

Plant Pathology Field Trial Results 2010

Plant Diagnostic Clinic Report Nematode Assay Service Report

Robert P. Mulrooney, Extension Plant Pathologist
Nancy F. Gregory, Plant Diagnostician

Department of Plant and Soil Sciences
University of Delaware



Misting lima bean downy mildew plots to enhance infection
See p. 4



Powdery mildew on summer squash see p.8

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R.P. Mulrooney, N.F. Gregory
Plant and Soil Sciences Dept
University of Delaware
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Cooperators

Dr. Tom Evans, Professor, Plant and Soil Sciences Dept.
Ms. Emmalea Earnest, Extension Associate for Vegetable Crops
Scott Hopkins, Farm Superintendant, Newark Farm
Brian Hearn, Farm Manager, REC, Georgetown

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The enclosed reports are a compilation of the plant pathology experiments conducted in Delaware during the 2010 growing season. The data presented in these reports are not to be used as disease control recommendations. Some of the fungicides tested are not currently labeled or available commercially. Contact your local Extension office for current information on disease control recommendations.

Bob Mulrooney
Extension Plant Pathologist
148 Townsend Hall
Newark, DE 19716-2170
Phone: 302-831-4865
email : bobmul@udel.edu

Nancy Gregory
Extension Plant Diagnostician
151 Townsend Hall
Newark, DE 19716-2170
Phone: 302-831-1390
email : ngregory@udel.edu

Evaluation of fungicides applied preventatively for the control of downy mildew of baby lima bean, 2010.

Fungicides were tested for control of downy mildew of baby lima bean at the University of Delaware's Experiment Station Farm in Newark, DE. The baby lima bean cultivar M-15 was planted on 7 Jul with a commercial four-row Monosem planter in a field which was planted in lima bean the previous year. Seeding rate was 4-5 seeds/ft. Dual Magnum 7.62E (1.75 pt/A) and Pursuit 2SC (2.0 oz/A) were applied pre-emergence for weed control. The soil type was a Matapeake silt loam soil. Nitrogen (30 lb/A) was side-dressed on 23 Jul. Treatments were arranged in a randomized complete block design with four replications. Each plot consisted of three sprayed rows, 20 ft long and spaced 30 in. apart. A single border row separated each plot. Supplemental trickle irrigation was applied as needed. The plots were inoculated with a sporangial suspension of *Phytophthora phaseoli* race E on 26 Aug and 14 Sep. Starting on 27 Aug and ending 24 Sep the plots were misted nightly for 15 minute intervals at 5, 6, 7 and 8 PM to increase leaf wetness and humidity to favor disease development. Fungicides were applied preventatively one, two or four times on 25 Aug, and 1, 9 and 15 Sep using a CO₂-pressurized backpack sprayer that delivered 30 gal/A at 52 psi. Applications were made with a broadcast boom equipped with four hollow cone nozzles (ConeJet TXVS-18) spaced 18 in. apart. On 29 and 30 Sep, the middle 10 ft of the center row of each plot was hand-pulled and evaluated for percentage of infected plants (presence of infection on the raceme, petiole or pod). Pods were removed from those plants and the percentage of infected pods, total number of pods/10 ft, fresh weight and shelled weight were determined. Fresh weight was determined by measuring the fresh weight of harvested pods that had harvestable seed or flat pods that were large enough to have harvestable seed. On 1 Oct the pods were shelled and the shelled weight of the lima beans was recorded.

The disease severity in the field was low to moderate early, but increased during the last two weeks of Sep with the return of cooler temperatures and timely rainfall. The season was very warm and dry during the duration of the test from planting through the middle of Sep. The rainfall amounts in inches for the period of the trial in Jul, Aug and Sep were 4.37, 1.52, and 1.92 respectfully. There was one period of 20 days without rain from 23 Aug into Sep. There were 25 days over 90°F during the duration of the trial. The best treatments for downy mildew control and yield were Omega 500F applied twice and ProPhyt applied twice at 3 pts/A. In most cases, the level of control was reflected in the increased fresh weight and shelled weight of beans. This was the third season testing Omega. Omega has a section 3 label for use on lima bean to control white mold and the addition of downy mildew would provide one fungicide that would control two of the most important diseases in the mid-Atlantic region. This year's test focused on actual use patterns of regional growers. Two applications of Omega at 14 days apart provided excellent control. One application was not as effective at controlling downy mildew, however shelled weight was not significantly reduced. This was the second trial at this location evaluating the effectiveness of Tanos in alternation with Kocide 3000, which was very effective at the 10.0 oz/A rate, but not significantly different than weekly applications of Kocide 3000 alone. Ridomil Gold/Copper is the industry standard in the region and performed well. No phytotoxicity was observed for any of the fungicides tested.

| Treatment, rate/A and application timing ^z | Incidence (%) of downy mildew ^y | | No. pods/10 ft | Fresh weight of pods/10ft (grams) | Shelled Weight Lbs/A |
|--|--|----------|----------------|-----------------------------------|----------------------|
| | Plants | Pods | | | |
| Tanos 50DF 8.0 oz + Kocide 3000 46DF 1.25 lb/A (A,C) alt. w Kocide 3000 46 DF 1.25 lb (B,D) | 85.8 cd ^x | 17.5 cd | 1210 a | 3776.3 b | 5,279.0 b |
| Tanos 50 DF 10.0 oz + Kocide 3000 46DF 1.25 lb/A (A,C) alt. w Kocide 3000 46DF 1.25 lb (B,D) | 70.2 bc | 8.8 bc | 1230a | 4231.3 ab | 6,507.1 ab |
| Kocide 3000 46DF 1.25 lb (A,B,C,D) | 79.1 bc | 11.4 bcd | 1205 a | 4012.5 ab | 6,666.4 ab |
| Ridomil Gold/Copper 65WP 2.0 lb (A,C) | 59.7 b | 6.7 b | 1165 a | 4051.3 ab | 6,599.2 ab |
| Omega 500F 5.5 fl oz. (A) | 95.6 de | 19.0 d | 1210 a | 3962.8 b | 6,376.6 ab |
| Omega 500F 5.5 fl oz (A, C)..... | 61.7 b | 5.1 ab | 1315 a | 4688.8 a | 7,002.2 a |
| ProPhyt 4.2SC 3.0 pts (A, C) | 23.5 a | 1.4 a | 1166 a | 4103.8 ab | 6,735.5 a |
| Nontreated | 100.0 e | 48.6 e | 859 b | 1896.3 c | 2,456.2 c |

^zApplication dates A=25 Aug, B=1 Sep, C= 9 Sep, D= 15 Sep

^yData were transformed from percentages by arcsin^{1/2}, analysis of variance and means were converted back to the percentages which are represented in the table.

^xMeans followed by the same letter are not statistically different from each other (Fisher's Protected LSD, P=0.05).

Baby lima bean susceptibility to the soybean cyst nematode

Bob Mulrooney, Extension Plant Pathologist

Introduction

Susceptibility of lima bean (*Phaseolus lunatus*) to the soybean cyst nematode (SCN) was investigated here in Delaware in 1981 in a field with a native SCN infestation at the Georgetown REC in Sussex County.

At the time it was demonstrated that snapbean ‘Gator Green’ and soybean ‘Essex’ were susceptible to SCN race 1, while one variety of Fordhook lima ‘Fordhook 242’ and six baby lima bean cultivars were resistant. The race or HG types that occur in Delaware soybean fields has changed from predominately race 3 in 1996 to race 1 and 5 in 2009.

The purpose of this study was to determine if baby lima bean was still resistant to the predominant population of SCN found in Sussex County.

Materials and Methods :

Seed of four commonly grown cultivars of baby lima bean (184-85, Cypress, C-elite, and M-15) were sent to the Extension Nematology Laboratory at the University of Missouri for screening for resistance to a single population of SCN from the UD Research and Education Center farm near Georgetown DE. This population was screened in the same lab and determined to be HG 2.5.7 and race 5. HG 2.5.7 was the predominant SCN population (80%) found in the recent SCN survey conducted in 2009-10. This population had female indices (FI) of 4 on Peking, 46 on PI88788, 20 on PI209322, 67 on PI548316 and 37 on Pickett. FI = (mean number of females on test soybean line divided by the mean number of females on the susceptible variety ‘Lee’ X 100).

This SCN population was reared on a susceptible soybean for 30 to 40 days in a water bath at 27°C to increase egg numbers and break any egg dormancy. Plant root systems were removed from pots, cysts were collected, and eggs were extracted for inoculating the lima bean cultivars. Five seedlings of each lima bean cultivar were grown in Cone-tainers, inoculated with 1,250 eggs and maintained in a greenhouse for 29 days in a water bath at 27°C. At the end of the test the roots were examined for the presence of cysts and the data recorded.

Results:

The following table summarizes the results showing very low reproduction on baby lima bean by this population of SCN. The number of cysts on the susceptible soybean cultivar ‘Lee 74’ tested at the same time was 218. Baby lima bean is still resistant to SCN in Delaware.

Table 1. Number of SCN cysts found on the root system of four cultivars of baby lima bean

| Cultivar | Rep. 1 | Rep. 2 | Rep. 3 | Rep. 4 | Rep. 5 |
|----------|--------|--------|--------|---------|---------|
| 184-85 | 0 | 0 | 0 | 0 | no data |
| Cypress | 0 | 0 | 0 | no data | no data |
| C-elite | 0 | 0 | 0 | 0 | 1 |
| M-15 | 0 | 0 | 0 | 1 | 0 |

Note: 3 lima seedlings did not survive

Evaluation of fungicides for control of downy mildew on pickling cucumbers, 2010.

The experiment was conducted on a Pepperbox loamy-sand soil at the Carvel Research and Education Center near Georgetown, DE. The experiment was arranged as a randomized complete block design with four replications. Plots were 7.5 ft wide and 20 ft long. Cucumbers were direct seeded in rows spaced 30 in. apart with 3 in. between plants within the row on 27 Jul. Fungicide applications were initiated on 13 Aug (first true leaf expanded) before any symptoms were seen on the plants, but symptoms were present in a nearby cucumber field. Downy mildew was observed at low incidence on 20 Aug. Subsequent applications were made on 20 and 30 Aug using a CO₂ pressurized backpack sprayer that delivered 30 gal/A at 52 psi. Applications were made with a broadcast boom equipped with 4 hollow cone nozzles (ConeJet TXVS-18) spaced 18 in. apart. Each plot was bordered by a single untreated row. This spray program approximates a commercial program to control downy mildew on pickling cucumbers in Delaware and the eastern shore of Maryland. Overhead irrigation was applied as needed during the trial period. Disease severity was measured on 3 Sep and at harvest on 13 Sep by estimating the percent of infected leaf area per plot. A 15 ft-long section of the middle row of each plot was hand harvested once on 13 Sep to simulate mechanical harvest which is the standard harvest method in the region. Cucumbers were graded according to size and quality. The weight of crooks and nubs (small and misshapen fruit) was subtracted from the total yield weight to obtain marketable yield. Yields were calculated using a bushel weight of 50 lbs for cucumbers.

Disease pressure was low to moderate at the beginning of the test as a result of hot, dry weather and low humidity. Favorable environmental conditions for downy mildew were present from the last fungicide application through harvest. Two sequential treatments with Presidio 4 fl oz followed by Ranman or Previcur Flex were the best treatments. All the treatment yields were significantly greater than the unsprayed control. Previcur Flex 1.2 pts plus Bravo WeatherStik used consecutively as well as the Previcur Flex/Ranman alternation were the least effective treatments at preventing foliage infection at the time of the last evaluation. There was no evidence of any phytotoxicity with any treatment under the conditions of this trial.

| Treatment, rate/A and timing ^z | Marketable Yield (bu/A) | Total Yield (bu/A) | % Crooks & Nubs | % Infected leaves ^y | |
|--|-------------------------|--------------------|-----------------|--------------------------------|---------|
| | | | | 3 Sep | 13 Sep |
| Untreated control | 24.1 b ^x | 160.4 b | 85.0 a | 47.50 e | 61.2 e |
| Previcur Flex 6F 1.2 pt + Bravo WeatherStik 6SC 2 pt (A,C) Ranman 400SC 2.75 fl oz + Bravo WeatherStik 6SC 2 pt (B) | 179.0 a | 287.1 a | 39.0 b | 15.00 bcd | 31.2 d |
| Previcur Flex 6F 1.2 pt + Bravo WeatherStik 6SC 2 pt (A,B) Ranman 400SC 2.75 fl oz + Bravo WeatherStik 6SC 2 pt (C) | 205.6 a | 324.9 a | 38.5 b | 17.50 cd | 26.2 cd |
| Previcur Flex 6F 1.2 pt + Bravo WeatherStik 6SC 2 pt (A,B,C) | 201.1 a | 349.9 a | 40.3 b | 20.00 d | 28.7 d |
| Ranman 400SC 2.75 fl oz + Bravo WeatherStik 6SC 2 pt + Silwet 2 fl oz (A,C) Previcur Flex 6F 1.2 pt + Bravo WeatherStik 6SC 2 pt (B) | 150.6 a | 237.6 ab | 33.8 b | 11.20 b | 22.5 c |
| Ranman 400SC 2.75 fl oz + Bravo WeatherStik 6SC 2 pt + Silwet 2 fl oz (A,B) Previcur Flex 6F 1.2 pt + Bravo WeatherStik 6SC 2 pt (C) | 179.3 a | 277.5 a | 35.4 b | 15.00 bcd | 21.2 bc |
| Presidio 4SC 4 fl oz + Bravo WeatherStik 6SC 2 pts (A,C) Ranman 400SC 2.75 fl oz + Bravo WeatherStik 6SC 2 pt + Silwet 2 fl oz (B) | 226.7 a | 345.5 a | 33.1 b | 13.70 bc | 21.2 bc |
| Presidio 4SC 4 fl oz + Bravo WeatherStik 6SC 2 pt (A,B) Previcur Flex 6F 1.2 pt + Bravo WeatherStik 6SC 2 pt (C) | 169.1 a | 257.4 ab | 35.1 b | 12.50 bc | 16.2 ab |
| Presidio 4SC 4 fl oz + Bravo WeatherStik 6SC 2 pts (A,B) Ranman 400SC 2.75 fl oz + Bravo WeatherStik 6SC 2 pt + Silwet 2 fl oz (C) | 154.7 a | 299.6 a | 45.3 b | 5.50 a | 12.5 a |

^zApplication dates A=13 Aug, B= 20 Aug, C= 30 Aug

^yData were transformed from percentages by arcsin√, analysis of variance and means were converted back to the percentages which are represented in the table.

^xMeans followed by the same letter are not statistically different from each other (Fisher’s Protected LSD, P=0.05).

2010 ipmPIPE Downy Mildew on Cucurbits Project

Delaware component: Bob Mulrooney, Extension Plant Pathologist
Emmalea Ernest, Extension Associate, Vegetables
Nancy Gregory, Diagnostician
Cooperative Extension
Dept of Plant and Soil Sciences
University of Delaware

OTHER COOPERATORS (alphabetically by state/province):

| | |
|------------------------------|---------------------------------|
| Alabama: Ed Sikora | New Jersey: Andy Wyendant |
| Delaware: Bob Mulrooney | New York: Meg McGrath |
| Florida: Amanda Gevens | North Carolina: Gerald Holmes |
| Georgia: David Langston | Ohio: Sally Miller |
| Illinois: Mohammed Babadoost | Oklahoma: John Damicone |
| Indiana: Dan Egel | Ontario: Elaine Roddy |
| Kentucky: Kenny Seebold | Pennsylvania: Beth Gugino |
| Louisiana: Don Ferrin | South Carolina: Anthony Keinath |
| Maryland: Kate Everts | Tennessee: Steve Bost |
| Massachusetts: Rob Wick | Texas: Tom Isakeit |
| Michigan: Mary Hausbeck | Virginia: Steve Rideout |
| Mississippi: David Ingram | Wisconsin: Alyson Thornton |

Project Objective

Our primary objective is to document when and where cucurbit downy mildew occurs. Our secondary objective is to determine which hosts are infected by the downy mildew fungus and at what level of severity.

Pathotype Determination

Objective: To determine which cucurbit hosts are infected and to pinpoint the time of infection on these hosts.

Methods:

Seed of seven cucurbit differentials was sown (Table 1) into peat pots with soil-less potting mix in early June to produce 15 good transplants per differential. Transplants were set in the field in late June when plants had 2 true leaves. Plants were spaced 2 ft apart within rows and rows were spaced 10 ft apart. The plots were established on black plastic mulch with drip irrigation at the Experimental Station Farm in Newark, and at the Carvel REC near Georgetown in early June.

Results:

Newark Sentinel Plot:

7/29- 'Straight Eight' cucumber

Georgetown Sentinel Plot

7/9- Cucumber 'Straight Eight'

No infection was detected on any of the other cucurbits in the sentinel plot. The season was dry and very hot and not conducive to DM infection.

Table 1. Cucurbits for ipmPIPE sentinel plots 2010.

| No. | Species | Cultivar name | Common name | Description |
|------------|---------------------------|----------------------|--------------------|--------------------|
| 1 | <i>Cucumis sativus</i> | Straight Eight | Slicing cucumber | DM sensitive |
| 2 | <i>Cucumis melo</i> | Hales Best Jumbo | Cantaloupe | |
| 3 | <i>Cucurbita pepo</i> | Table Queen | Acorn squash | |
| 4 | <i>Cucurbita maxima</i> | Big Max | Giant pumpkin | |
| 5 | <i>Cucurbita moschata</i> | Waltham butternut | Butternut squash | |
| 6 | <i>Citrullus lanatus</i> | Micky Lee | Watermelon | Round, seeded |

2010 Pennsylvania Vegetable Marketing and Research Program Pennsylvania Vegetable Growers Association Report

Title: On-farm evaluation of cucurbit powdery mildew fungicide resistance using a cucurbit seedling bioassay.

Principle Investigator:

Beth K. Gugino, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802; (814) 865-7328; bkgugino@psu.edu.

Collaborators:

Meg McGrath, Dept. of Plant Pathology, Cornell University - LIHREC, 3059 Sound Ave., Riverhead, NY 11901; 631-727-3595; mtm3@cornell.edu.

Andy Wyenandt, Dept. of Plant Biology and Pathology, Rutgers University, 121 Northville Road, Bridgeton, NJ 08302; 856-455-3100 ext. 4144; wyenandt@njaes.rutgers.edu.

Steve Rideout, Dept. Plant Pathology, Physiology and Weed Science, Virginia Tech – ESAREC, 33446 Research Drive, Painter, VA 23420; 757-414-0724 ext. 17; srideout@vt.edu.

Kate Everts, Dept. of Plant Science and Landscape Architecture, University of Maryland – LESREC; 27664 Nanticoke Road, Salisbury, MD 21801; 410-742-8780; keverts@umd.edu.

Bob Mulrooney, Dept. of Plant and Soil Sciences; University of Delaware, 148 Townsend Hall, Newark, DE 19716; 302-831-4865; bobmul@udel.edu.

Introduction:

Resistance is a major issue confronting powdery mildew management in cucurbit crops. Fungicides are the main management tool. Mobile fungicides needed to effectively control powdery mildew are at risk for developing resistance. Growers often do not know they are using a fungicide affected by resistance, even when it is no longer effective, because they are using it in a program with other fungicides. Applying a fungicide that is inadequately effective because of resistance is not only a waste of money, and puts the crop at risk for disease control failure, but also facilitates resistance developing to other fungicides used. Alternating among fungicides in different chemical classes is the main practice for managing (e.g. delaying) resistance development.

The goal of this project was to determine sensitivity to resistance-prone fungicides for the powdery mildew pathogen in the Mid-Atlantic region (PA, NY, NJ, MD, VA and DE) and then use this information to guide regional fungicide recommendations. This was accomplished by using a simple cucurbit seedling bioassay that has been used successfully in PA, NJ and NY in the past. In 2008, pathogen sensitivity to fungicides, in particular to DMI fungicides and Pristine, on Long Island, NY, exhibited some differences compared to eastern PA, leading to different fungicide recommendations and thus revealing the need for local information on resistance. It is especially critical for growers to know the resistance status in their region in order to be able to select the most appropriate fungicides to use in a resistance management program with Quintec since its label was expanded in 2009 to include other cucurbit crops in addition to melon. Additionally, in 2008 and 2009 regional differences to boscalid resistance were detected. In NY and PA in 2008, a few isolates collected at the end of the season were completely resistant to boscalid (able to tolerate 500 ppm, which is equivalent to a labeled rate). Again in 2009, a few isolates collected in NY and from fungicide trials in NJ were completely resistant to boscalid in lab assays while in PA reduced sensitivity was detected using the seedling bioassay in commercial fields. These differences reflect the variation in the occurrence of resistant strains and again the importance of understanding regional variation when recommending fungicides for managing cucurbit powdery mildew. It is also important for understanding sensitivity shifts within the pathogen

population over time when multiple years of data are compared so when resistance is detected, it provides justification for Section 18 requests.

Here, we report our efforts during 2010 to address the following objectives.

Objectives:

The purpose of this project was to:

1. Determine the sensitivity of the powdery mildew pathogen to the active ingredients in the fungicides currently recommended in PA, NY, NJ, MD, VA and DE.
2. Incorporate results into fungicide recommendations.
3. Disseminate results and recommendations to growers via newsletters as well as summer and winter grower meetings.

Methods and Results:

***Objective 1:** Determine the sensitivity of the powdery mildew pathogen to the active ingredients in the currently recommended fungicides in PA, NY, NJ, MD, VA and DE.*

A seedling fungicide sensitivity bioassay was conducted in three cucurbit fields in south central PA as well as in NY, NJ, MD, DE and the Eastern Shore of VA. Greenhouse grown pumpkin seedlings of a susceptible cultivar (e.g. Sorcerer or Howden) were treated with different fungicides at different doses based on the label rates as well as previously conducted bioassays and placed out in fields where early symptoms of powdery mildew were observed for at least 4 hours to collect spores. The bioassay seedlings were re-collected and maintained in a greenhouse. After approximately 7 to 10 days, the seedlings were evaluated for symptom development and/or severity. The fungicides and doses evaluated included thiophanate-methyl (Topsin M, FRAC code 1) at 50 ppm, trifloxystrobin (Flint, FRAC code 11) at 50 ppm, boscalid (Endura, FRAC code 7, an active ingredient in Pristine) at 50, 175 ppm and 500 ppm (label rate), myclobutanil (Rally, FRAC code 3) at 40, 80 and 120 ppm, triflumizole (Procure, FRAC code 3) at 80 and 120 ppm, tebuconazole (Folicure, Tebuzol, FRAC code 3) at 40 and 80 ppm, difenconazole (Inspire, FRAC code 3) at 40 ppm, and quinoxifen (Quintec, quinoxifen, FRAC code 13) at 1 and 10 ppm. Grower fields were identified in collaboration with several county extension educators in each of the respective states or the bioassay was conducted on near-by research farms.

A seedling fungicide sensitivity bioassay was conducted in two to eight fields in each of five states between late July and mid-October 2010 for a total of 16 fields. In MD, VA, NJ and PA powdery mildew disease pressure was low in the fields assayed therefore making data interpretation more difficult.

Resistance to FRAC code 11 fungicides (trifloxystrobin – Flint at 50 ppm) was detected at a high level in the majority of fields assayed in NY, NJ, PA, MD, DE and VA. This is not surprising since resistance to this group is thought to be common and widespread. It was surprising however to find that resistance to FRAC code 1 fungicides was not detected in all the fields assayed in NY and that the proportion of the pathogen population that was resistant was substantially lower than what has been observed in previous years. This was not the case in fields assayed in the other states. Resistance to FRAC code 1 and code 11 fungicides is considered qualitative, thus increasing the application rate/dose will not improve control; the pathogen is either susceptible or resistant.

In NY, PA, DE and VA strains of the cucurbit powdery mildew pathogen detected were able to tolerate 500ppm boscalid (FRAC code 7), the active ingredient in Endura. Not surprisingly in those same fields, strains resistant to lower doses (175 and 50ppm) of boscalid were also detected. Strains able to tolerate the 500ppm concentration would be fully resistant to this chemistry in the field because it is

within a range that reflects a field application at the highest label rate of Pristine. Due to cross-resistance, resistance to the pyraclostrobin (FRAC code 11), the other component of Pristine, is thought to already exist within the powdery mildew pathogen population. Despite these observations, in fungicide efficacy trial in PA, Pristine (18.5 oz/A) still significantly reduced season-long powdery mildew severity compared to the untreated control however control was improved when used in a program alternating with Procure (FRAC code 3) or with Procure and Quintec (FRAC code 13). In contrast, Pristine was only effective early in powdery mildew development in the fungicide efficacy trial conducted in NY.

Powdery mildew developed on all doses of myclobutanil (Rally, FRAC code 3) evaluated; however development was the least at the highest dose (120 ppm) in fields in NY, PA and DE where this dose was evaluated. Powdery mildew also developed on the majority of plants treated with the lowest dose of triflumizole (Procure, FRAC code 3) and to a lesser extent at the higher dose (120 ppm). Resistance to this group of fungicides is quantitative therefore the highest label rate of Procure (8 oz/A) is still recommended because it provides twice as much active ingredient as Rally at its highest label rate. In the 2010 pumpkin powdery mildew fungicide trial in PA, Procure (8 oz/A) is provided good powdery mildew control compared to the untreated control. On Long Island, NY, where four different FRAC code 3 fungicides were evaluated, cucurbit powdery mildew exhibited some variation in sensitivity to FRAC code 3 fungicides but was most sensitive to difenconazole (Inspire, FRAC code 3). Unfortunately, difenconazole was only evaluated using the powdery mildew bioassay in NY this past season.

All of the cucurbit powdery mildew populations assayed across the five states exhibited a very high level of sensitivity to quinoxyfen (FRAC code 13), the active ingredient in Quintec. There was only an extremely low level of detection of strains able to tolerate 1 and 10 ppm in each of the Mid-Atlantic states.

In MD and NY, powdery mildew sensitivity was monitored at the end of the season using an additional set of bioassay plants. By the end of the season, the sensitivity of the pathogen population is often related to season-long fungicide use and efficacy. In MD, the percent of powdery mildew colonies that developed on pumpkin leaves treated with 50 ppm boscalid (Endura, FRAC code 3) compared to the untreated control almost tripled from 30 Jul to 12 Oct. For the leaves treated with 50 ppm thiophanate-methyl and 50 ppm trifloxystrobin, populations increased 5.5 and 4.5 times that of the untreated control by the end of the season. In NY, shifts in the pathogen population to a higher frequency of resistant strains in response to fungicide use were also detected and associated with efficacy of powdery mildew control. For example, in a Farm 6 (Table 2) where powdery mildew control was considered good throughout the season, the proportion of the population tolerating 500 ppm boscalid increased from 0% on 31 Aug to 11% on 21 Sept compared to Farms 9 and 10. In these fields where control was poor, the proportion of the population tolerating 500 ppm boscalid increased from 14 and 11% on 31 Aug to 70 and 52% on 21 Sept.

Current cucurbit powdery mildew recommendations: For cucurbit powdery mildew management, the current recommendation is to start applying mobile fungicides (Quintec, Pristine, and Procure) when the scouting threshold of 1 out of 50 older leaves showing symptoms has been reached. Early in the season there is less selection pressure for resistant powdery mildew strains because there are fewer spores to be exposed to the active ingredient. Later in the season switch to a protectant spray program. When applying mobile fungicides (Quintec, Pristine, or Procure) always tank mix with a protectant and alternate between modes of action or FRAC codes. Two consecutive applications of Quintec can be applied but there is a total crop limit of 4 applications. After initiating a spray program

continue to scout the fields looking at both the upper and lower leaf surface to evaluate your level of powdery mildew control.

Table 1. The locations where powdery mildew populations estimated as tolerant to different concentrations (ppm) of fungicides in commercial pumpkin plantings or research farm trials in the mid-Atlantic region in 2010 using a pumpkin seedling bioassay.

| FRAC code | Active ingredient | Trade name | Dose (ppm) | Mid-Atlantic states | |
|-----------|---------------------------|------------------|------------|------------------------|--|
| | | | | Evaluated | Resistance detected at some level |
| 1 | Thiophanate-methyl | Topsin M | 50* | NY, NJ, PA, DE, MD, VA | NY (variable), NJ, PA, DE, MD, VA (very low) |
| 11 | Trifloxystrobin | Flint | 50* | NY, NJ, PA, DE, MD, VA | All states |
| | | | 50 | NY, NJ, PA, DE, MD, VA | NY, PA, DE, MD, VA (?) |
| 7 | Boscalid | Endura | 175 | NY, NJ, PA | All states |
| | | | 500* | NY, PA, DE, VA | All states |
| | | | 40 | NY, NJ, PA, DE, MD, VA | NY, PA, DE |
| 3 | Myclobutanil | Rally | 80 | NY, PA | NY, NJ, PA (very low) |
| | | | 120 | NY, NJ, PA, DE, VA | NY, PA, DE (very low), VA (?) |
| 3 | Triflumizole | Procure | 40 | NY, NJ, PA | NY, PA |
| | | | 80 | NJ, PA | Very low |
| 3 | Tebuconazole | Folicur, Tebuzol | 40 | NY, PA | NY, PA |
| 3 | Difenconazole | Inspire | 40 | NY | Not detected |
| 13 | Quinoxyfen | Quintec | 1 | PA, NJ, DE, MD, VA | Very low to not detected |
| | | | 10 | NY, NJ, PA, DE | Very low to not detected |

* Dose corresponds to practical (field) resistance because a pathogen strain resistant to this dose would not be controllable in the field with a labeled rate of the fungicide.

Table 2. Percentage of powdery mildew populations estimated tolerant to different concentrations (ppm) of fungicides in commercial plantings of pumpkin and research plantings of squash and pumpkin on Long Island on a) 31 Aug 2010 and b) 21 Sept 2010.

| a) 31 Aug 2010 | | | | | | | | | |
|--------------------------|--------------------|------------|------------|---------------------|-----------|------------|---------------------|---------------------|------------|
| Bioassay location | FRAC code 7 | | | FRAC code 3 | | | FRAC code 3 | FRAC code 13 | |
| | Endura | | | Nova | | | Tebuzol | Quintec | |
| | Boscalid | | | Myclobutanil | | | Tebuconazole | Quinoxyfen | |
| | 50 | 175 | 500 | 40 | 80 | 120 | 40 | 1 | 10 |
| Farm 5 | 48 | 21 | 24 | 30 | 42 | 6 | 24 | ND | 0 |
| Farm 6 | 11 | 0 | 0 | 11 | 4 | 7 | 74 | ND | 0 |
| Farm 7 | 9 | 12 | 0 | 3 | 5 | 0 | 6 | ND | 0 |
| Farm 9 | 100 | 100 | 14 | 25 | 25 | 0 | 14 | ND | 0 |
| Farm 10 | 79 | 53 | 11 | 21 | 37 | 2 | 79 | ND | 1 |
| Average | 49 | 37 | 10 | 18 | 23 | 3 | 39 | -- | 0.4 |
| b) 21 Sept 2010 | | | | | | | | | |
| Bioassay location | Boscalid | | | Myclobutanil | | | Tebuconazole | Quinoxyfen | |
| | 50 | 175 | 500 | 40 | 80 | 120 | 40 | 1 | 10 |
| | | | | | | | | | |
| Farm 5 | 35 | 44 | 48 | 3 | 0 | 0 | 25 | 1 | 0 |
| Farm 6 | 10 | 8 | 11 | 0 | 0 | 0 | 14 | 0 | 0 |
| Farm 7 | 47 | 11 | 25 | 1 | 0 | 0 | 2 | 16 | 2 |
| Farm 9 | 91 | 75 | 70 | 1 | 0 | 0 | 66 | 13 | 0 |
| Farm 10 | 71 | 31 | 52 | 9 | 0 | 0 | 54 | 5 | 1 |
| Average | 51 | 34 | 39 | 3 | 0 | 0 | 32 | 7 | 0.6 |

Basil Downy Mildew Monitoring Program- 2010

Robert P Mulrooney, Extension Plant Pathologist
Nancy F. Gregory, Extension Plant Diagnostician

Introduction

Downy mildew of basil is a new, destructive disease that is expected to occur routinely in the USA as it has been doing in Europe since first occurrence. Downy mildew was reported as severe at many farms in the northeast USA in 2008, the first year it was observed in this region. Growers generally did not realize their basil had a disease because the most noticeable symptom on affected plants was yellowing, which was assumed to be the result of a nutritional problem.

With basil downy mildew now established in Florida, a monitoring program was started conducted starting in 2009 and continued in 2010 to determine whether this pathogen can move northward through the eastern USA as can occur with the cucurbit downy mildew pathogen, and whether a monitoring program can assist growers to be prepared for downy mildew occurrence in their basil crop. The success of this activity depends on reports from anyone growing basil.

2010 Results

In 2010 a formal monitoring activity was conducted as an add-on to the ipmPIPE cucurbit downy mildew monitoring program (<http://cdm.ipmpipe.org>). For the cucurbit downy mildew program, sentinel plots with various cucurbit crop types are grown throughout the eastern USA, from FL and TX to NY and WI, and routinely examined for symptoms of downy mildew. Basil was grown at many of the sentinel plots in 2010 including Delaware.

Two monitoring sites were established in Delaware in 2010, one at the Carvel Research and Education Center near Georgetown, DE in Sussex County and the other on the Newark Experimental Station Farm in New Castle County. Basil transplants (*Ocimum basilicum* 'Martina Genovese') were grown in the greenhouse in Newark and 15 plants were planted at the two sites in early June. The plants were monitored weekly for the presence of downy mildew. Downy mildew was never detected at the Sussex County site, but detected in Newark on September 21, 2010. Typical small black lesions were observed on the upper side of the infected leaves and the sparse mycelial growth with sporangia and sporangiophores were observed with the dissecting microscope.

In addition to the sentinel plots two other sites in DE reported downy mildew on basil one was from a garden in the Lewes area in Sussex County on July 8 and the other was a small commercial farm in the Milford area. Neither of these reports were confirmed in the diagnostic lab.

2010 Delaware ipmPIPE Sentinel Plot Survey for Soybean Rust

Bob Mulrooney, Extension Plant Pathologist, University of Delaware

The sentinel plot survey for soybean rust was reduced dramatically when funding for the extensive sentinel plot system was reduced to funding only the Tier 1 states in the South. Funding was also maintained for the maintenance and populating the ipmPIPE website where the monitoring information is made available to the public.

Sentinel Sites

One soybean sentinel plot was established at the University Carvel REC near Georgetown.

Survey Activities

This site was planted in early June with a Group VII variety 'USG7732NRR' and monitored every two weeks for soybean rust beginning in mid-August until frost. Twenty randomly selected leaves were examined with a 10X hand lens in the field and any leaves with possible infections were bagged and brought to the lab for microscopic observation. No rust was detected in 2010.

Extension Outreach

A soybean rust update was included periodically in our weekly crop newsletter (24 issues) "Weekly Crop Update". The report included information about the development of the disease in the South and predictions of possible movement north. This was emailed and posted to the web as well as mailed to subscribers. Information from the ipmPIPE website along with our local sentinel plot information was included in the update.

2009-10 Soybean Cyst Nematode Survey Results

Robert Mulrooney, Extension Plant Pathologist

Nancy F. Gregory, Plant Diagnostician

Introduction

The soybean cyst nematode (*Heterodera glycines*) is the most limiting biotic factor of soybean production in Delaware. In 1993 and 1994 a major effort was made to survey the soybean acreage for the soybean cyst nematode (SCN) and determine the race composition of the SCN populations present at the time. The Delaware Soybean Board funded this project and the results demonstrated that roughly 60% of the populations that were race tested were race 3 and 30% race 1 and the remainder a mix of races 5, 7, and 9. Since that time Round-Up Ready soybeans were introduced with a single source of resistance to SCN derived from a soybean plant introduction referred to as PI88788. At the time of the first survey we demonstrated a significant yield reduction in one variety trial where race 3 resistant soybeans were planted in a field known to be infested with race 1. This was the first indication that not all race 1 populations could be controlled with a race 3 or 3, 14 resistant soybean variety. For the past 10 years SCN has not been identified as causing much yield loss because symptoms that were seen previously, namely severe stunting and chlorosis, only seem to be present when a susceptible variety is grown or high egg numbers combined with dry weather at planting occurs when a resistant variety is planted. During the 2008 growing season a small number of soybean fields had stunted plants, chlorosis, and SCN was present on the roots. All of these fields were planted with a Round-Up Ready variety with resistance to SCN. The difference in 2008 was that it was dry from planting through the first thirty days after planting. High SCN egg numbers and dry weather early are known to be very detrimental to early soybean growth and can produce stunting, chlorosis and yield loss.

Within the last 5 years there are indications that race 3 is no longer the predominant race. A small set of samples tested here and those sent to other institutions have tested as race 1. Since the majority of resistance in Round-Up Ready soybeans is from PI88788 which allows reproduction of race 1 populations, these varieties may have reduced effectiveness in suppressing current SCN populations. Other control measures may be needed if the current population structure is no longer predominately race 3. No surveys of SCN have been conducted in Delaware since 1996.

Materials and Methods

Sixty-three soil samples from fields with known history of soybean production with or without known SCN infestations were sampled during the spring summer and fall. Thirteen samples were taken from New Castle County, 22 from Kent and 28 from Sussex. Fields were sampled randomly by taking approximately 25 soil cores in a zigzag pattern to a four to six inch depth and within the row if soybean stubble was present. Samples were placed in plastic bags and stored at 40°F until processed. *H. glycines* cysts were separated from the soil by the wet sieving method. A 250-cm³ sub-sample was taken from the well-mixed soil sample and suspended in water. The suspension was poured through nested 595-over 250-µm pore sieves. Cysts and debris retained on the 250 µm pore (60 mesh) sieve were washed into a large 100-ml polypropylene test tube and the water level increased to 40 ml. A stainless steel bit with 1-mm helical ridges attached to a variable speed stirrer was used to crush the cysts: the stirrer's rheostat was turned to 6,000 rpm while the test tube containing the cysts was held gently against the rotating bit for 60 seconds. Contents of the tube were washed through nested 75-µm-pore (200 mesh) over 25-µm-pore (500 mesh) sieves. Eggs collected on the 25-µm-pore sieve were stained with acid fuchsin. After staining, the egg suspensions were standardized to 100 ml, stirred, and a 5 ml subsample was removed with a pipette for counting. Results were reported as number of eggs per 250 cm³ soil.

For race and HG typing, 14 samples were selected from Kent (4) and Sussex (10) Counties where there were at least >1,000 eggs/250 cm³ of soil (except for one sample from Kent County). Samples were sent by 2-day express to the University of Missouri Extension Nematology Laboratory for analysis. Populations were reared on susceptible soybean for 30 to 40 days in a water bath at 27°C to increase egg numbers and break any egg dormancy. Plant root systems were removed from pots, cysts were collected, and eggs were extracted for use in race and HG Type test. Female Index (FI) was

calculated for each soybean line as follows: FI = (mean number of females on test soybean line divided by the mean number of females on the susceptible variety 'Lee' X 100.

Results

In this study, 63 soil samples were processed for egg counts. In all, 35 (55.6%) of the samples had detectable populations of SCN. The highest number of eggs detected was 11,448 eggs/ 250cm³ soil, and the lowest was 72 eggs/ 250cm³ soil.

Table 1. Frequency distribution of soil samples among classes of egg counts per 250 cm³ soil (0.5 pt)

| Egg Rating | NCC | % | Kent | % | Sussex | % | Statewide % |
|---|-----|-----|------|------|--------|------|--------------|
| None 0 eggs | 13 | 100 | 14 | 63.8 | 1 | 4.0 | 44.4 (28) |
| Low 1-499 eggs | 0 | 0 | 2 | 9.0 | 3 | 10.7 | 8.0 (5) |
| Moderate 500-1,499 | 0 | 0 | 1 | 4.6 | 6 | 21.4 | 11.1 (7) |
| High 1,500-4,999 | 0 | 0 | 3 | 13.6 | 8 | 28.6 | 17.5 (11) |
| Very high 5,000-50,000 | 0 | 0 | 2 | 9.0 | 10 | 35.7 | 19.0 (12) |

Fifteen soil samples(42.8%) of the 35 samples that had cysts were sent for race and HG Typing.

Table 2. Table of Race/HG Tests for SCN populations collected as part of the SCN Survey, 2009.

| Sample # | Indicator Line – Female Index : FI = (mean number of females on test soybean line divided by the mean number of females on the susceptible variety 'Lee 74' X 100 | | | | | | | | HG type | Race |
|-----------|---|---------|---------|----------|----------|---------|----------|---------|---------|------|
| | HG 1 | HG 2 | HG 3 | HG 4 | HG 5 | HG 6 | HG 7 | Pickett | | |
| | Peking | PI88788 | PI90763 | PI437654 | PI209332 | PI89772 | PI548316 | Pickett | | |
| 30 | 0% | 70% | 0% | 0% | 65% | 0% | 64% | 7% | 2.5.7 | 1 |
| 31 | 18% | 65% | 0% | 0% | 81% | 0% | 64% | 73% | 1.2.5.7 | 2 |
| 33 | 1% | 67% | 0% | 0% | 70% | 0% | 67% | 15% | 2.5.7 | 5 |
| 42 | 1% | 63% | 0% | 0% | 46% | 0% | 73% | 18% | 2.5.7 | 5 |
| 44 | 0% | 59% | 0% | 0% | 63% | 0% | 61% | 0% | 2.5.7 | 1 |
| 48 | 0% | 80% | 0% | 0% | 46% | 0% | 67% | 1% | 2.5.7 | 1 |
| 49 | 2% | 68% | 0% | 0% | 41% | 1% | 58% | 10% | 2.5.7 | 1 |
| 50 | 2% | 76% | 0% | 0% | 77% | 0% | 63% | 9% | 2.5.7 | 1 |
| 51 | 11% | 75% | 1% | 0% | 66% | 0% | 90% | 27% | 1.2.5.7 | 2 |
| 52 | 7% | 62% | 0% | 0% | 66% | 0% | 74% | 29% | 2.5.7 | 5 |
| 54 | 2% | 70% | 0% | 0% | 79% | 0% | 72% | 12% | 2.5.7 | 5 |
| 57 | 1% | 75% | 0% | 0% | 73% | 0% | 61% | 8% | 2.5.7 | 1 |
| 58 | 0% | 63% | 0% | 0% | 72% | 0% | 85% | 3% | 2.5.7 | 1 |
| 59 | 7% | 44% | 1% | 0% | 51% | 0% | 67% | 36% | 2.5.7 | 5 |
| 63 | 15% | 67% | 0% | 0% | 84% | 0% | 68% | 52% | 1.2.5.7 | 2 |

The race composition has changed dramatically since 1996. Seven race 1 populations (47%) have been identified, 5 race 5 populations (33%) and 3 race 2 populations (20%). The other alarming result is the high female index (FI) for these populations on PI88788. The range is from 44- 80% of the susceptible variety. The average FI is 67.

Discussion

These results indicate that under adverse growing conditions and high initial egg numbers, stunting and yield loss would be expected if a race 3, 14 resistant variety with PI88788 as its source of SCN resistance is grown here in Delaware. Consequently, growers may need to plant soybean cultivars derived from non-PI88788 resistance sources to successfully manage soybean cyst nematode in the future. This is a problem since there are none that are Round-Up Ready that can be planted at this time. There is little interest in growing conventional soybeans and the varieties that could be grown here are not available in sufficient quantities to satisfy the immediate need. Growers are going to have to manage SCN by judicious variety selection and rotations with non-host crops for the immediate future.

Acknowledgements

This work was supported in part by a grant from the Delaware Soybean Board and is gratefully acknowledged. We thank also Bill Cissel, Joanne Whalen and Cory Whaley for identifying fields for sampling and collecting samples. Consultants Tom Coleman and Rob Ekholm also provided several soil samples and we thank them as well. We would like to acknowledge the excellent work that Bob Heinz, lab director of the University of Missouri Extension Nematology Laboratory, did performing the race/HG testing on the Delaware SCN populations.

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2010 Delaware Plant Diagnostic Clinic Report
Department of Plant and Soil Sciences
University of Delaware

Nancy F. Gregory, Plant Diagnostician
Bob Mulrooney, Extension Plant Pathologist

The Plant Diagnostic Clinic at the University of Delaware is housed in the Department of Plant and Soil Sciences, and is located in Townsend Hall, Room 151. The clinic serves the public through Delaware Cooperative Extension, directly serving commercial growers, nurserymen, landscapers, gardens, and private homeowners. Samples also are received through the county offices, from Extension specialists, and the Master Gardener Program. The clinic is the National Plant Diagnostic Network (NPDN) laboratory for Delaware. The lab is also the plant pathology laboratory for the Delaware Department of Agriculture, USDA/APHIS CAPS diagnostics and the ipmPIPE lab for Delaware. The clinic operates with two staff, the Plant Diagnostician, the Extension Plant Pathologist, and some part-time employees.

During 2010, the Plant Diagnostic Clinic processed over 600 non-survey samples, out of 2,516 total samples. There were 541 routine clinic samples processed. Other samples were diagnosed in field situations, and not brought in for analysis. Phone inquiries and email requests for information concerning plant problems numbered around 30, in addition to physical specimens submitted to the lab. Soil samples for nematode assays were also processed in the lab, but are not included in this report. Under a Cooperative Agreement with USDA/APHIS, a Farm Bill plum pox survey was done. Just under 2000 samples were processed (1951) and all were negative for the presence of plum pox virus in ELISA testing. There were also 21 bay laurel (*Laurus nobilis*) samples tested for *Phytophthora ramorum* as a part of a USDA/APHIS trace forward. ELISA testing was negative for 19 and the other two samples tested negative in PCR testing done at the USDA/APHIS regional lab at Penn State.

Excessive rainfall in 2009, ten inches above the normal for the season, contributed to plant stress, and favored pathogens, especially bacteria on many hosts. The wet weather pattern continued in March and April of 2010. Dry conditions then set in during June and drought stress became an issue for many agronomic crops and landscape plantings in 2010, especially in Sussex County. Rainfall totals were compiled as follows:

DEOS Summary 2010 – Rainfall in inches - Normal for Delaware is 40 inches

| | | | | | |
|------------|-------|------|---------|----------|------------|
| Newark | April | July | October | December | 2010 Total |
| | 2.72 | 4.39 | 4.70 | .80 | 34.92 |
| Dover | April | July | October | December | 2010 Total |
| | 2.50 | 4.34 | 5.49 | 2.27 | 38.70 |
| Georgetown | April | July | October | December | 2010 Total |
| | 1.38 | 2.39 | 4.21 | 1.50 | 30.44 |

Of the 541 routine samples received, the majority were from within Delaware.

Others were received from Maryland, New Jersey, Pennsylvania, and Vermont, totaling 89 samples, or 16.45% from out of state. Delaware samples accounted for 84% of the total, with the total numbers skewed by the addition of plum pox survey numbers for Kent County. The majority of samples were physical samples received (98%), although 30 were digital images only, an increasing number each year. Maryland received eleven samples from Delaware, mostly from turfgrass from golf courses.

There were many different diagnoses, from different crop areas. The crop sources for those were, in order of predominance, Ornamentals, Fruit, Vegetables, Field Crops, and Turf. Other categories included Insect ID, Christmas Trees, Mold/Fungal Id, and Others. The varied diagnosis categories ranked* in incidence as follows:

- Environmental/Physiological
- Fungal Diseases
- Bacterial Diseases
- Viral Diseases
- Nematodes
- Insect (Damage and ID's)
- Plant/Weed ID
- Fungal ID

*Percentages were not determined due to many specimens having more than one diagnosis. For example, insect damage and fungal dieback were common on physiologically stressed trees. The top specific diagnoses were as follows:

| Diagnosis 2010 | |
|-----------------------|----------------|
| Diagnosis | Samples |
| Physiological | 115 |
| Environmental | 29 |
| Root rot | 19 |
| Insect | 12 |
| Anthracnose | 11 |
| Virus | 10 |
| Crown Rot | 9 |
| Botrytis blight | 9 |
| Bacterial blight | 6 |
| Bacterial Leaf Spot | 6 |
| Insect Damage | 5 |
| Powdery Mildew | 5 |
| Fireblight | 5 |

These numbers show that physiological and environmental causes are primary or play a role in 26.6 % of samples received. This diagnosis, when communicated, can save growers and landscapers money and time when they avoid unnecessary spray treatments.

Two USDA quarantine pests were detected. Japanese apple rust caused by *Gymnosporangium yamadae* was confirmed in the telial stage on *Juniperus chinensis* as well as in the aecial stage on crabapple and domestic apple in New Castle County. After having been first confirmed in Delaware in 2009, the pathogen is still under review by the USDA/APHIS New Pest Advisory Group. Overall, this disease appears to be rather well established in Delaware. Chrysanthemum white rust (*Puccinia horiana*), was identified in October 2010. Plants were eradicated from a retail vendor; to date this pest is not established in the United States. Brown rust was also identified on chrysanthemum, but is not a USDA quarantine pathogen.

New reports for the year 2010 included tobacco rattle virus on *Epimedium rubrum*, in Chester Co., PA, confirmed by Agdia, Inc., as well as AMV on obedient plant (*Physostegia*). Groundsel rust (*Puccinia lagenophorae*) was detected, a rust that had once been considered as a biological control for that weed host. The aquatic weed, brittle naiad (*Naja minor*), was identified from a pond in PA. Downy mildew caused by *Plasmopara helstedii* was diagnosed on Rudbeckia and tar spot (*Rhynchospora* sp.) on *Ilex opaca*. Australian willow (*Geijera parviflora*) was diagnosed with Nectria canker, and bacterial blight (*Pseudomonas aeruginosa*). Downy mildew on basil caused by *Peronospora belbahrii*, was confirmed from sentinel plots, but not confirmed in commercial or backyard plantings. Pecan weevil, *Curculio caryae*, was found on pecan nuts. An unusual response to a white fly infestation was observed on *Rudbeckia*, along with distortion on *Echinacea* due to sunflower moth.

Foliage diseases on soybean such as Septoria brown spot and downy mildew were not common due to dry weather. Sudden death syndrome caused by *Fusarium virguliforme* was confirmed in New Castle County as well as Maryland in early August, possibly in fields that had the disease the year before. Bacterial blight, Alternaria leaf spot, Phyllosticta leaf spot, frog-eye leaf spot and Cercospora blight were seen on soybean during the season but not yield limiting. Charcoal rot was found late in the season, along with quite a bit of stem and pod anthracnose.

Weather conditions in the spring of 2010 were favorable for seedling diseases in row crops and vegetables. Cold wet weather in March and April followed by wet conditions in May and June resulted in slow seedling growth and damping off. Many agronomic fields remained flooded until closed to planting time. Bacterial infections and Pythium root rot were prevalent on corn, barley, and wheat. Bacterial stalk rot on corn was confirmed. Wheat and barley viruses (wheat spindle streak and wheat soil-borne mosaic) were not as problematic as in previous years. Disease incidence in small grains was low in most areas of the state. There were some fields with low incidence of leaf rust and stripe rust. In June, *Pythium*, *Fusarium*, and *Phytophthora* root and stem rots were found on peas, tomatoes, peppers and squash. *Fusarium* crown rot was diagnosed throughout the season on many crops such as asparagus, pepper, cucumber, eggplant, bean, and tomato. *Pythium* stem and root rot was diagnosed on cucumber, bean, potato, tomato and a number of annual bedding plants. Bacterial pith necrosis of tomato was diagnosed for the second year in a row. Bacterial leaf spot was confirmed on pepper, tomato, lettuce, and Swiss chard. Alternaria leaf spots were diagnosed on yarrow, carrot, and beet. Leaf rust was confirmed on corn, wheat, and barley. There were very few samples of head scab on wheat, but one on sorghum. Stalk rots and red root rot (*Phoma terrestris*) were diagnosed on corn late in the season, along with a suspected *Physoderma* brown spot detection. Late blight was not found in 2010 in Delaware, which was fortunate given the amount of disease the previous year. Downy mildew on cucumber appeared in early August, but was not seen on other cucurbits. Watermelon and pumpkin production was good this season, despite confirmation of bacterial fruit blotch

caused by *Acidovorax* on watermelon in August. Stink bug damage on limas and pole limas was significant, along with *Alternaria* leaf spot. Black rot caused by *Didymella sp.* was seen on acorn squash in October.

Notable diseases on fruit included *Monilinia* blight on cherry, rusts, *Blumeriella* leaf spot on sweet and sour cherry, *Septoria* leaf spot on persimmon, black rot and *Botrytis* on grape, and scab on peaches. There was *Pseudomonas* bacterial blight on seedlings of canary melon, cantaloupe and watermelon in the field in April. Strawberry plants were diagnosed with *Fusarium* crown rot and anthracnose on the stolons. Fire blight was severe on pear, most likely due to a carry over from the wet weather infections in 2009. Cedar quince rust caused by *Gymnosporangium clavipes* was confirmed on fruit of callery pear 'Redspire'.

Evergreen ornamentals suffered tip and twig dieback, following two seasons of fluctuating temperatures and drought. This was often difficult to accurately diagnose, but *Phomopsis* and *Pestalotiopsis* were among the pathogens found. *Seiridium* canker continues to affect Leyland cypress, as over-crowded trees mature. *Phytophthora* root rot was diagnosed on juniper, arborvitae, Canaan fir, Fraser fir, Douglas fir, and rhododendron that were situated in areas with poor drainage. *Rhizosphaera* needle cast was diagnosed on blue spruce and Norway spruce. Douglas fir was affected by *Rhabdochloa* and late season drought and spider mite damage. Fire blight was prevalent on flowering pear, and continued to show up as brown terminals late into the fall. Sycamore anthracnose was very prevalent on susceptible London planetree and American sycamore. Most trees were defoliated early but had pushed out a new set of leaves by mid-June. *Monilinia* blight on Japanese quince caused dieback of twigs and caused blossom and twig blight on Kwanzan cherry. The blight was very prevalent in New Castle County, and the pathogen was identified as *Monilinia laxa* by Dr. Guido Schnabel at Clemson. A record early detection (May 4, 2010) of powdery mildew on flowering dogwood was made in Newark. Dutch elm disease was confirmed on 'Princeton' American elm, a cultivar that has been reported to have some resistance to DED.

Late season *Septoria* leaf spots were common on numerous hosts including pear, *Prunus*, sunflower and *Rudbeckia*. Bacterial leaf scorch was noticeable in the landscape; most commonly affected were northern red oak and pin oak. *Hypoxyylon* canker was confirmed on several hardwood species of oak, maple, and sycamore, and appears to be increasing in incidence in the area. *Pythium* and *Fusarium* crown rots were diagnosed in numerous perennials (*Vinca*, *Veronica*, *Cimicifuga*, shasta daisy) under drought stress late in the season.

The UD Plant Diagnostic Clinic gratefully acknowledges the following University of Delaware colleagues who assisted with diagnoses and identifications as Advisory Consultants for samples in 2010: Entomology and Applied Ecology Dept.; Brian Kunkel, Joanne Whalen, and Charles Bartlett; Plant and Soil Science Dept, Tom Pizzolato, John Frett, Caroline Golt, and Richard Taylor.

Nematode Assay Service 2010 Report
Cooperative Extension Service
Department of Plant and Soil Science
University of Delaware

Bob Mulrooney, Extension Plant Pathologist
Nancy Gregory, Extension Plant Diagnostician

The Nematode Assay Service (NAS) at the University is housed in the Department of Plant and Soil Sciences, and is located in Room 151 Townsend Hall. The NAS provides nematode identification and enumeration for soil and plant samples submitted by consultants, growers, researchers, and the gardening public. The NAS provides this service to residents of Delaware and the surrounding states. The clinic operates with two staff, the Extension Plant Pathologist and the Plant Diagnostician, who prepares samples for reading and does soybean cyst egg counts. Currently our fee structure is \$10.00 for either a full larvae screen or soybean cyst nematode (SCN) egg count for both in-state and out-of-state clients.

In addition to our regular soil and root extractions of nematodes, we screen for foliar nematode, and pinewood nematode using extractions from suspect plant parts.

In 2010, the NAS processed 108 for fee samples submitted for analysis. There were fifteen samples from out of state (14%). There were 199 research samples processed that were part of the soybean variety testing program evaluating varieties for resistance to SCN. Several soil or plant samples came in through the Diagnostic Clinic routine sample queue with damaging levels of plant parasitic nematodes, including pinewood nematode (1), soybean cyst nematode (2) and root knot nematode (1).

Of these 108 for fee samples submitted for analysis, the crop sources for these were:

| | | |
|-------------|----|------|
| Field crops | 65 | 62 % |
| Fruit | 32 | 29 % |
| Vegetables | 8 | 7 % |
| Ornamentals | 4 | 4 % |

Thirty-five (35) or 33% of the samples submitted had nematode levels that were determined to require some control measure.

Nematode species detected in numbers that required control were the soybean cyst nematode, *Heterodera glycines*; southern root knot nematode, *Meloidogyne incognita*; lesion nematode, *Pratylenchus penetrans*; dagger nematode, *Xiphinema* sp., and stubby root nematode, *Trichodorus* sp. Root knot nematodes continue to be detected causing stunting and yield loss on lima beans and cucurbit crops. Dagger nematodes (*Xiphinema* sp.) were found at damaging levels in several samples that were to be planted to wine grapes. A number of soil samples were submitted from fields in Maryland to be planted to wine grapes. Final reports were saved in a 'pdf' form that could be saved on the computer, and printed or e-mailed to the submitter. Control recommendations and fact sheets when appropriate, were included with the report to the submitter.

Potato Disease Advisory Report -2010

Bob Mulrooney, Extension Plant Pathologist

Joanne Whalen, Extension IPM Specialist

The Potato Disease Advisory is a weekly or twice weekly email and fax sent to selected clientele that are potato producers, Extension professionals or in allied industries. This advisory was initiated in 1995 as part of a larger effort to inform growers and others on the late blight epidemic that occurred elsewhere in 1994 and prevent its occurrence in DE. It has continued every year since that time since late blight is still a threat to the Delaware potato industry if we have favorable weather for the disease and growers have late blight in their seed lots. Initially 100 contacts were maintained but there are fewer now since the potato industry is not as large as it once was.

The Potato Disease Advisory Report tabulates disease severity values used for predicting late blight if the fungus is present and is used by the growers to help make fungicide applications in a timely manner. The Advisory utilizes the WISDOM software program developed at the University of Wisconsin to predict late blight and early blight. Additional comments are included on other disease issues pertinent to the time of season and what is being seen in the field by Extension personnel and commercial scouts and fieldmen. The Advisory is in effect from mid-May through mid-August depending on the season.

In 2010, nineteen Potato Disease Advisories were sent to clients from mid-May through August. The information is also disseminated weekly via Weekly Crop Update. The season was wet early but hot and dry at the end of the growing season. Late blight was not detected in DE in potato or tomato.

A sample report follows :

Potato Disease Advisory #7

June 9, 2010

Cooperative Extension System

University of Delaware

Bob Mulrooney, Extension Plant Pathologist

Disease Severity Value (DSV) Accumulation as of June 8, 2010 is as follows:

Location: Art and Keith Wicks Farm, Rt 9, Little Creek, Kent County.

Green row: May 6

| Date | LATE BLIGHT | | | EARLY BLIGHT |
|------------|-------------|-----------|------------|----------------------|
| | Daily DSV | Total DSV | Spray Recs | Accumulated P- days* |
| 5/27- 5/28 | 1 | 30 | 10-days | - |
| 5/29-5/30 | 1 | 31 | 10- days | - |
| 5/31 | 0 | 31 | 10-days | 199 |
| 6/1 | 1 | 32 | 10-days | 206 |
| 6/2 | 0 | 32 | 10-days | 214 |
| 6/ 3- 6/5 | 0 | 32 | 10-days | 232 |
| 6/6 – 6/8 | 0 | 32 | 10-days | 257 |

Maintain the recommended spray interval. At 300 P-days fungicide sprays will be needed to control early blight. This should occur this week. At this point weekly fungicide applications would be suggested. There have been no confirmed reports of late blight on potatoes in the region.

* **P days**- We use the predictive model WISDOM to determine the first fungicide application for prevention of **early blight** as well. The model predicts the first seasonal rise in the number of spores of the early blight fungus based on the accumulation of 300 physiological days (a type of degree-day unit, referred to as P-days) from green row. To date, **257 P-days** have accumulated at the site. Once 300 P-days have accumulated, the first fungicide for early blight control should be applied. This usually occurs when rows are touching.

If **pink rot or leak** is a concern and no pink rot fungicide was applied at planting consider applying one of the following when potatoes are nickel-sized and repeating 14 days later. Apply in as much water as possible (20-30 gal/A): Mefanoxam/chlorothalonil (Ridomil/Bravo) 2 lb/A, or Ridomil Gold/MZ 2.5 lb/A, or Ridomil Gold/Copper 2 lb/A. If Platinum/ Ridomil Gold was applied at planting the label allows **one** foliar application of one of those products at tuber initiation if conditions warrant.

The **Spray Recs** column in the table is also generated by the WISDOM software program. This recommendation combines the DSV accumulation for late blight as well as the P-day accumulations for early blight and computes a spray recommendation. **This is presented as a guide only. Spray decisions should be made with local conditions in mind and this information can help to determine if disease conditions are favorable.**

USDA/APHIS Cooperative Efforts for Delaware Plant Diagnostics in 2010

The University of Delaware Plant Diagnostic Clinic lab serves as an important resource for USDA/APHIS and the Delaware Department of Agriculture, enabling Delaware to respond to threats of high consequence pathogens in a timely manner. Additional survey work such as for kernal bunt enables Delaware crops to be certified for export.

USDA/APHIS *Phytophthora ramorum* Trace Forward for Delaware - March 2010

Delaware Plant regulatory officials, SPHD and SPRO, were notified on 3/17/10 that the state had received a plant shipment of four flats of *Laurus nobilis* (bay laurel) from a nursery that had tested positive for the presence of *Phytophthora ramorum*. The nursery is a production facility located in Lancaster, Pennsylvania and the presence of *Phytophthora ramorum* was confirmed on March 15, 2010. The only species infected were *Laurus nobilis* (bay laurel). There were, however, some rose plants located in the same greenhouses. The detections were seedling flats in a nursery and not in the landscape or forestry environment.

Personnel from Delaware Department of Agriculture visited a Sussex County, Delaware retailer on March 18, 2010 with a HOLD ORDER utilizing DDA's Nursery Law. Plans were developed utilizing the USDA/APHIS trace forward protocol found at:

http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/pdf_files/traceforwardprotocol.pdf

In cooperation with the UD Plant Diagnostic Clinic NPDN lab, a sampling strategy was developed. There were 113 *Laurus nobilis* plants in small pots, along with one other *Daphniphyllum macropodium* (HAP) on site. Samples were collected for 21 plants exhibiting symptoms of leaf spot or dieback and delivered to Nancy Gregory at the University of Delaware in Newark, DE on March 18 for testing. Plants were accompanied by PPQ 391 forms (2010-P RAM-DE-01 through 21). Plant material was tested using full plate ELISA and two samples tested positive (#06 and #19). Those two samples were shipped to Grace O'Keefe, the USDA/APHIS/PPQ Plant Pathology Identifier at Penn State University on March 22, 2010. Both plant samples were part of the trace forward survey, and subsequently tested negative as per the CPHST qPCR real time protocols. State regulatory officials were notified of the negative results on 3/24/2010, and the diagnostic lab then notified as well as the grower.

There was a later trace forward in June for which Delaware did not receive material, and therefore was not a part of subsequent testing.

Chrysanthemum White Rust – October, 2010

Three samples of chrysanthemum were obtained from a retailer in Sussex County DE on October 19, 2010. Symptoms of rust were noted. Microscopic evaluation at the Plant Diagnostic Clinic in Newark confirmed white rust, caused by *Puccinia horiana* and also brown rust caused by *Puccinia tanacetii*. Samples were sent to the National Mycologist with USDA/APHIS in Beltsville along with PPQ 391 forms, and the actionable white rust pathogen was confirmed. Plants were destroyed, and the retailer was re-visited by DDA personnel to ensure that no further infections were present.

NPDN and USDA/APHIS Joint Exercise Scenarios – August 2010

The University of Delaware Plant Diagnostic Clinic participated in exercise scenario planning in a meeting held at UD in the spring of 2010. In August, the diagnostician participated in a Functional Exercise scenario in cooperation with NPDN, USDA/APHIS, and DDA. The exercise began with submission of a suspect sample to the Clinic Lab and a tentative diagnosis of a Federal Suspect Agent. For the full day Functional Exercise, Nancy served as the on-site subject matter expert, assisting Incident Command.

DE Plum Pox Farm Bill Survey and Diagnostics - Fiscal Year 2010

Final Accomplishment Report

State: DELAWARE Year: 2010-2011

List dates covered by this report: _May 10, 2010 through Dec 31, 2010

Cooperator: University of Delaware

Cooperators Project Coordinator:

Name: Nancy F. Gregory, Plant Diagnostician
Agency: University of Delaware
Address: Dept of Plant & Soil Sciences, 152 Townsend Hall,
531 S. College Avenue
City/State/Zip: Newark, DE 19716

Phone: 302-831-1390 Fax: 302-831-0605
Email: ngregory@udel.edu

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- A. The primary objective of this project was to assist Delaware Department of Agriculture (DDA) in the national survey for Plum Pox virus (PPV) in areas of Delaware that produce stone fruit. The Cooperator conducted a PPV survey as funded through the Farm Bill, to determine if and where PPV occurred in the U.S and Delaware. All data was entered into the NAPIS database and the NPDN database. The 2010 survey concentrated on detection in production orchards, as there are none in Delaware that are used to produce budwood. Assistance was provided by hiring a field technician for the survey and lab technicians to process samples according to the guidelines and protocols for diagnosis and detection provided by USDA-APHIS-PPQ.
 - B. Objectives of the survey project were met, as samples were collected, processed, and determined to be free of the plum pox virus in all peach orchards sampled.
 - C. There were no cost overruns in the survey project.

If the program is survey in nature add the following information:

A. Survey Methodology (trapping protocol): Detection surveys for PPV in orchards are based on the use of a hierarchical sampling method. This involves collecting 8 leaf samples from each of 25 percent of the trees in an orchard. Trees to be sampled are selected in groups of 4, with 32 leaves that are collected from the four trees being ELISA tested as four 8 leaf samples. To determine the total number of samples to be collected in an orchard being surveyed, the following formula can be used:

Number of trees per acre x number of acres in the orchard

For example, a 9 acre orchard with a planting rate of 140 trees per acre, 315 eight leaf samples would be submitted for ELISA testing. Sampling at lower rates significantly reduces the likelihood of detecting PPV, and sampling at higher rates is only warranted if there are unusual risk factors present.

The selection of trees or orchards to be sampled and the rate at which sampling is conducted should be based on the risk associated with the material being sampled. Foundation trees used to produce budwood for the production of registered nursery stock trees or certified budwood source trees present the highest risk, and all of these trees should be sampled at the level of 8 leaves per tree. The second level of risk are individual trees outside of orchard settings, or orchards from which budwood is or recently has been cut – either registered or certified budwood, or common budwood. Individual trees outside of orchards should be sampled at the level of 8 leaves per tree. All of the orchards containing trees from which budwood has been cut should be sampled at the 25 percent level using the hierarchical sampling model. Once orchards containing trees used for budwood production have been sampled, the remaining funds may be used to conduct hierarchical surveys of a representative group of orchards throughout the state.

In Summary:

- All foundation trees should be sampled. **None in Delaware**
- All other trees used as budwood sources and not in orchards should be sampled. **None in Delaware**
- Any orchards containing trees from which budwood is cut should be sampled at a 25 percent level, using a hierarchical sampling model. **None in Delaware.**
- Any remaining funds can be used to survey a representative group of orchards, with sampling being conducted at the same 25 percent level. Without foundation and budwood stock, this is where the efforts in Delaware will be concentrated. Acreage in Delaware stands at approximately 250 acres of orchard land in production. A representation of approximately 30% would be sampled, from 6 major orchards. Field personnel will assist DDA, and UD personnel will carry out diagnostic efforts.

Survey Plan as Finalized in May, 2010

Delaware USDA/APHIS Farm Bill Plum Pox Virus Survey 2010

Sampling ~1000 samples x 2 = 2000 samples total (replicated twice)

Delaware does not have foundation trees or trees from which budwood is taken. Sampling at a 25% rate for other trees. Orchards that will be contacted include:

Sussex County

Orchard – 80 – 100 acres **Approx 372 samples**

Orchard – 20 – 40 acres **Approx 124 samples**

Kent County

Orchard – 80 – 100 acres **Approx 372 samples**

Orchard – 10 acres **62 samples**

Orchard – 10 acres **62 samples**

New Castle County

One Orchard < 10 acres **50 samples**

Contacts – contact info, maps, gps, tentative dates, spray re-entry, etc
Sampling in field Monday and Wednesday

Field sampling 25% Hierarchical sampling (Sampling strongly influences results!)

Assume approx 100 trees per acre – sample 25% of trees in orchard (25 per acre)
Approx 6.2 four tree samples per acre (62 per 10 acres)
Ultimately 1000 bags brought in = sampling 167 acres in DE

Actual samples from trees into bags

Trees larger than 6 foot, symptoms?

Groups of 4 trees – Need to flag and tag trees, 24 per acre

16 leaves taken (4 per tree) for a total of 16 in a sample (tested in lab as 2 ELISA samples)

Sample all scaffolds on a tree (all major branches)

Take leaf samples mid-branch – pole pruners?

Storage and Transport

Store sample bags in cooler, not directly on ice blocks

Transport to Newark, put in refrigerator in 204 WOR Monday and Wednesday

Must store and be at cool temp ~4 C to begin ELISA

ELISA Weekly - Tuesday into Wednesday and Thursday into Friday

Tuesday – Day 1 9:00 AM ELISA

Coat plates, label bags and diagrams, make buffer, get ice, tear samples, grind in buffer
After 2:00 PM – Load plates

Wednesday – Day 2 9:00 AM ELISA

Prepare wash buffer, wash and proceed

Approx 1:00 PM read plates and make threshold determinations

Thursday – Day 1 ELISA

Friday – Day 2 ELISA

B. Rationale underlying survey methodology: Funds were used to conduct hierarchical surveys of a representative group of orchards throughout the state. There are approximately six to eight commercial growers in Delaware, so all grower orchards were sampled.

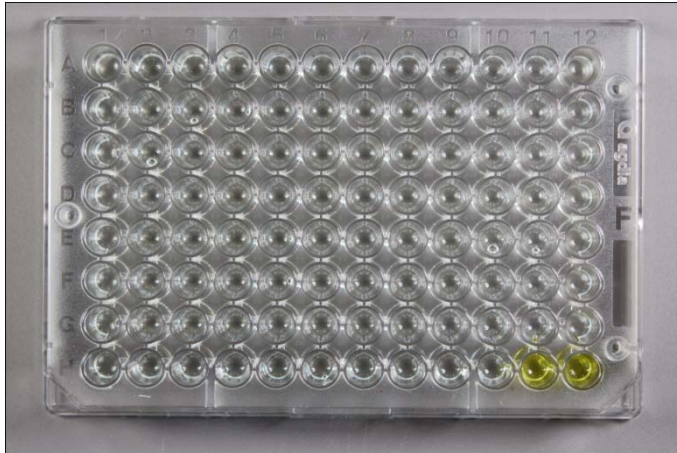
C. Survey dates: The survey for plum pox virus was conducted from May 10, 2010 through July 31, 2010.

D. Taxonomic Services: All sampled were processed by Nancy Gregory, University of Delaware Plant Diagnostician, using protocols developed and approved by USDA/APHIS/PPQ. Standard ELISA kits were purchased from Agdia, Inc., of Elkhart, IN. Any suspect positive samples from ELISA were to be sent to the USDA/APHIS National Molecular Diagnostics Laboratory in Beltsville, MD, but this was not necessary due to none with values over the threshold.

E. Benefits and Results of Survey: Criteria for accomplishments included the presence or absence of the plum pox virus in a representative sampling of Delaware peach trees, as detected by ELISA assays. 1,951 samples were processed over the length of the survey. The results indicated that all 1,951 test samples were below the threshold level for detection of plum pox virus by the ELISA assay. All positive

and negative controls responded correctly throughout all assays, indicating accurate testing methodology and results. Test panel results for the USDA were also submitted correctly, indicating proficiency in testing protocols. These results indicate that plum pox virus was not detected in peach trees throughout Delaware. These results ensure the safety for shipping and consumption of peaches grown in Delaware, and the orchards from which they were harvested.

Example of ELISA plate with positive control in lower right and all other wells negative:



Sample data file below from plate reader values in ELISA plate:

Plate: PPV2010 1 Date Created: 5/13/2010 12:10:22 PM

DE-KC-PPV10-F-1 through 22, sampled 5/11/2010

Raw Data(405)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0.131 | 0.159 | 0.118 | 0.133 | 0.124 | 0.128 | 0.135 | 0.123 | 0.132 | 0.134 | 0.133 | 0.119 |
| 0.105 | 0.106 | 0.121 | 0.115 | 0.114 | 0.115 | 0.128 | 0.124 | 0.134 | 0.136 | 0.147 | 0.149 |
| 0.119 | 0.121 | 0.138 | 0.125 | 0.138 | 0.127 | 0.146 | 0.168 | 0.153 | 0.158 | 0.227 | 0.122 |
| 0.111 | 0.144 | 0.143 | 0.172 | 0.163 | 0.127 | 0.132 | 0.141 | 0.133 | 0.122 | 0.165 | 0.145 |
| 0.12 | 0.118 | 0.162 | 0.134 | 0.142 | 0.138 | 0.149 | 0.151 | 0.136 | 0.145 | 0.166 | 0.137 |
| 0.129 | 0.121 | 0.124 | 0.151 | 0.13 | 0.174 | 0.129 | 0.161 | 0.128 | 0.119 | 0.111 | 0.119 |
| 0.103 | 0.112 | 0.125 | 0.114 | 0.116 | 0.121 | 0.117 | 0.124 | 0.139 | 0.146 | 0.181 | 0.102 |
| 0.103 | 0.116 | 0.126 | 0.123 | 0.12 | 0.138 | 0.118 | 0.199 | 0.14 | 0.162 | OUT | ***** |

Threshold for suspect positive reading is 2 X Negative Control = .230

Positive control was bright yellow and values exceeded readable in wells 11H and 12H

F. NAPIS Database submissions: Program pest and date of submission NOTE: This information is available per state on the NAPIS web site. Plum pox virus. Data indicating negative test results for plum pox virus on peach and stonefruit, entered into NAPIS on 6/24/2010 and 8/6/2010. Data also entered into NPDN database through PDIS. Data entered 6/15/2010, 6/23/2010, 6/24/2010, 7/20/2010, 7/23/2010, 7/25/2010, and 7/27/2010.