Ohio Vegetable & Small Fruit Research & Development Program

Final Report

2018

Project Title: Vegetable and Fruit Disease Diagnosis

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Why was this project funded? This diagnostics project is a service to commercial vegetable and fruit growers in Ohio. We request funding each year to help support efforts of the OSU Vegetable and Fruit Pathology Laboratories 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) 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. 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 2018, we diagnosed 466 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 2018 we diagnosed 417 physical and 52 electronic fruit and vegetable samples. Therefore, the value of this service in 2018 to Ohio fruit and vegetable growers is at least $26,060. ***This represents a 6.5:1 return on grower's investment in this project.***

Sample Type	**Commodity**		**Estimated Value ($)**
	Vegetable	**Fruit**	
Physical	316	101	$25,020
Electronic	35	17	$1,040
Total	**351**	**118**	**$26,060**

2. Two new fruit and nut diseases were reported in Ohio and a new species of *Colletotrichum* causing anthracnose crown rot of strawberry. These findings will be used to leverage funding from federal and state agencies to study the biology and epidemiology of these pathosystems.

What was discovered? The majority of fruit and vegetable samples were submitted by or on behalf of commercial vegetable producers in Ohio, with the bulk of the samples coming from Wayne and Holmes counties. The number of fruit samples increased this year by 34% from 2017. A new species of *Colletotrichum* causing strawberry crown rot was identified and QoI fungicide resistance was confirmed. Powdery mildew (*Podosphaera macularis* mating type 1) of hop was confirmed for the first time in Ohio as was blossom end rot on chestnut.

Sources of the vegetable samples are shown in Figure 1.

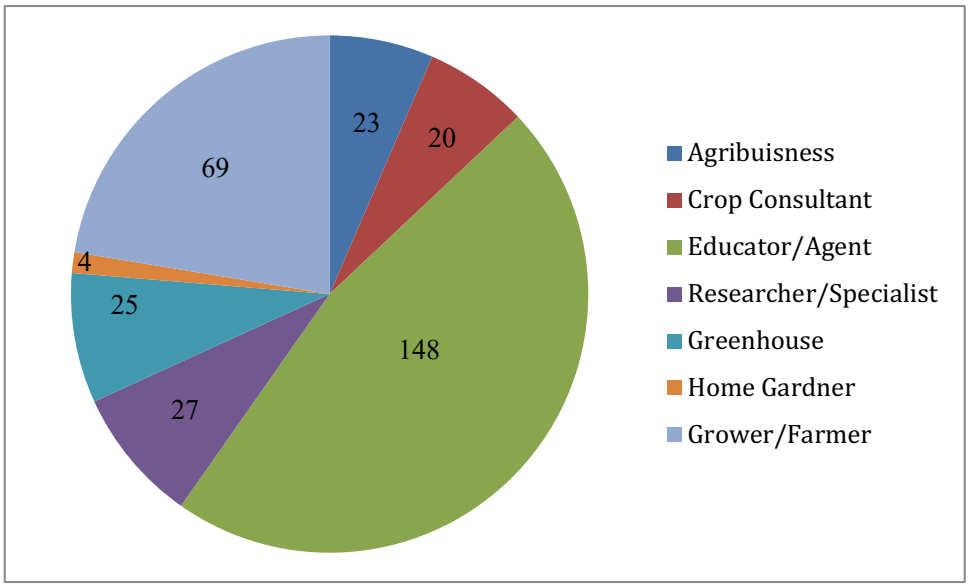

Figure 1. Sources of samples submitted to the OSU Vegetable Pathology Laboratory during 2018.

Vegetable samples were received from 38 Ohio counties, and 11 samples came outside of the state of Ohio (one from Kentucky, one from Virginia, two from North Carolina, two from Mexico, and five from Texas) (Figure 2). The number of counties for this year is similar to 2017 (39 counties in 2017), however, the number of samples received has slightly decreased (316 vs. 367 in 2017). Late spring 2018 weather was very atypical, characterized by high temperatures and lack of rain. This unusual weather delayed the appearance of the diseases in the field, and consequently the beginning of the diagnostic season.

Wayne County and Holmes County submitted the highest number of samples (83 and 49, respectively), many in collaboration with the OSU Wayne County Extension scouting program. Ten or more samples were received from Erie, Huron, Sandusky and Franklin counties.

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

The majority of the samples received were solanaceous crops (tomatoes, peppers, eggplants, and potatoes) followed by cucurbits (cucumbers, melons, watermelon, zucchini, squash and pumpkins) (Fig. 3).

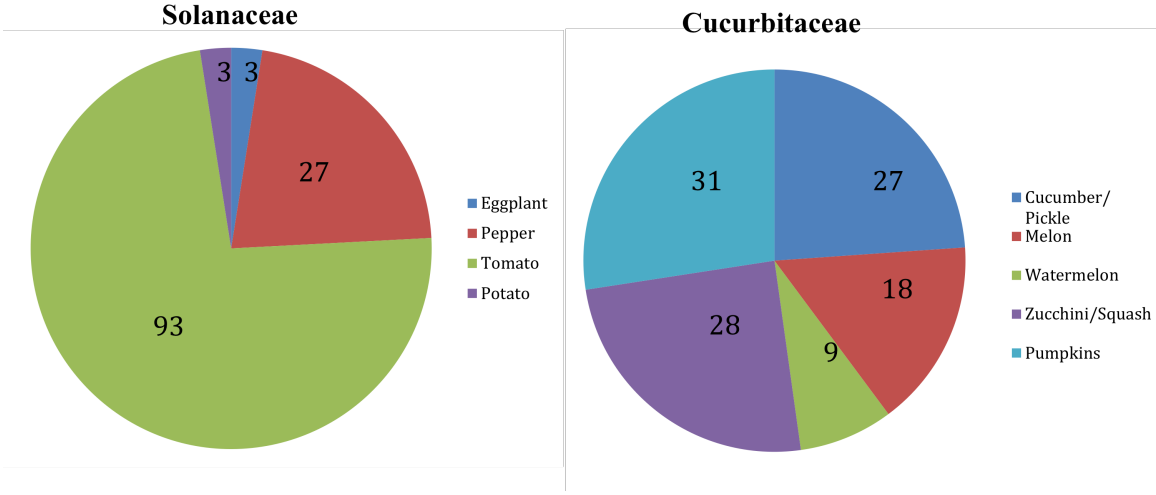

Figure 3. Number of samples for the top two abundant crop families received for diagnosis by the OSU Vegetable Pathology Laboratory in 2018.

Among the solanaceous crops, tomatoes were the most frequently received followed by peppers, while among the cucurbitaceous crops we received almost the same number of samples for cucumbers, zucchini/squashes, and pumpkins (Fig. 4)
Ten or more samples were leafy greens, cole crops, and flowers/edible flowers. The remaining samples included legumes and alliums (onion, garlic etc.) (Fig. 4). The "other" category included beets, carrot, sweet potato and sweet corn. We also received and tested for *Clavibacter michiganensis* subsp. *michiganensis* in three samples of irrigation water from hydroponic greenhouses.

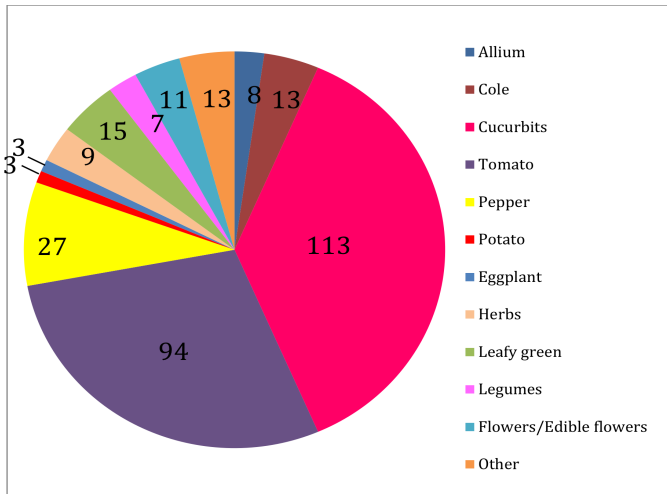

Figure 4. Number of samples received for diagnosis by the OSU Vegetable Pathology Laboratory in 2018 by crop type.

We pinpointed the first appearance of downy mildew in cucumbers, melons, pumpkins and squash in eight 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 collards and radish in Huron County. This year downy mildew in cucurbits was reported later in the year compared to 2017 (beginning of August vs. beginning of July) due to the unusually warm weather. Other important fungal diseases for cucurbitaceous crops were powdery mildew (14 samples) and Plectosporium blight (10 samples).
Septoria blight on tomatoes due to the favorable (rainy) weather conditions appeared in mid July instead of mid August. Similarly, we observed a high incidence of pathogenic *Alternaria* spp. : five tomato samples showed early blight infections, and 12 samples, from different crops, had Alternaria leaf spot.
Phytophthora infections were also recorded among different crops (pepper, tomato, cucurbits, and ornamentals). *Fusarium* and *Rhizoctonia* infections were the top two soilborne diseases diagnosed in 2018 (12 and 10, respectively).
Sixty-nine samples were affected by bacterial diseases. Cucurbits were the most affected crop (40 samples in total, where 23 had bacterial leaf spots, nine had angular leaf spot, and eight samples had bacterial wilt). Tomato canker (*Clavibacter*

michiganensis subsp. *michiganensis*) was isolated from a few hydroponic greenhouses across the country.

Warm wet weather conditions at the beginning of the summer were conducive for Phytophthora blight (*Phytophthora capsici)* . We diagnosed five cases on cucurbits, two on peppers, and one on mums. *P. capsici* was also detected in one hydroponic tomato sample. Pythium root rot was also diagnosed in six hydroponic vegetable samples (three tomatoes, and three leafy green crops). Water molds are difficult to manage once established, usually starting with clean greenhouse each growing cycle is the best option to control these diseases.

FRUIT SAMPLE FINAL REPORT

In total, 118 samples were received for diagnosis, an increase of 34% from 2017 (Table 1). Approximately 13% of these samples were forwarded to Dr. Elizabeth Long, Department of Entomology for confirmation of insect damage. Most of the samples that could not be identified were due to sample quality problems.

Figure 1. Number of fruit, nut and hop samples received for diagnosis by The OSU Fruit Pathology Laboratory, by Ohio county.

Fruit samples were received from 34 counties, with the majority coming from Wayne county (Fig. 1). Apple (23%), strawberry (17%), and hop (15%) were the top three crops submitted to the Fruit Pathology Laboratory for diagnostics (Fig. 2). The number of blueberry samples doubled and the number of strawberry samples tripled from 2017. Two new crops- chestnut and pawpaw, and one weed sample (honeyvine) were submitted for diagnostics.

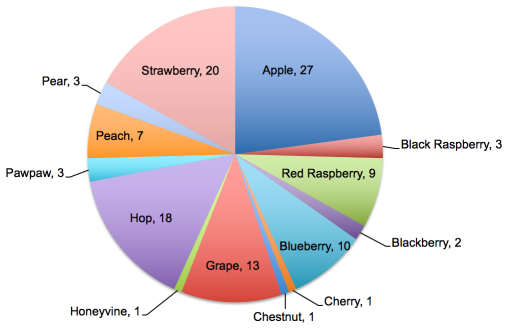

Figure 2. Number of samples received for diagnosis by The OSU Fruit Pathology Laboratory in 2018 by crop type.

On apple (Table 1), fire blight and fungal fruit rot diseases were diagnosed the most frequently, although abiotic disorders including herbicide damage were the most common diagnoses. Diagnosis was not confirmed for four of the samples, although scale damage was suspected. Fire blight was also diagnosed on pear.

Crown and root rots were the main diseases diagnosed for strawberry. A new species of *Colletotrichum*, *C. nymphaeae* (subspecies of the *C. acutatum* species complex) causing strawberry crown rot was identified and QoI fungicide resistance (EC_{50} values > 100 µg/L) was confirmed for the first time.

Downy mildew and powdery mildew on hop were diagnosed. Although hop powdery mildew was probably present in Ohio in previous years this is the first year that it was confirmed. Molecular characterization indicates that only mating type 1 is present in Ohio, indicating that the fungus is not likely overwintering as cleistothecia in hopyards. Half of the hop samples were received late in the season and were in poor condition; they were not diagnosed.

The number of blueberry samples increased this year. Botryosphaeria die back was reported again this year and anthracnose fruit rot was also reported.

The typical diseases on grapes (black rot, downy mildew and Phomopsis) were diagnosed. In addition, Alternaria leaf spot was diagnosed. Alternaria is an

opportunistic secondary pathogen that can go to both the fruit and leaves but it was only reported on the leaves. Fungicides that are used for Phomopsis or anthracnose should be effective (i.e. Captan or Mancozeb), however more frequent applications of these fungicides after fruit set will be needed. Herbicide damage (glyphosate and dicamba) continues to be diagnosed on grape.

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.

One sample each of bacterial spot, peach canker and twig blight were diagnosed on peach. The twig blight and peach canker samples were from homeowners while the bacterial spot sample was from a commercial orchard.

Two new crops, pawpaw and chestnut, were diagnosed this year. Pawpaw samples were diagnosed with Phyllosticta leaf spot and chestnut with blossom end rot (caused by *Colletotrichum* spp.). In addition, one weed sample that came from a vineyard was received. While the symptoms were fungal-like no fungus was isolated from the leaf tissue.

Table 1. Summary of fruit samples, number of samples, counties from which the samples were received, and sample diagnosis for the 2017 growing season.

Crop	Diagnosis	Number of Samples	County
Apple	Abiotic	7	Wayne (3), Lorain, Richland, Crawford, Mahoning
	Fire blight	6	Wayne (2), Perry, Hocking, Carroll, Coshocton
	Fungal fruit rots	5	Wayne (2), Auglaize, Holmes, Hocking
	Insect damage	4	Wayne, Mahoning (2), Stark
	Necrotic leaf spot	1	Auglaize
	Unconfirmed	4	Wayne
Blackberry	Abiotic	1	Wayne
	Insect damage	1	Ross
Black raspberry	Abiotic	1	Wayne
	Insect damage	1	Wayne

Crop	Diagnosis	Number of Samples	County
	Phytophthora root rot	1	Noble
Blueberry	Abiotic	2	Muskingum, Wayne
	Anthracnose	1	Warren
	Botryosphaeria dieback	2	Mahoning, Warren
	Insect damage	2	Warren, Wayne
	Phomopsis twig blight	1	Perry
	Unconfirmed	2	Pike, Wayne
Cherry	Abiotic	1	Wayne
Chestnut	Blossom end rot	1	Carroll
Grape	Abiotic (herbicide)	4	Wayne (3), Unknown
	Black rot	1	Hardin
	Crown gall	1	Ashtabula
	Downy mildew	1	Wayne
	Insect damage	1	Wayne
	Phomopsis cane and leaf spot	1	Wayne
	Rhizopus berry rot	1	Putnam
	Alternaria leaf spot	1	Ashtabula
	Bunch stem necrosis/sour rot	1	Franklin
	Unconfirmed	2	Wayne
Honeyvine	Unconfirmed	1	Wayne
Hop	Downy mildew	10	Erie, Knox, Highland, Madison, Pike, Shelby (4), Wayne
	Powdery mildew	2	Madison, Mahoning
	Unconfirmed	6	Hamilton, Mahoning, Montgomery, Pike, Shelby, Unknown

Crop	Diagnosis	Number of Samples	County
Pawpaw	Phyllosticta spp.	3	Pike (3)
Peach	Bacterial spot	1	Wayne
	Peach canker	1	Unknown
	Insect damage	3	Wayne (2), Van Wert
	Twig blight (brown rot)	1	Knox
	Unconfirmed	1	Wayne
Pear	Fire blight	2	Medina, Richland
	Unconfirmed	1	Richland
Red raspberry	Abiotic	3	Auglaize, Medina, Wayne
	Phytophthora root rot	1	Montgomery
	Insect damage	2	Mahoning, Wayne
	Sphaerulina leaf spot	1	Fulton
	Powdery mildew	1	Wayne
	Unconfirmed	2	Putnam
Strawberry	Anthracnose crown rot	1	Washington
	Abiotic	1	Wayne
	Black root rot	3	Knox, Ross, Wayne
	Mycosphaerella Leaf spot	3	Monroe, Wayne (2)
	Pythium root rot	1	Pike
	Phomopsis cane and leaf spot	1	Hardin
	Insect damage	1	Wayne
	Unconfirmed root rots	9	Washington, Wayne (8)
	Total	**118**	