**Ohio Vegetable & Small Fruit Research & Development Program**

**Final Report**

**2020**

**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 Laboratory 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**. In 2020, we took a digital first approach to diagnostics. We requested that clients send digital images first and if we were unable to diagnose the problem, we arranged for a contactless sample drop-off. We then utilized a range of traditional and modern, state-of-the-art diagnostic methods. These included 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 was received digitally, by courier, US mail, or in person, it was immediately catalogued and given a unique number. After initial evaluation, the submitter was contacted within 24 hours by phone or email and provided with a preliminary diagnosis and management recommendations. In many cases this was also the final diagnosis. If culturing or other time-consuming tests were required, final results may not have been available for several days to one week.

**Take-home messages.** This year the vegetable and fruit diagnostic program ran differently because of the Covid-19 pandemic. The state of the emergency declared by the OSU in early March reduced the activities allowed on campus. However, the diagnostic program was recognized as an essential service to commercial growers and was exempted on April 4th. Commercial growers have relied on this service for more than 15 years. Information from the lab was shared with the growers directly and through our blogs and Tweets: VeggieDisease.News blog (u.osu.edu/miller.769), the VegNet Newsletter (vegnet.osu.edu), Twitter (@OhioVeggieDoc and @OHFruitPathology), 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. The sources (grower name, address) of the diagnostic samples are never revealed to the public. Grower communication in 2020 was predominantly through phone calls, video calls and by sharing pictures representative of the problem on social media platforms, websites and in newsletters. This year we were unable to attend crop walks, in-person field days, or other in-person trainings.

**Impacts.**

In 2020, we diagnosed 285 samples. This represents a 32% reduction in the number of samples processed during the same period of time in 2019 and reflects the closure of the university due to COVID-19.

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 2020 we diagnosed 223 physical and 56 electronic fruit and vegetable samples. Therefore, the value of this service in 2020 to Ohio fruit and vegetable growers is at least $14, 860. ***This represents a 3.7:1 return on grower’s investment in this project.***

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| **Sample Type** | **Commodity** | | **Estimated Value ($)** |
|  | **Vegetable** | **Fruit** |  |
| Physical | 188 | 41 | $13, 740 |
| Electronic | 35 | 21 | $1, 120 |
| **Total** | **223** | **62** | **$14, 860** |

**What was discovered?**

We received samples from hydroponic greens production facilities that we diagnosed as Pythium root rot. We isolated and identified two species of *Pythium*, *P. oopapillum* and *P. dissotuchum*, that have never been reported in Ohio on greens and were associated with spinach and basil, respectively.

For both tomatoes and peppers, bacterial diseases (mainly bacterial spot, bacterial canker and Pseudomonas leaf spot (peppers) were the most frequently diagnosed. Fusarium wilt emerged as a problem in both peppers and tomatoes. Tomato spotted wilt virus (TSWV; Tospovirus) was diagnosed in tomato and bean (three samples). We did not diagnose any cases of Tomato brown rugose fruit virus (ToBRFV; Tobamovirus). This virus is mechanically transmitted and is causing severe damage to greenhouse tomato global production worldwide (Europe, Turkey, Jordan, Mexico and China). APHIS has recently issued a Federal Order imposing restrictions on the import of tomato and pepper seeds, fruits and transplants in order to prevent the spread of this viral disease to the US.

For vine crops, 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 in early July. Downy mildew and powdery mildew were the most frequently reported diseases among cucurbits.

Marssonina leaf blotch of apple, caused by *Marssonina caronaria*, was identified for the first time in Ohio. The disease is a minor problem of apple as it is easily controlled using fungicides. However, in wet years, fungicides can be washed off, resulting in an outbreak. Abiotic diseases of fruit were a significant problem this year and accounted for 20% of the samples received.

**A. Vegetable Diagnostics Final Report**

A total of 223 samples (188 physical and 35 electronic) were diagnosed in 2020. The majority of the samples were submitted by or on behalf of commercial vegetable producers in Ohio (**Figure 1**).

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| **Figure 1.** Sources of samples submitted to the OSU Vegetable Pathology Laboratory during 2020. |

Vegetable samples were received from 32 Ohio counties and five samples came from outside the State of Ohio (Indiana) (**Figure 2**). The number of counties for this year was similar to the number recorded in 2019 and 2018 (35, 38 counties, respectively). The number of samples was lower than in 2019 (223 vs. 323), but this was due to limited extension activities and the fact that in-person drop-off of the samples was not allowed due to COVID-19 restrictions. The highest number of samples were submitted from Huron County and Sandusky County (42 and 25, respectively), many in collaboration with the Muck Crops Agricultural Research Station in Willard, and the North Central Agricultural Research Station in Fremont. Ten or more samples were received from Erie, Columbiana, Hamilton and Wayne counties. The samples from Wayne County were mainly collected by the OSU Wayne County Extension IPM Scouting program.



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

Most of the samples received were solanaceous crops (tomatoes, peppers, and eggplant) followed by cucurbits (cucumbers, melons, watermelon, zucchini, squash and pumpkins) (**Figure 3**). Among the solanaceous crops tomatoes were the most frequently received (**Table 1),** followed by peppers (**Table 2**), while among the cucurbitaceous crops, cucumbers were predominant (**Table 3**). The remaining samples included legumes and leafy greens, while the “other” category included beets, rhubarb, tomatillo, and weeds (honeysuckle weed, and pig weed). We also tested plugs and recirculation water for the presence of oomycete propagules.

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**Figure 3.** Number of samples received for diagnosis by the OSU Vegetable Pathology Laboratory in 2020.

**Table1**. Diseases and abiotic disorders diagnosed on tomato samples in 2020. These samples were from fields (N=36), greenhouses (N=12), and high tunnels (N=14).



**Table 2**. Diseases and abiotic disorders diagnosed on pepper samples in 2020



\*Some samples had more than one disease

**Table 3.** Diseases and abiotic disorders diagnosed on cucurbit samples in 2020.

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| --- | --- | --- |
| **Diagnosis**\* | **Number of Samples** | **County** |
| Downy mildew | 22 | Huron  Sandusky  Medina  Wayne  Stark  Muskingum  Holmes |
| Powdery mildew | 10 | Sandusky  Huron  Wayne  Medina  Holmes |
| Abiotic | 10 | Huron  Holmes  Holmes |
| Angular/bacterial leaf spot/ bacterial wilt | 5 | Huron  Seneca |
| Phytophthora blight | 4 | Miami  Huron  Wayne  Medina |
| Plectosporium blight | 3 | Highland |
| Anthracnose | 2 | Columbiana  Huron |
| Gummy stem blight | 2 | Medina |
| Undetermined | 2 | Warren  Clark |
| Pythium damping off | 1 | Wayne |

\*Some samples had more than one disease

**B. Fruit Diagnostics Final Report**

Sixty-two fruit samples (41 physical and 21 electronic) samples were received for diagnosis (Table 1). This represents a 24% reduction in the number of samples processed during the same period of time in 2019 and reflects the closure of the university due to COVID-19. Including grape, 29% of the samples were small fruit, 53% tree fruit, and 18% hop or nut (Figure 1). Samples were received from 28 counties in Ohio (Figure 2). Samples from Oregon and Indiana were also processed. Among all of the samples, 20% had abiotic injuries such as chemical damage, winter stress, or root asphyxiation, 8% were insect related injuries, and 11% of the samples had injuries or symptoms that could not be identified. Two samples (3%) were healthy and exhibited typical phenotypic traits for the variety. Undetermined hop and peach samples exhibited virus-like symptoms but tested negative for common viruses associated with these crops.

Table 1. Diseases, abiotic disorders, and insect pests diagnosed on fruit, hop and nut samples submitted to the Fruit Pathology Program in 2020

| **Crop (No. samples)** | **Diagnosis** | **Number of Samples** | **County** |
| --- | --- | --- | --- |
| Apple (27) | Normal plant physiology (leaf yellowing on HoneyCrisp) | 1 | Preble |
|  | Abiotic-SAD or root asphyxiation | 1 | Perry |
|  | Abiotic-chemical injury | 2 | Erie, Henry |
|  | Crown gall | 1 | Stark |
|  | Bitter rot | 4 | Stark, Knox, Geauga |
|  | Abiotic-drought stress | 2 | Erie, Huron |
|  | Black stem borer | 3 | Lorain, Licking, Wayne |
|  | Apple scab | 1 | Stark |
|  | Cedar apple rust | 1 | Greene |
|  | Sooty blotch and flyspeck | 1 | Huron |
|  | Black rot | 2 | Wayne |
|  | Frogeye leaf spot | 1 | Erie |
|  | Marssonina leaf blotch | 1 | Carroll |
|  | Abiotic- possibly winter stress or drought | 3 | Out-of-state (IN), Mahoning, Knox |
|  | White rot | 3 | Carroll, Geauga, Mahoning |
| Blackberry (4) | Red-necked cane borer | 1 | Medina |
|  | Grey mold | 1 | Huron |
|  | Virus (not identified) | 1 | Wayne |
|  | Leaf rust and Abiotic-sun scald | 1 | Out-of-state (OR) |
| Black raspberry (2) | Abiotic-chemical injury | 1 | Darke |
|  | Undetermined | 1 | Wayne |
| Blueberry (2) | Anthracnose fruit rot | 1 | Warren |
|  | Phytophthora root rot | 1 | Brown |
| Cherry (2) | Abiotic-root asphyxiation | 1 | Cuyahoga |
|  | Brown rot | 1 | Lorain |
| Chestnut (2) | Glomerella twig blight | 2 | Carroll |
| Black walnut (1) | Bacterial spot | 1 | Wayne |
| Grape (6) | Normal plant physiology | 1 | Clark |
|  | Anthracnose | 1 | Vinton |
|  | Abiotic- chemical (captan) and ozone injury | 1 | Guernsey |
|  | Powdery mildew | 1 | Fulton |
|  | Grape Leaf Roll Associated Virus  Anthracnose | 1  1 | Fairfield  Athens |
| Hop (8) | Fusarium canker | 1 | Warren |
|  | Normal plant physiology | 1 | Medina |
|  | Abiotic- chemical injury | 1 | Shelby |
|  | Undetermined | 1 | Fairfield |
|  | Undetermined | 1 | Pike |
|  | Undetermined | 3 | Pike |
| Peach (2) | Peach leaf curl | 1 | Erie |
|  | Undetermined | 1 | Coshocton |
| Plum (2) | Bacterial spot | 1 | Medina |
|  | Black stem borer | 1 | Geauga |
| Red raspberry (1) | Phytophthora root rot | 1 | Lorain |
| Elderberry (1) | Elder shoot borer | 1 | Lorain |
| Strawberry (2) | Botrytis grey mold | 1 | Wayne |
|  | Leaf blight, scorch and spot | 1 | Wayne |
| **TOTAL (62)** |  | **62** |  |

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| Figure 1. Percent of samples submitted to the Fruit Pathology Program in 2020 that were small fruit, tree, fruit, hop and nut. | Figure 2. Number of samples for disease diagnoses processed by The Ohio State University-Wooster Campus, Fruit Pathology Program in 2020, by Ohio county. |