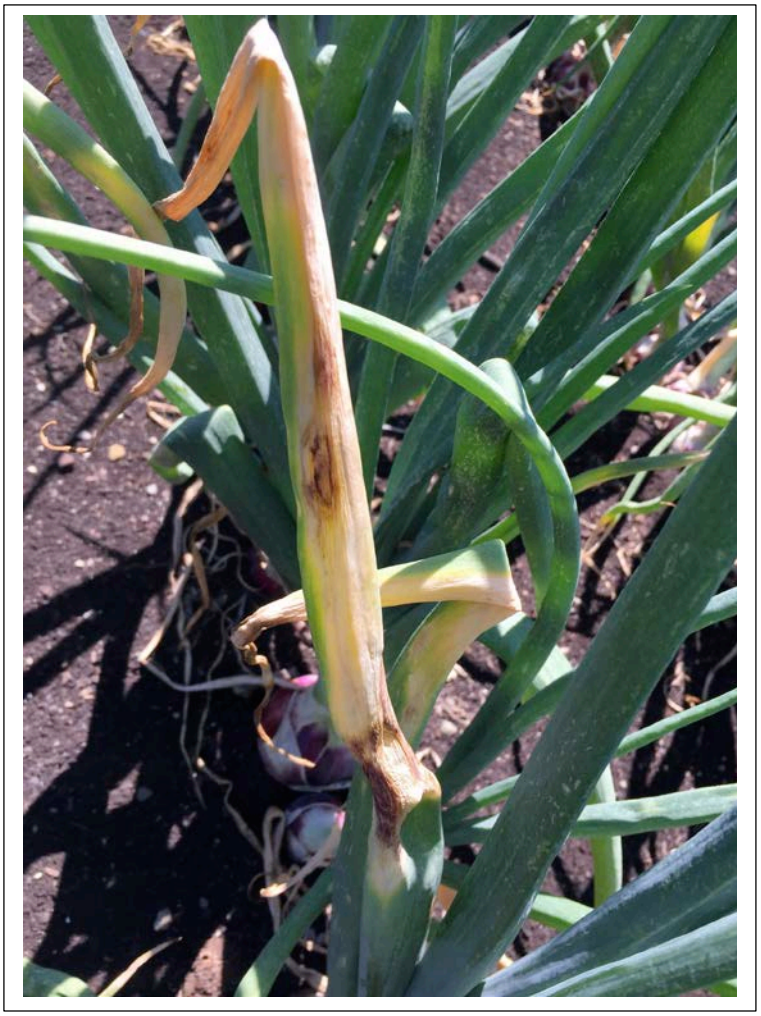
Stemphylium vesicarium (cause of Stemphylium leaf blight) was the most prevalent fungus associated with foliar disease in onion fields in 2015 (Table 1). The isolation frequency of *S. vesicarium* was not significantly affected by production type (organic versus conventional; Table 2). Moreover, the isolation frequency of *S. vesicarium* was not significantly different between onion production regions within New York ($P = 0.143$). This finding suggests that some of the fungicides used within the conventional program may therefore be of low efficacy for the control of this pathogen. The high isolation frequency of *S. vesicarium* from foliar disease was irrespective of symptom type but most commonly with an asymmetric, necrotic lesion (Fig. 1). The sexual stage of *S. vesicarium*, *Pleospora allii* was also frequently observed on lesions.

Table 1. Percentage of fields in which specific fungi were found associated with foliar disease of onion in organic and conventional fields in New York in 2015.

Fungi (Disease)	Organic (%)[a]	Conventional (%)[a]
Stemphylium vesicarium (Stemphylium leaf blight)	100	100
Alternaria porri (Purple blotch)	50	0
Alternaria alternata	80	59.1
Peronospora destructor (Downy mildew)	60	4.5
Botrytis spp. (Leaf blight and neck rot)	30	9.1

[a] Number of fields (10 = organic; 22 = conventional).

Figure 1. Stemphylium leaf blight symptoms in an onion field in New York in 2015.



In conventional fields, there was a low prevalence and incidence of *Peronospora destructor* (cause of downy mildew), and *Botrytis* spp. (associated with multiple diseases depending upon species, including neck rot).

Table 2. Effect of production practice (organic versus conventional) on the isolation frequency (%) of fungi from diseased onion leaves in New York in 2015.

Fungi	Organic (%) (283 leaves)	Conventional (%) 846 leaves	*t* (*P* =)[a]
Stemphylium vesicarium	85.5	86.4	-0.16 (0.436)
Alternaria porri	14.5	0	2.33 (0.022)
Alternaria alternata	49.5	6.0	3.85 (0.001)
Peronospora destructor	11.1	0.1	2.13 (0.031)
Botrytis spp.	2.1	0.5	1.42 (0.091)

[a] If the probability was less than 0.05, this indicates a statistically significant difference.

The isolation frequency of *Alternaria porri* (cause of purple blotch) and *A. alternata* (also a known pathogen of onion) was significantly higher in organic than conventional production. These findings suggest the fungicides being used within conventional production are highly efficacious for the control of purple blotch and downy mildew. There was a low frequency of other fungi that were most likely to be saprophytic, including *Helminthosporium* spp., *Humicola* spp., *Fusarium* spp., and *Cladosporium* spp.

Further Work

The objectives of further research are to investigate the potential reasons for the high incidence of *S. vesicarium* in conventional onion fields. This will include testing of representative isolates for sensitivity to fungicides commonly used for disease control and determining the relative efficacy of fungicides in different resistance groups to those already in use.

Acknowledgments

We are grateful for funding from the New York Onion Research and Development Program and the growers for access to their fields.