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

**Final Report**

**2022**

**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. During 2022 the C. Wayne Ellett Plant and Pest Diagnostic Clinic (OSU CWE PPDC) was merged with the OSU fruit and vegetable diagnostic programs and moved to the CFAES Wooster Campus (Selby Hall) under the leadership of Dr. Francesca Rotondo.

**Project outline**. We continued to use the digital diagnostic approach, started in 2020 due to the lockdown imposed by COVID pandemic. We had a total of 40 samples submitted electronically. We also used 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 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 programs was back to normal routine activities, including in-person sample drop-off. The in-person interaction has contributed to reconstituting a solid commitment with the commercial growers who rely on this service. The findings from the diagnostic clinic were shared with the growers directly and through our blogs and Tweets: Ohio Veggie Disease News blog (u.osu.edu/miller.769), the VegNet Newsletter (vegnetnews.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 2022 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 able to attend crop walks, in-person field days and on-farm visits. We carried on online trainings, zoom meetings and webinars. Cut flowers and ornamentals are becoming a popular commodity for many growers in Ohio.

**Impacts.** In 2022, we diagnosed a total of 312 samples. The estimated cost of providing the basic service to growers, considering labor and supplies, is $65 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. Therefore, the value of this service in 2022 to Ohio fruit and vegetable growers is at least $18,025. ***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** | **Ornamental** **cut flowers** |  |
| Physical | 185 | 71 | 16 | $17,680 |
| Electronic | 22 | 16 | 2 | $800 |
| **Total** | **207** | **87** | **18** | **$18,480** |

**What was discovered?** In hydroponic greens production, *Pythium dissotocum* (group B2) and P*ythium aphanidermatum* continue to be important pathogens that significantly impact yields in this type of production.

For both tomatoes and peppers, bacterial spot was the most frequently diagnosed. Fusarium wilt continues to be a problem in both processing and fresh market tomatoes. Phytophthora blight was often reported in both peppers and cucurbits. Tomato spotted wilt virus (TSWV; Tospovirus) was diagnosed in tomato, while Potato Virus Y (PVY, potiviridae) was diagnosed on potato.

For vine crops, we pinpointed the first appearance of downy mildew in cucumbers, melons, pumpkins and squash in six 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 Wayne County. This year downy mildew in cucurbits appeared in early July. Downy mildew and powdery mildew were the most frequently reported diseases among cucurbits.

For fruit crops, Neopestalotiopsis stem blight on blueberry was diagnosed in the early growing season. *Neopestalotiopsis* has also been diagnosed on strawberry in different counties in the state. Currently, research on this pathogen is ongoing to expand our knowledge for effective disease management.

**A. Vegetable Diagnostics Report**

A total of 207 samples (185 physical and 22 electronic) were diagnosed in 2022. 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 vegetable samples submitted to the OSU Plant and Pest Diagnostic Clinic during 2022. |

Vegetable samples were received from 24 Ohio counties, no samples were received from out of State (Figure 2). The highest number of samples were submitted from Wayne County (N= 46) and Huron County (N=32). The samples from Wayne County were mainly collected by OSU Wayne County Extension IPM Scouting educators, while the samples from Huron county were in collaboration with the Muck Crops Agricultural Research Station in Willard. Ten or more samples were received from Sandusky (North Central Agricultural Research Station in Fremont), Columbiana, Hamilton and Holmes counties.



**Figure 2.** Map of the counties that submitted vegetable samples for diagnosis to the OSU Plant and Pest Diagnostic Clinic.

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 followed by peppers (Table 1), while among the cucurbitaceous crops, cucumbers were predominant (Table 2). The remaining samples included cole crops (Table 3), leafy greens, herbs, and alliaceae. The “others” category included legumes, rhubarb, tomatillo, dandelions and okra. Many vegetable farms in Ohio have started cut flowers and ornamental cultivation as new source of profit. We received a total of 18 ornamental/cut-flower samples. For this commodity, diseases caused by oomycete and fungal root rotting pathogens (Pythium root rot, Phytophthora root rot, Fusarium wilt, and Rhizoctonia root rot) were the major issues.



**Figure 3.** Number of vegetable samples received for diagnosis by the OSU Plant and Pest Diagnostic Clinic in 2022.

**Table 1**. Diseases, pests and abiotic disorders diagnosed on solanaceous crops

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| **Solanaceous crops****(N samples)** | **Diagnosis** | **County** |
| Tomato (49) | Bacterial leaf spot, late blight, Fusarium wilt, Tomato spotted wilt virus, gray mold, Septoria leaf spot, Tobacco mosaic virus, spider mites, abiotic stress, nutrient deficiency | Erie, Franklin, Highland Holmes, Lucas, Sandusky, Wayne |
| Pepper (24) | Bacterial leaf spot, Pseudomonas leaf spot, herbicide damage, Phytophthora blight, blossom end rot, broad mites, abiotic stress (wet feet) | Ashland, Holmes, Huron, Sandusky, Wayne |
| Eggplant (7) | Gray leaf mold, Verticillium wilt, mechanical injury | Columbiana, Huron, Wayne |
| Potato (3) | Potato Virus Y, soft rot | Holmes, Morrow |

**Table 2**. Diseases, pests and abiotic disorders diagnosed on cucurbits

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| **Cucurbits****(N samples)** | **Diagnosis** | **County** |
| Cucumber (20) | Angular leaf spot, downy mildew, potyvirus, gummy stem blight, mites, nutritional disorder | Licking, Medina, Hamilton, Holmes, Huron, Portage, Sandusky Wayne |
| Zucchini (3) | Alternaria leaf spot, bacterial spot, fungus gnat, powdery mildew |   |
| Cantaloupe (3) | Alternaria leaf spot, bacterial leaf spot, downy mildew | Huron, Wayne, Fulton |
| Watermelon (2) | Anthracnose, possible vascular pathogen | Huron, Wayne |
| Pumpkin (18) | Bacterial leaf spot, downy mildew, powdery mildew, bacterial wilt, Cucumber mosaic virus | Huron, Medina, Morrow, Sandusky, Wayne |
| Squash (11) | Powdery mildew, bacterial spot, downy mildew, bacterial leaf spot, Phytophthora blight | Holmes, Huron. Wayne |

**Table 3.** Diseases, pests and abiotic disorders diagnosed on cole crops

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| **Cruciferous crops****(N samples)** | **Diagnosis** | **County** |
| Broccoli (6) | Alternaria leaf spot, Rhizoctonia  | Medina, Holmes |
| Cabbage (7) | Soft rot, black rot, white mold, Fusarium yellows, herbicide damage | Erie, Sandusky, Holmes |
| Radish (3) | Thrips damage, Aphanomyces black rot | Huron |
| Mustard (2) | Soft rot, thrips | Holmes, Huron |

**B. Diagnostics Fruit Report**

Eighty-seven fruit samples (71 physical and 16 electronic) were received for diagnosis (Table 1).

The majority of the samples were small fruit (including grape), while the remaining were tree fruit, and hop or nut (Figure 4). Samples were received from 20 counties in Ohio (Figure 5), and one from Iowa. The majority of the samples were submitted by commercial growers and extension educators (Figure 6). Fungal diseases (65%) were predominant, followed by abiotic injuries (20 %, mostly chemical damage and nutrient deficiency), insect related injuries (10%) and bacterial disease (5%) (Table 4).

**Figure 4.** Number of fruit samples received for diagnosis by the OSU Plant and Pest Diagnostic Clinic in 2022.



**Figure 5.** Map of the counties that submitted fruit samples for diagnosis to the OSU Diagnostic Clinic.

**Figure 6.** Sources of fruit samples submitted to the OSU Diagnostic Clinic during 2022.

**Table 4.** Diseases, pests and abiotic disorders diagnosed on fruit and hop samples in 2022

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| **Crop (N samples)** | **Diagnosis** | **County** |
| Blackberry (2) | Cold damage, Glyphosate damage | Wayne |
| Blueberry (6) | Neopestalotiopsis blight, insect damage, cold damage, possible borer damage | Brown, Fulton. Morrow |
| Raspberry (7) | Phythium root rot, Phytophthora root rot, spray damage, Glyphosate damage | Brown, Wayne |
| Strawberry (27) | Rhizoctnonia crown rot, Pythium root rot, Fusarium wilt, Neopestalotiopsis leaf blight, anthracnose, leaf scorch, leaf blight | Columbiana, Greene, Franklin, Hamilton, Highland, Huron, Morrow, Pike, Wayne |
| Apple (18) | Nectria canker, Botriosphaera canker, bitter rot, Alternaria fruit rot, pit rot, fire blight, stink bug damage | Columbiana, Erie, Licking, Sandusky, Wayne |
| Chestnut (3) | Oak wilt | Carroll, Iowa |
| Grape (11) | Downy mildew, grape ripe rot, Botrytis bunch rot, anthracnose, black rot, 2.4 D damage | Franklin, Licking, Warren, Wayne |
| Peach (3) | Bacterial leaf spot, Insect damage, cold damage | Columbiana, Summit, Wayne |
| Pear (4) | Cicada damage, abiotic stress | Summit, Cuyahoga |
| Plum (2)  | Insect damage | Columbiana |
| Hops (4) | Mites, Pythium root rot | Franklin, Sandusky, Tuscarawas |