Ohio Vegetable & Small Fruit Research & Development Program

Final Report

2019

Project Title: Vegetable and Fruit Disease Diagnosis

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Why was this project funded? This diagnostics project is primarily a service to commercial vegetable and fruit growers in Ohio. We request funding each year to help support OSU Vegetable and Fruit Pathology programs' efforts to assist growers in diagnosing crop diseases, particularly in the case of unusual or difficult-to-diagnose cases and diseases that have explosive potential and require early detection on a regional scale.

Project outline. We utilize a range of traditional and modern, state-of-the-art diagnostic methods. These include light microscopy to identify fungal and oomycete (*Phytophthora*, *Pythium*, downy mildew) pathogens based on morphology, culturing followed by microscopic or other identification, biochemical and plant tests for bacterial identification, serological assays, mainly for virus and bacterial identification, specific polymerase chain reaction (PCR and quantitative PCR) assays and genomic sequencing. When a sample is received by courier, US mail, or in person, it is immediately catalogued and given a unique number. After initial evaluation, the submitter is contacted within 24 hours by phone or email and provided with a preliminary diagnosis and management recommendations. In many cases this is also the final diagnosis. If culturing or other time-consuming tests are required, results may not be available for several days to one week.

Take-home messages. The vegetable and fruit diagnostic program provided timely information on the arrival of important diseases of vegetable, small fruit, tree fruit and hop crops throughout Ohio. For the first time our program also received commercial hemp samples. Information on the diseases and their management was

then provided to growers and the general public on the Ohio Veggie Disease News blog (u.osu.edu/miller.769), the VegNet Newsletter (vegnet.osu.edu), Twitter (@OhioVeggieDoc), Ohio Fruit News (OFN; https://u.osu.edu/fruitpathology/fruit-news-2/), the fruit pathology Facebook page (@fruitpathology), the Ohio Grape IPM Facebook page (@ohiograpeipm), and directly to county Extension educators.

Impacts.

1. In 2019, we diagnosed 418 samples. The estimated cost of providing the basic service to growers, considering labor and supplies, is $60 per physical sample. This does not include the cost of advanced diagnostics necessary in some cases or overhead costs. We estimate that the cost of diagnosing electronic samples is $20/sample. In 2019 we diagnosed 362 physical and 42 electronic fruit and vegetable samples. Therefore, the value of this service in 2019 to Ohio fruit and vegetable growers is at least $22, 560. ***This represents a 5.6:1 return on grower's investment in this project.***

Sample Type	**Commodity**		**Estimated Value ($)**
	Vegetable	**Fruit**	
Physical	288	74	$21,720
Electronic	35	7	$840
Total	**323**	**81**	**$22, 560**

What was discovered?

One new nut (English walnut) disease was reported in Ohio for the first time. Tree fruit asphyxiation was a major issue for Ohio growers, affecting peach and apple the most. Grapevines were also impacted by root asphyxiation. We also determined that the powdery mildew fungus that we diagnosed on grape was resistant to QoI fungicides. These findings will be used to leverage funding from federal and state agencies to study the biology and epidemiology of these pathosystems.

A. Vegetable Disease Diagnostics

A total of 323 samples were diagnosed in 2019, the majority of the samples were submitted by or on behalf of commercial vegetable producers in Ohio (Figure 1).

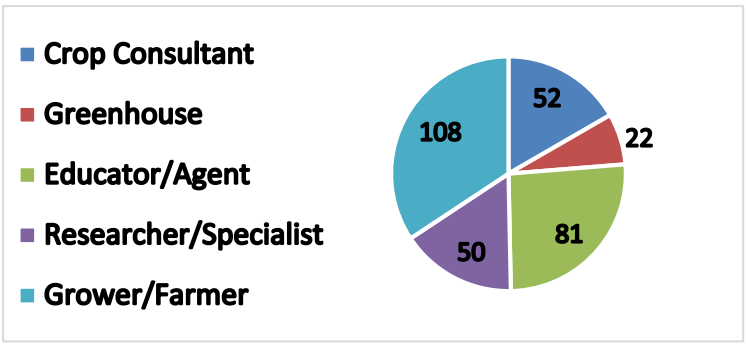


Figure 1. Sources of samples submitted to the OSU Vegetable Pathology Laboratory during 2019.

Vegetable samples were received from 35 Ohio counties and 19 samples came outside of the state of Ohio (one from Georgia, one from North Carolina, one from Canada, two from Virginia, two from Cambodia, and five from Indiana, and seven from Texas) (Figure 2). The number of counties for this year was similar to the number for 2017 and 2018 (38 and 39 counties, respectively), and the number of samples also was similar to the one received in 2018 (315).

Wayne County and Huron County submitted the most samples (74 and 50, respectively), many of which in collaboration with the OSU Wayne County Extension scouting program. Ten or more samples were received from Erie, Holmes, Sandusky and Columbiana counties.

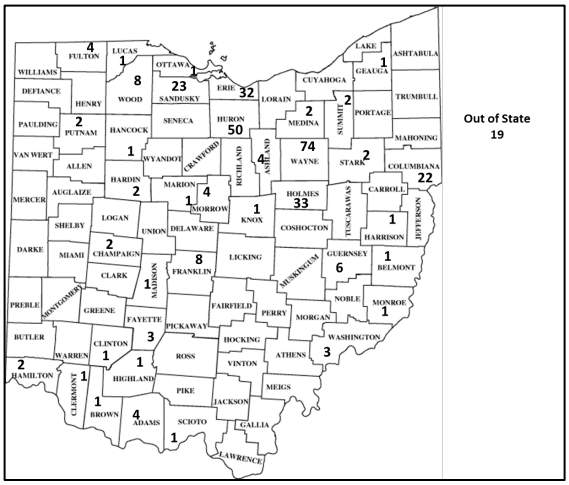


Figure 2. Number of vegetable samples received for diagnosis by the OSU Vegetable Pathology Laboratory, by Ohio county.

The beginning of the 2019 growing season was characterized by heavy rains and flooding events that delayed planting for many crops. This caused different abiotic stresses, such as anoxia and water logging. The extremely wet conditions together with the cool temperatures also favored an early start of bacterial diseases, mainly caused by *Pseudomonas* spp. (bacterial speck and angular leaf spot).

Most of the samples received were solanaceous crops (tomatoes, peppers, eggplants, and potatoes) followed by cucurbits (cucumbers, melons, watermelon, zucchini, squash and pumpkins) (Fig. 3A). Among the solanaceous crops tomatoes were the most frequently received followed by peppers (Fig. 3B), while among the cucurbitaceous crops zucchini/squashes were the most predominant followed by cucumbers, and pumpkins (Fig.3C).

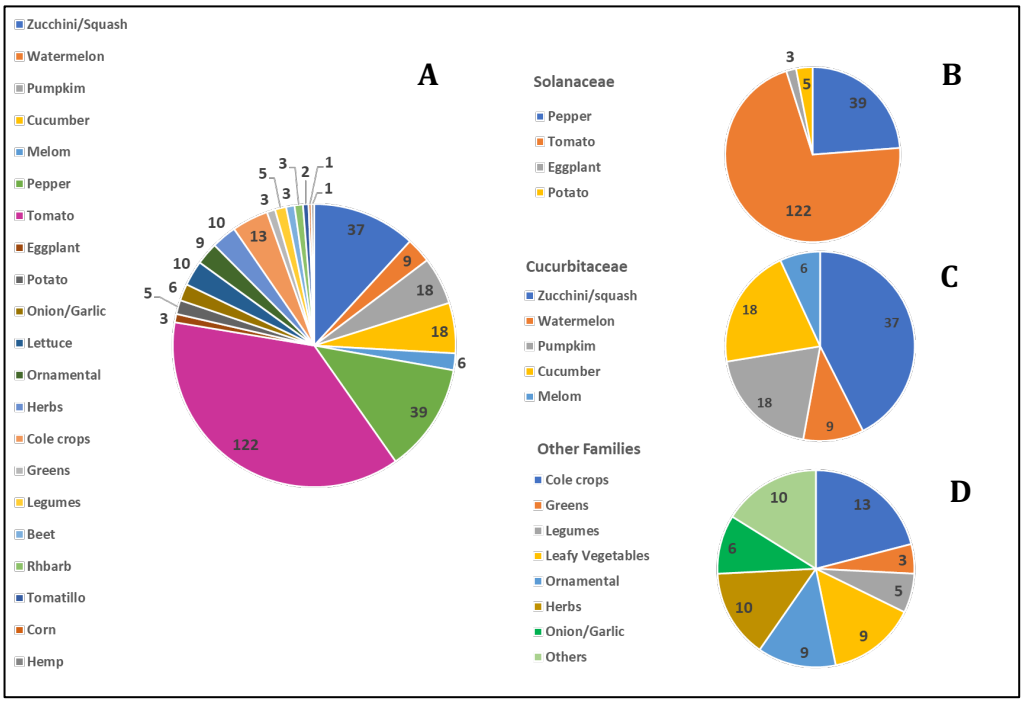


Figure 3. Number of samples received for diagnosis by the OSU Vegetable Pathology Laboratory in 2019 (A). The panels B, C, and D report the number of samples according to the family crop.

Ten or more samples were leafy greens and cole crops, nine sample were herbs, and eight samples were ornamental. The remaining samples included legumes and greens, while the "other" category included beets, hemp, sweet potato, tomatillo, rhubarb and sweet corn.

We pinpointed the first appearance of downy mildew in cucumbers, melons, pumpkins and squash in four counties in the state. All first reports were submitted to the multistate cucurbit downy mildew forecasting site (Cucurbit ipmPIPE; http://cdm.ipmpipe.org/). Downy mildew was also reported on basil in Huron County. This year downy mildew in cucurbits appeared at the end of August, and this was even more unusual compared to what was considered a late appearance in 2018 (beginning of August). This delay could be due both to the unusual weather and to improved strategies adopted by the greenhouses in the Great Lakes Region to control downy mildew during the winter.

Similar to 2018, powdery mildew (23 samples) and Plectosporium blight (nine samples) infected many cucurbitaceus crops. Septoria blight and early blight on tomatoes made an early appearance (end of June) due to the favorable weather conditions. We also observed a high incidence of foliar pathogens like *Alternaria*, *Stemphylium*, *Corynespora* and *Cercospora. Phytophthora* infections were also recorded among different crops (pepper, potato and cucurbits). *Fusarium* was the

most diagnosed soilborne disease in 2019 (14 cases, seven on tomato). Ninety-eight fungal diseases were diagnosed in 2019. Water molds in the field were mainly associated with cucurbits (12 samples), while we detected *Pythium* infections on lettuce and herbs from hydroponic greenhouses (five samples).

Eighty-three samples were affected by bacterial diseases, and cucurbits, peppers and tomatoes were the most affected crops. At the beginning of the field season *Pseudomonas* spp. were the predominant bacterial species, while *Xanthomonas* infections started to appear by the end of June.

Tospoviruses [*Tomato spotted wilt virus* (TSWV) and *Impatiens necrotic spot virus* (INSV)] were diagnosed in tomato and peppers (eight samples), while Tobamoviruses [*Tobacco mosaic virus* (TMV)] were detected in field tomatoes (three samples). Several hydroponic tomato samples were received with possible symptoms of *Tomato brown rugose fruit virus* (TBRFV; Tobamovirus) were received but tested negative for this virus. TBRFV is mechanically transmitted, and it is causing severe damage to tomato production worldwide (Europe, Turkey, Jordan, Mexico and China). APHIS has recently issued a Federal Order imposing restrictions on the import of tomato and pepper for seeds, fruit and transplants in order to prevent the spread of this viral disease to the US.

B. Fruit Diagnostic Final Report

In total, 81 samples were received for diagnosis (**Table 1**). Samples were received from 29 counties, with the majority coming from Wayne county followed by Licking county (**Figure 1**). We also received three out-of-state samples. Apple (22%), grape (22%), and blackberry (10%) were the top three crops submitted to the Fruit Pathology Laboratory for diagnostics (**Table 1**). Two new crops- walnut and hemp were submitted for diagnostics.

On apple fungal fruit rot diseases were diagnosed the most frequently, although abiotic disorders were also frequently identified. Diagnosis was not confirmed for four of the samples, although scale damage was suspected. Root asphyxiation was reported on apple, peach and grape, representing 7% of the samples.

The number of blueberry samples decreased this year, but the number of black berry samples increased. Virus and Phomopsis were reported on blueberry. Together brambles accounted for 17% of the samples in 2019. Cane diseases were identified and on blackberry common and orange rust were also identified. No new reports of downy mildew on blackberry were diagnosed again this year.

Only three strawberry samples were received this year, downy significantly from last year. Black root rot, Phytophthora root rot and leaf spot were identified. Although we did not receive any Botrytis grey mould samples, Botrytis grey mould was reported as a major issue for strawberry growers this year.

The typical diseases on grapes (black rot, downy mildew, powdery mildew and Phomopsis) were diagnosed. In addition, crown gall, anthracnose and grapevine leaf roll associated virus 3 were diagnosed. Abiotic disorders including sun scald, root asphyxiation, lightening injury, and adventitious roots were also diagnosed.

Together brambles accounted for 12% of the samples in 2018. No new reports of downy mildew on blackberry were diagnosed. Leaf spots and root rots were most commonly diagnosed.

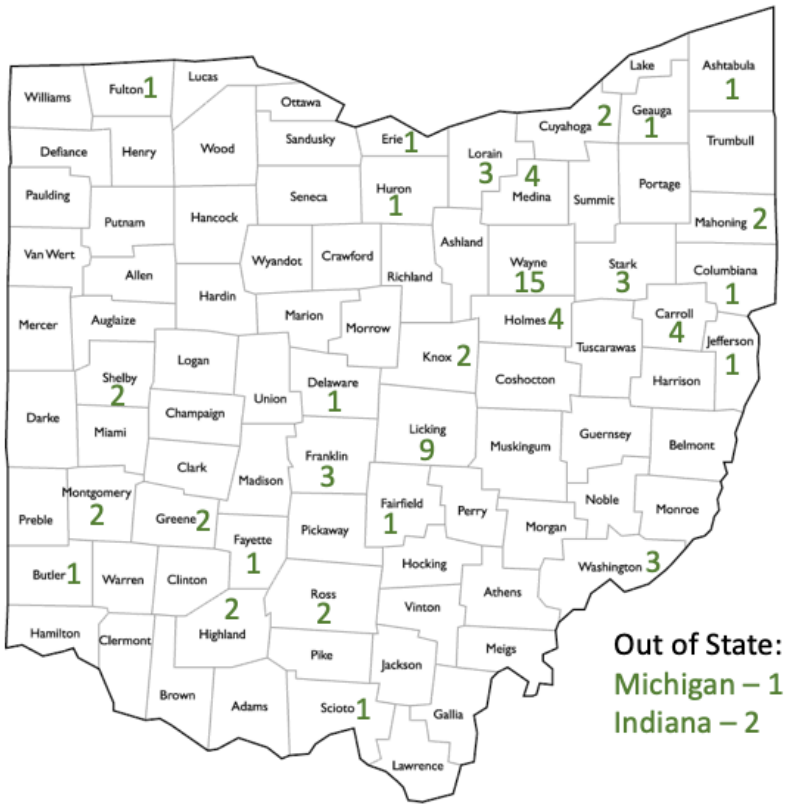
Bacterial spot was most commonly diagnosed on peach this year. We also received a sample of powdery mildew on peach that is produced in a high tunnel.

Two new crops, English walnut and hemp, were received for diagnosis this year. The English walnut sample was severely infected with bacterial spot. The commercial hemp sample had stem damage due to the stem touching the black plastic and burning. This year we received an additional two chestnut samples. The leaves had necrosis and were wilting but we could not identify the causative agent.

Crop (number samples)	Diagnosis	Number of Samples	County
Apple (18)	Abiotic	1	Licking
	Bacterial Spot	1	Carroll
	Bitter rot	2	Fairfield, Washington
	Black rot	1	Washington
	Tree drowning	2	Licking, Lorain
	Fire blight	1	Scioto
	Frog eye leaf spot	1	Licking
	Insect damage	2	Cuyahoga, Wayne
	Necrotic leaf blotch	1	Ross
	Sunscald and rot	2	Indiana, Lorain
	Unknown	1	Holmes
	White rot	3	Carroll, Geauga, Licking
Blackberry (7)	Abiotic	1	Wayne
	Blackberry rust	1	Greene
	Insect damage	1	Stark
	Common leaf rust	1	Washington
	Phytophthora root rot	1	Indiana
	Spur blight	1	Licking
	Virus	1	Wayne
Black raspberry (2)	Anthracnose	1	Jefferson
	Spur blight	1	Licking
Blueberry (3)	Phomopsis twig blight	1	Medina
	Unknown	1	Lorain

Crop (number samples)	Diagnosis	Number of Samples	County
	Virus	1	Stark
Boysenberries (1)	Leaf Spot	1	Michigan
Cherry (3)	Brown rot	1	Highland
	Tree drowning	1	Ross
	Herbicide damage	1	Fayette
Chestnut (2)	Unknown fungal disease	2	Carroll
English walnut (2)	Bacterial Spot	1	Wayne
	Unknown fungal infection	1	Wayne
Grape (18)	Anthracnose	1	Wayne
	Brown rot	1	Franklin
	Crown gall		
	Crown gall and root asphyxiation	1	Knox
		1	Knox
	Downy mildew	3	Mahoning (2), Medina
	Lightening damage	1	Wayne
	Multiple (black rot, phomopsis leafspot, cane blight)	1	Butler
	Sunscald	2	Franklin, Licking
	Powdery mildew	4	Holmes, Huron, Mahoning, Madison
	Unknown	1	Medina
	Virus (Grape Leaf Roll Associated Virus 3)	1	Ashtabula
	Adventitious roots (due to water stress)	1	Wayne
Hemp (1)	Abiotic	1	Huron
Hop (7)	Downy mildew	1	Columbiana
	Mites	3	Erie, Highland, Shelby
	Spray damage	1	Delaware
	Unknown/Abiotic	2	Cuyahoga, Shelby
Peach (6)	Bacterial spot	3	Holmes (2), Wayne
	Tree drowning	2	Franklin, Wayne
	Powdery mildew	1	Wayne
Pear (1)	White rot	1	Licking
Plum (1)	Abiotic	1	Medina
Raspberry (6)	Abiotic	1	Montgomery

Crop (number samples)	Diagnosis	Number of Samples	County
	Insect damage	2	Greene, Stark
	Spur blight	1	Licking
	Unknown	1	Fulton
	Virus	1	Wayne
Strawberry (3)	Black root rot	1	Montgomery
	Leaf spot	1	Wayne
	Phytophthora root rot	1	Wayne
TOTAL		**81**	



Number of fruit, nut, hop and hemp samples received for diagnosis by the OSU Fruit Pathology Laboratory, by Ohio county.