UNIVERSITY OF DELAWARE | Cooperative Extension

COLLEGE OF AGRICULTURE & NATURAL RESOURCES

Delaware Plant Pathology Diagnostic, Field, and Survey Reports 2013

Nancy F. Gregory, Plant Diagnostician

Brian A. Kunkel, Extension IPM Specialist

Nathan M. Kleczewski, Extension Plant Pathologist

Department of Plant and Soil Sciences

University of Delaware

Barley Yellow Dwarf on Wheat

Boxwood Blight Symptoms on Foliage

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N. F. Gregory
Plant and Soil Sciences Dept.
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Cooperative Extension Bulletin

http://extension.udel.edu/ag/

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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

Contributors of funding or materials:

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ipmPIPE	DE Dept. of Agriculture

Acknowledgements

- Many thanks to the Farm Superintendant, Scott Hopkins (Newark Experiment Station) and Brian Hearn (Georgetown, Carvel REC) and their crews that maintained plot areas for us, including soil preparation, spraying, irrigation, harvesting, etc.
- Michael Cannon and Khanh Nguyen for general lab and field work, lima bean inoculum preparation, and data entry.
- Rodney Dempsey for all his help keeping the growth chambers working for downy mildew inoculum production.

The enclosed reports are a compilation of the plant pathology experiments and projects conducted in Delaware during the 2013 growing season. Information presented in these reports is not to be used as disease control recommendations, unless indicated. Reference to commercial products or trade names does not imply endorsement by University of Delaware Cooperative Extension. Contact your local Extension office for current information on disease control recommendations.

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

Delaware Department of Agriculture
Small Crops Research Initiative – Block Grant
First Annual Report 2013

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PROJECT TITLE: Field and Greenhouse Screens of Lima Bean Germplasm for Resistance to *Phytophthora capsici*, the Causal Agent of Lima Bean Pod Rot. T.A Evans, E.G. Ernest and N.F. Gregory. University of Delaware

ACTIVITIES PERFORMED: In summer 2013 ninety-two lima bean breeding lines were screened for resistance to downy mildew race F resistance at the UD research farm in Georgetown, Delaware. Forty-one of the lines were advanced breeding lines from the UD lima bean breeding program, which were also being screened for yield, maturity and quality characteristics in a separate trial. Of these lines, sixteen did not develop symptoms of downy mildew in the field and are presumed to be resistant. Some of the resistant lines, which also have desirable yield and quality characteristics will be tested in future years to confirm the 2013 results and screen for resistance to race E. The elite resistant lines will also be used as parents in the crossing program to develop additional breeding lines.
The remaining lines that were screened in the field were inbred lines that are the result of E resistant x F resistant crosses that are still segregating for E and F resistance. Twenty-two of these fifty-one lines did not develop symptoms of downy mildew and are presumed to be resistant. The resistant lines will be grown in the greenhouse to produce seed for screening in the field in 2014.

Table 1 - Disease Reaction Results for Individual Lines Screened for Downy Mildew Race F Resistance in the Field in 2013.

Line	Pedigree	Disease Reaction*
E x F Resistance Breeding Lines		
DE 0834B2E10 C	M-15 x Cypress	**N**
DE 0834B2E10 F	M-15 x Cypress	**N**
DE 0834B2E10 G	M-15 x Cypress	**N**
DE 0834B2E10 H	M-15 x Cypress	**N**
DE08034B2E12 B	M-15 x Cypress	**N**
DE08034B2E12 C	M-15 x Cypress	**N**
DE08034B2E12 D	M-15 x Cypress	**N**
DE08034B2E12 E	M-15 x Cypress	**N**
DE08034B2E12 F	M-15 x Cypress	**N**
DE08034B2E12 G	M-15 x Cypress	**N**
DE08034B2E12 H	M-15 x Cypress	**N**
DE08034B2E12 I	M-15 x Cypress	**N**
DE08034B2E12 J	M-15 x Cypress	**N**

DE08034B2E12 K	M-15 x Cypress	**N**
DE08034B2E12 L	M-15 x Cypress	**N**
DE08034B2E12 M	M-15 x Cypress	**N**
DE08034B2E12 O	M-15 x Cypress	**N**
DE08034B2E3 G	M-15 x Cypress	**N**
DE08034B2E3 J	M-15 x Cypress	**N**
DE08032C5F4 H	Cypress x M-15	**N**
DE08032C5F4 I	Cypress x M-15	**N**
DE08032C5F4 L	Cypress x M-15	**N**
DE 0834B2E10 A	M-15 x Cypress	**S**
DE 0834B2E10 B	M-15 x Cypress	**S**
DE 0834B2E10 D	M-15 x Cypress	**S**
DE 0834B2E10 E	M-15 x Cypress	**S**
DE 0834B2E10 K	M-15 x Cypress	**S**
DE08034B2E12 A	M-15 x Cypress	**S**
DE08034B2E12 N	M-15 x Cypress	**S**
DE08034B2E12 P	M-15 x Cypress	**S**
DE08034B2E12 S	M-15 x Cypress	**S**
DE08034B2E3 B	M-15 x Cypress	**S**
DE08034B2E3 C	M-15 x Cypress	**S**
DE08034B2E3 D	M-15 x Cypress	**S**
DE08034B2E3 E	M-15 x Cypress	**S**
DE08034B2E3 F	M-15 x Cypress	**S**
DE08034B2E3 H	M-15 x Cypress	**S**
DE08034B2E3 I	M-15 x Cypress	**S**
DE08034B2E3 L	M-15 x Cypress	**S**
DE08034B2E3 M	M-15 x Cypress	**S**
DE08034B2E3 N	M-15 x Cypress	**S**
DE08034B2E3 O	M-15 x Cypress	**S**
DE08034B2E3 P	M-15 x Cypress	**S**
DE08034B2E3 Q	M-15 x Cypress	**S**
DE08034B2E3 R	M-15 x Cypress	**S**
DE08032C5F4 A	Cypress x M-15	**S**
DE08032C5F4 B	Cypress x M-15	**S**
DE08032C5F4 C	Cypress x M-15	**S**
DE08032C5F4 E	Cypress x M-15	**S**
DE08032C5F4 F	Cypress x M-15	**S**
DE08032C5F4 G	Cypress x M-15	**S**
Advanced Breeding Lines		
DE0900701D	184-85 x DE0801304	**N**
DE0900703A	184-85 x DE0801304	**N**
DE0900802A	M-15 x DE0802705	**N**

DE0901101C	184-85 x DE0801502	**N**
DE0901101D	184-85 x DE0801502	**N**
DE0901201A	DE0801702 x B2C	**N**
DE0901201B	DE0801702 x B2C	**N**
DE0901302B	M-15 x DE0801501	**N**
DE0901601C	Celite Select x DE0801603	**N**
DE0900704A	184-85 x DE0801304	**N**
DE0900705C	184-85 x DE0801304	**N**
DE0900705E	184-85 x DE0801304	**N**
DE0901206D	DE0801702 x B2C	**N**
DE0901404B	M-15 x DE0801503	**N**
DE0801802B	PI 440807 x Cypress	**N**
DE0802702C	PI 534918 x M-15	**N**
DE0900302A	F-169 x FH 1072	**S**
DE0900603A	Cypress x DE0801701	**S**
DE0900604A	Cypress x DE0801701	**S**
DE0900604B	Cypress x DE0801701	**S**
DE0900701C	184-85 x DE0801304	**S**
DE0901101A	184-85 x DE0801502	**S**
DE0901204A	DE0801702 x B2C	**S**
DE0901204B	DE0801702 x B2C	**S**
DE0901204C	DE0801702 x B2C	**S**
DE0901204D	DE0801702 x B2C	**S**
DE0901502A	Celite Select x DE0802704	**S**
DE0901502B	Celite Select x DE0802704	**S**
DE0901601A	Celite Select x DE0801603	**S**
DE0901601B	Celite Select x DE0801603	**S**
DE0901805A	Celite Select x DE0801503	**S**
DE0901805B	Celite Select x DE0801503	**S**
DE0901805D	Celite Select x DE0801503	**S**
DE0901805E	Celite Select x DE0801503	**S**
DE0901902B	184-85 x DE0802701	**S**
DE0407905		**S**
DE0802102A	PI 534918 x Cypress	**S**
DE0802102B	PI 534918 x Cypress	**S**
DE0802102C	PI 534918 x Cypress	**S**
DE0802701B	PI 534918 x M-15	**S**
DE0802702A	PI 534918 x M-15	**S**

*Lines are marked as S=susceptible or N=no disease observed

Very little of the diverse lima bean germplasm which may carry resistance genes to *P. capsici* will flower and produce pods under Delaware's summer field conditions. Consequently much of the screening of diverse material for *P. capsici* resistance must be done in the greenhouse. In summer 2013, eleven lines were screened in the field at UD's Georgetown research farm for resistance to *P. capsici*. Two of the lines were susceptible checks, five lines were diverse lines that had not been tested before and were expected to produce pods under field conditions, the remaining four lines were diverse lines that had appeared resistant in past greenhouse or field screens. Results of the screening are presented in the table below.

Table 2 - Disease Reaction Results for Individual Lines Screened for *Phytophthora capsici* Resistance in the Field in 2013.

Line	Description	Reaction
PI 362772	greenhouse resistant	did not flower
PI 256405	greenhouse resistant	did not flower
1102-6	new line to test	minimal disease
1102-25	new line to test	did not flower
PI 162688	new line to test	susceptible
PI 476859	new line to test	susceptible
PI 347826	possible resistant	susceptible
PI 477041	possible resistant	susceptible
Cypress	susceptible check	susceptible
C-elite Select	susceptible check	susceptible

The two lines which had appeared to be resistant in past field screenings (PI 347826 and PI 477041), developed symptoms in the 2013 screen. Not unexpectedly the two lines identified as resistant in past greenhouse screens did not flower in the field under long day conditions, and we were unable to evaluate their reaction to the disease.

PI 362772 and PI 256405 will be screened in the greenhouse again in Fall/Winter 2013-14 to confirm their resistance reaction. These two lines will also be crossed to adapted susceptible lima lines in Fall 2013 to develop breeding populations that will be screened for resistance in the future. Attempts to make crosses with these lines in the greenhouse in Fall 2012 was unsuccessful so segregating populations will not be available for screening until Summer 2014.

PROBLEMS AND DELAYS: There were no problems or delays in the proposed research.

FUTURE PROJECT PLANS: An additional ten lines that were obtained from the USDA germplasm collection and are from the same regions as PIs 362772 and 256405 will be screened in the greenhouse in Fall/Winter 2013-14 for *P. capsici* resistance in an attempt to identify additional sources of resistance.

Crosses between PI 256405 (a putative *P. capsici* resistant line) and elite green baby lima lines were made in Winter 2013/2014. Seed from successful crosses will be selfed in the greenhouse in spring 2014. Individuals from the F_2 generation will be either screened in the field in 2014 or advanced by single seed descent (SSD) to obtain a later, more inbred lines to screen for resistance; this may be desirable if the trait is controlled by multiple genes. Development of multiple lines through single seed descent will also allow us to obtain more material with a bush growth habit, which should not be photoperiod sensitive in the field. Depending on the success of field screening in 2014 we will attempt greenhouse screening of some segregating lines in Fall 2014. Because of the difficulty in working with Fordhook types, backcrossing *P. capsici* resistance genes into Fordhook limas will be initiated after the heritability of the trait has been confirmed in the baby lima crosses described above.

Field screening of advanced breeding lines, and segregating populations for resistance to races E and F of downy mildew will continue in 2014. Additional crosses between E and F resistant baby lima breeding lines will be made in Winter 2013/2014 and the F_2 progeny of these crosses will be screened for resistance to races E & F in the field and greenhouse in summer and fall 2014. We also hope to be implementing marker assisted selection for race F resistance, which will be helpful in identifying a line where repulsion linkage between the E and F resistance genes has been broken.

Significant results from work in 2013 and 2014, such as identification of new *P. capsici* resistant lines, characterization of *P. capsici* resistance heritability, and progress in *P. phaseoli* resistance breeding will be presented to interested audiences in the following venues:

Fruit and Vegetable Growers Association of Delaware Annual Education Meeting (Jan 2015) and planned Lima Bean Forum (Dec 2014) -- Lima bean growers, crop consultants, seed company representatives and vegetable processors

Bean Improvement Cooperative Annual Report (2015) – bean breeders (public and private)

Regional (Potomac) meeting of the American Phytopathological Society (2014) – plant breeders, plant pathologist, Extension professionals

USDA/APHIS CAPS FY2013
Delaware Survey for Karnal Bunt of Wheat
Final Report

Cooperators: University of Delaware

State: Delaware

Project: Survey for Karnal Bunt of Wheat, July 2013

Project Coordinators:

GREGORY, N.F., Department of Plant and Soil Sciences, University of Delaware, Newark, DE, 19716-2170, phone: 302-831-1390 or 302-831-2548; FAX: 302-831-0605, **ngregory@udel.edu**

I. Introduction

Karnal bunt is a fungal disease of wheat and triticale (a hybrid of wheat and rye). The disease is caused by the fungus *Tilletia indica* Mitra. Typically, only a portion of the wheat kernel is affected, hence the disease is also called partial bunt. The disease is most severe when the weather is cool and wet at the time the wheat is heading out. The first discovery of Karnal bunt in the United States was in Arizona in March, 1996. Additionally, limited wheat growing areas of California, New Mexico, and Texas were regulated because of association with Karnal bunt infected seed or grain produced in the infested areas in Arizona. In succeeding years in the regulated areas, Karnal bunt was found at low levels, but not found in national surveys of other wheat growing counties in the United States. In the harvest season of 2001, wheat fields in additional Texas counties were found to be infested. Regulatory quarantines were further imposed to protect US wheat export markets. Karnal bunt has minimal effect on quality and yield of wheat. The disease can be managed by use of clean seed, seed treatment and appropriate agricultural practices. The processing of grain used for consumption often kills *Tilletia* spores and grain used for consumption is not a risk for the spread of Karnal bunt. A survey and laboratory examination of Delaware harvested grain has been done every other year to detect any possible infestation with *Tilletia*, and support the ability of Delaware to grow, market, and export grain.

II. Methods and Results:

Composite samples of wheat grain harvested in all three counties of Delaware were sampled for the presence of Karnal bunt between June 20 and July 30, of 2013. The protocol for wheat grown for grain in Delaware called for an examination of the grain for bunted kernels. Five samples representative of all three Delaware counties were collected by the staff of the Delaware Department of Agriculture at Delaware grain mills, comprising a composite of all wheat from Delaware growers. Processing of samples within Delaware was done by the University of Delaware Plant Diagnostician in Newark, according to the protocol found in the most recent APHIS-PPQ Karnal Bunt Survey Procedures Manual. The protocol included handling of samples in a reception area, followed by analysis in a lab under clean conditions. One 500 ml aliquot of grain from each 4 pound sample was examined using a stereomicroscope for the presence of bunted kernels. No kernels were found that appeared bunted. There were low levels of scab caused by *Gibberella zeae* (*Fusarium graminearum*), ranging from 2 to 6 % in samples. No samples were sent to the USDA/APHIS PPQ National Identifiers (John McKemy and Megan Romberg) in Beltsville. All results were recorded and the State Survey Coordinator entered data into NAPIS database. All material was disposed of as per project guidelines.

No *Tilletia indica* infected kernels were observed in any of the samples, microscopic observation data as follows:

DE-101- Sample DE-N-2013-101 – Mountaire Farms, Townsend, DE, New Castle County **– no Karnal bunt**, 3% scab, < 1% black point. Vomitoxin level 6.5 ppm.

DE-102- Sample DE-K-2013-102 – Mountaire Farms, Harrington, DE, Kent County **– no Karnal bunt**, 6% scab, < 1% black point, some seed germinating. Vomitoxin level 4.8 ppm.

DE-103-Sample DE-S-2013-103 – Perdue Grain, Seaford, DE, Sussex County **– no Karnal bunt**, 4% scab, < 1% black point. Vomitoxin level 5.3 ppm.

DE-104- Sample DE-S-2013-104 – Mountaire Farms, Millsboro, DE, Sussex County – **no Karnal bunt**, 3% scab, < 1% black point. Vomitoxin level 4.3 ppm.

DE-105- Sample DE-S-2013-105 – Perdue Grain, Bridgeville, DE, Sussex County, **no Karnal bunt**, 7% scab, <1% black point. Vomitoxin level 7.5 ppm.

Approved and signed by:

_  **_ Date:___08/05/2013___________**
Cooperator

________________________ Date:______________________
ADODR

2013 ipmPIPE Downy Mildew on Cucurbits Sentinel Plot Report

Delaware component: Nancy Gregory, Diagnostician
Emmalea Ernest, Extension Agent, Vegetables
Nathan Kleczewski, Extension Plant Pathologist
UD Cooperative Extension
University of Delaware

OTHER COOPERATORS (alphabetical by state/province):
Alabama: Ed Sikora
Delaware: Nathan Kleczewski, N Gregory
Florida: Amanda Gevens
Georgia: David Langston
Illinois: Mohammed Babadoost
Indiana: Dan Egel
Kentucky: Kenny Seebold
Louisiana: Don Ferrin
Maryland: Kate Everts
Massachusetts: Rob Wick
Michigan: Mary Hausbeck
Mississippi: David Ingram
New Jersey: Andy Wyendant
New York: Meg McGrath
North Carolina: Gerald Holmes
Ohio: Sally Miller
Oklahoma: John Damicone
Ontario: Elaine Roddy
Pennsylvania: Beth Gugino
South Carolina: Anthony Keinath
Tennessee: Steve Bost
Texas: Tom Isakeit
Virginia: Steve Rideout
Wisconsin: Alyson Thornton

Project Objective
The 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. Samples of infected material were forwarded on to North Carolina when collected.

Methods:
Seed of nine cucurbit differentials were sown 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: 7/29/2013 - ‘Straight Eight’ cucumber
Georgetown Sentinel Plot : 7/8/2013 - on ‘Straight Eight’ cucumber

The first report in Sussex County, DE was made on 6/25/2013 on cucumber, with first reports in MD and NJ on 6/24/13 and 7/5/13 respectively. Cucurbit downy mildew was widespread in the region by 7/26/13. Cucurbit downy mildew was observed on pumpkin, watermelon, cantaloupe, and butternut squash by 8/5/13.

Basil Downy Mildew Monitoring Program, ipm PIPE – 2013 Report

Nancy F. Gregory, Extension Plant Diagnostician, UD Cooperative Extension, Newark, DE
Emmalea Ernest, Extension Agent, Georgetown, DE

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 in 2009 and has continued yearly 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.

2013 Results

In 2011 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, including Delaware, in 2011, 2012, and 2013.

Two monitoring sites were established in Delaware in 2013, 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 not detected at the Newark location or the Georgetown site in 2013.

DDA Specialty Crops Block Grant 2010-2013 Final Report
PROJECT TITLE: Study of Rhabdocline Disease Resistant Douglas Fir Trees
H. James Landis

USDA/AMS award agreement: 12-25-1059
Third Year and Final Report - 2013

PROJECT SUMMARY:
Rhabdocline needlecast fungus has infected many Delaware Christmas tree plantations in the past ten years, with losses from moderate to severe. The fungal infections have been controlled by the use of the fungicide chlorothalonil, but its use significantly increases the cost of growing Douglas fir. The Douglas fir is one of the most popular fir trees and demand is quite strong from Delaware consumers. Most Delaware Christmas Tree growers' prefer to use the seed from the Lincoln NF located in the Southern aspects of the Rocky Mountain Range. Seedlings grown from this seed source have had incidence of fungal infection.

Written, verbal, pictorial reports have indicated that Douglas fir that has seed taken from the Mid-Rocky (Deep Mountain) to the extreme Northern Rocky mountain range (Schuschwap Lake) are less susceptible to infection by the Rhabdocline needlecast fungus. This project was designed to evaluate whether these two (2) seed source Douglas fir trees would be more or less resistant or susceptible to Rhabdocline than Douglas fir trees coming from the Lincoln NF seed source. Regardless of needlecast, Lincoln NF source trees appear superior.

PROJECT APPROACH:
It has been the experience of the Delaware Christmas Tree Growers' that Rhabdocline infection is most visible and prevalent in older trees. As a result it was determined to purchase balled & burlaped (B&B) Douglas fir trees in the 5' to 6' range. The trees were older and hardier than seedlings or transplants. A plan was developed to make purchases of Douglas fir trees from each seed source to be evaluated. With tree growers' in each of Delaware's three counties it was determined to establish a test farm in each county (New Castle, Kent, and Sussex). Each farm chosen had evidence of the Rhabdocline needlecast infection in years prior to this project. Soil testing was also done at each test site and soils found to be acceptable for growth of Douglas fir. Orders and delivery schedules of 252 Douglas fir trees was made in January of 2011. Each test site was to receive 84 trees (28 of the Lincoln seed source, 28 of the Deep Mountain seed source, and 28 of the Schuschwap Lake seed source). Lincoln trees came from Pennsylvania, and the Deep Mountain and Schuschwap Lake trees came from Michigan. The suppliers of these trees were reputable firms.

Working with Nancy Gregory of the University of Delaware Cooperative Extension Service growers developed a planting grid for the position of each tree from each seed source. A plot plan consisted of four rows of trees with 21trees in each row, alternating each seed source specimen. Thus row one would start with a Lincoln and end with a Schuschwap; row two starts with a Schuschwap and ends with a Deep Mountain; row three begins with a Deep Mountain and ends with a Lincoln; row four starts with a Lincoln and ends with a Schuschwap. This plan was designed to expose the trees randomly to Rhabdocline infection.

All of the trees were delivered to the New Castle County test farm in Townsend, DE. At that location a tractor with a loader attachment was available to move the trees from the transport trucks to the ground. Trees were delivered on April 26 and April 27, 2011. Each balled & burlaped tree weighed in at an average of 275 lbs. Then, 168 trees were moved to the two other test sites in Kent and Sussex counties. All 252 trees were planted over a period of about two weeks at all three test sites. It was attempted to plant the trees where the top of the balled root system was even with the ground. After planting, each tree was assigned a number via a tagging system that identified the seed source of the tree, its actual tree number, and the farm on which the tree was located. This was done so as to track the history (disease problems, insects, hardiness, horticultural characteristics, etc.) of the tree during this project.

On May 20, 2011, a visit from the University of Delaware Extension Service with a Plant Pathologist (Nancy Gregory) and an Entomologist (Brian Kunkel) visited all three farms and concluded that the trees we received were healthy and free of disease. Furthermore it was determined that in May and October of each year of the project these same personnel would inspect and report on health and status of the trees in the experimental plots. Many thanks go to the University of Delaware Extension Service specialists for their valuable assistance with this project.

GOALS AND OUTCOMES ACHIEVED:
The project was designed to be one of a long-term basis. It was because of this that several inspections by the University of Delaware Extension Service were scheduled as follows: October 2011, 2012, 2013, and May of 2012 and 2013, examining test trees planted in May of 2011. All inspections were made as first scheduled and the inspection team remained constant throughout the entire project.

As previously stated the first inspection was made on May 20, 2011. This was done to assure the trees we received were healthy and disease free, and such was the case.

The second inspection was done on October 11, 2011. There was no evidence of any active diseases but overall there were ten dead trees and ten trees put on a “watch” list due to some dying shoots or questions of hardiness. It was suspected that the cause of the dead trees may have been due to the planting process, establishment, or drought conditions that prevailed over the summer.

May 10, 2012, was the next inspection –the 3rd. There was no evidence of fungal infection by Rhabdocline. This inspection reported ten dead trees and sixteen trees put on the “watch” list. The “watch” list trees included hardiness symptoms such as color, dead shoots, and some indication of potential disease. Samples taken from a few of the trees on the “watch” list proved to be negative for any disease. A point of note here is that other than dead trees the trees on the “watch” list are just about even with regard to the seed source origin, or cultivar.

At the next inspection of October23, 2012 there were a few more dead trees from the Lincoln and Deep Mountain sources. Three trees (one from each seed source) looked like there might be some fungal infection, but tests were negative; and four trees across all of the tree types were put on the “watch” list for hardiness and color.

The May 16, 2013, inspection revealed an invasion of not the Rhabdocline, but that of SWISS NEEDLECAST fungal infection – equally a threat to the health of Douglas fir trees. Numerically this is what the outcome of the May 2013 inspection revealed:

Swiss Needlecast Infected trees:

- Farm #1 - 57 out of 75 trees were infected or 76%
- Farm #2 - 49 out of 73 trees were infected or 67%
- Farm #3 - 25 out of 79 trees were infected or 32%

More infection was found on the trees from the Schuschwap seed source and the least from the Lincoln. The Farm #3 in Sussex County had the least amount of infection and the Farm #1 in New Castle County had the most. All farms had 2 trees each that were put on the “watch” list for Rhabdocline Needlecast infection but incubation in the lab proved negative.

October 22, 2013, inspections were done on test sites #3 and #2 (Sussex and Kent Counties respectively). The intensity of this evaluation was more detailed and site #1 (New Castle County) was done a few days later on October 25, 2013. It was decided that for this evaluation we would take each remaining tree’s seed source, assign an average Overall Tree Rating at the date of inspection, an average Rhabdocline Tree Rating, an average Swiss Needlecast Rating and an average Final Tree Rating for each farm, again as of the evaluation date. This type of data was the best way to disseminate findings. Following are results for numbers of trees, in parentheses:

SEED SOURCE	AVG. OVERALL TREE RATING	AVG.RHABDOCLINE RATING	AVG.SWISS NEEDLECAST RATING	FINAL RATING
FARM #1 (Sussex County)				
Lincoln(24)	1.17	0.00	1.00	2.13
Deep Mtn.(24)	2.43	0.00	1.04	3.50
Schuschwap(24)	2.48	0.00	1.13	3.36
FARM #2 (Kent County)				
Lincoln(20)	1.05	0.05	0.85	1.95
Deep Mtn.(26)	2.12	0.08	0.85	3.19
Schuschwap(26)	1.73	0.04	0.69	2.42
FARM #3 (Sussex County)				
Lincoln(24)	1.75	0.08	.917	2.83
Deep Mtn.(21)	2.52	0.00	1.19	3.71
Schuschwap(24)	2.63	.167	1.08	3.13

In summary, The Lincoln tree appeared the best in overall rating over the length of our evaluation. The Schuschwap followed by the Deep Mountain were rated second and third respectively. The presence of Rhabdocline was not confirmed over the course of the experiments. The hypothesis of our experiment to expect Rhabdocline Needlecast disease on the Lincoln trees and to a lesser extent, or even non-existent on the Deep Mountain and Schuschwap has not been proven. The highpoint of our investigation was that even though the Lincoln seed source tree may be susceptible to needlecast, the Lincoln tree cultivar was hardy, the best horticultural cultivar, and the most saleable Douglas fir in the test plots, regardless of the County.

IMPACT TO STAKEHOLDERS:
The Delaware Christmas Tree Growers' Association and the University of Delaware Cooperative Extension Service have collaborated and participated in this project, and kept stakeholders informed and updated as to results. Dr. Rick Bates of the Penn State Horticultural Department has had input on this project. We will write and publish the findings of this project. CHRISTMAS TREES MAGAZINE, our "Trade Publication" will take our findings to their national subscriber list. We will work with the University of Delaware to arrange publication of results.

DISCUSSION:
Douglas fir from the Lincoln seed source is the most saleable tree cultivar; however fungicides must be applied to control needlecast fungi, including Rhabdocline and Swiss needlecast caused by *Phaeocryptopus*.

Ordering larger trees seemed to be the way to initiate the project, but moving and planting of the trees was difficult. Uneven planting depth for each tree is another reason to start with smaller trees.

An unexpected impact of this project was the Swiss Needlecast Fungus that attacked these Douglas fir trees. No matter what the tree seed source, all trees sustained infection by *Phaeocryptopus*, showing it to be a more severe problem currently in the coastal region of the Mid-Atlantic States. The entomologist from the University of Delaware Extension Service found little, if any, insect problems with any of the test trees. The hypothesis of predicting Rhabdocline Needlecast on Lincoln trees, with resistance by the others was not proven. Weather was a factor over the three year study, with initial drought conditions and recent record rains and saturated soils. One more May 2014, inspection is planned.

CONTACT PERSON:
H James Landis
P. O. Box 116
Harbeson, DE 19951
E-mail: landistreefarm@aol.com

Nematode Assay Service 2013 Annual Report
Delaware Cooperative Extension
Department of Plant and Soil Science
University of Delaware

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

The Nematode Assay Service (NAS) at the University of Delaware 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 of MD and PA that no longer offer nematode analyses. Delaware agreed to receive soil samples from clients that utilized those labs. The clinic operates with two staff, the Extension Plant Pathologist, retired, and the Plant Diagnostician, who prepares samples for reading and does soybean cyst egg counts. Currently the fee structure is $20.00 for a full larvae screen, with additional fees for fruit samples and soybean cyst nematode (SCN) egg counts. Fees are the same for both in-state and out-of-state clients.

In addition to regular soil and root extractions of nematodes, screening is done for foliar nematode, and pinewood nematode using extractions from suspect plant parts.

In 2013, the NAS processed 501 for fee samples submitted for analysis, 243 of which were from Delaware locations. Two hundred fifty-eight (258) or 51% of the samples submitted did not originate from Delaware, but instead from Maryland, Pennsylvania, Virginia, and New York. Included in the total samples were approximately 80 paid research samples that were part of nematode screening for Cooperative Extension research projects. The projects included a fruit tree nematode control study in Maryland and an ipm soil health project in Sussex County, DE. Approximately ten plant samples came in through the Diagnostic Clinic routine sample queue with damaging levels of plant parasitic nematodes, including soybean cyst nematode and root knot nematode on several host species.

Of the 501 for fee samples submitted for analysis, the crop sources for these were:

Field crops	279	55 %
Fruit	93	19 %
Vegetables	66	13 %
Ornamentals	29	6 %
Turf	7	1 %

One hundred and thirty-five (135) or 27 % of the samples had nematode levels that were determined to require some control measure. Some actual thresholds were not exceeded, but nematodes present may vector viruses, especially in fruit such as grape. Other reports indicating control would be necessary included acacia in greenhouse conservatory locations, where nematode control at low levels may be better than allowing populations to build.

Nematode species detected in numbers that required control were the soybean cyst nematode, *Hederodera glycines*; southern root knot nematode, *Meloidogyne incognita*; lesion nematode, *Pratylenchus penetrans*; dagger nematode, *Xiphinema* sp., spiral nematode *Helicotylenchus* sp., stunt nematode, *Tylenchorhynchus* sp., and the spiral nematode *Scutellonema* sp. Root knot nematodes were detected causing stunting and yield loss on soybeans, lima beans, cucurbit crops and field crops. Some soils from ornamental plantings also had above-threshold numbers of root-knot. Dagger nematodes (*Xiphinema* sp.) were found at damaging levels in numerous samples that were to be planted to wine grapes. Even low levels of dagger nematodes are of concern in grapes and fruit trees due to the vectoring of plant viruses.

Final reports were saved in an Excel file that can be printed and faxed, or e-mailed to the submitter. Threshold guidelines, control recommendations and fact sheets were included with reports when appropriate.

NCERA -224: Arthropod Pests & Diseases of Ornamentals: Delaware & SE PA
2012-2013 Report

University of Delaware Cooperative Extension:
Brian Kunkel & Nancy Gregory

Regional Weather:

Overall the total precipitation for each county for Delaware was slightly above normal this past year. The wettest months of the year were June, July and August.

Table 1. Total precipitation for Delaware over past year (November 2012- November 2013)

County	Precipitation (inches)	Departure from Normal (inches)
New Castle	46.6	+2.5
Kent	48.5	+4.5
Sussex	49.7	+4.8

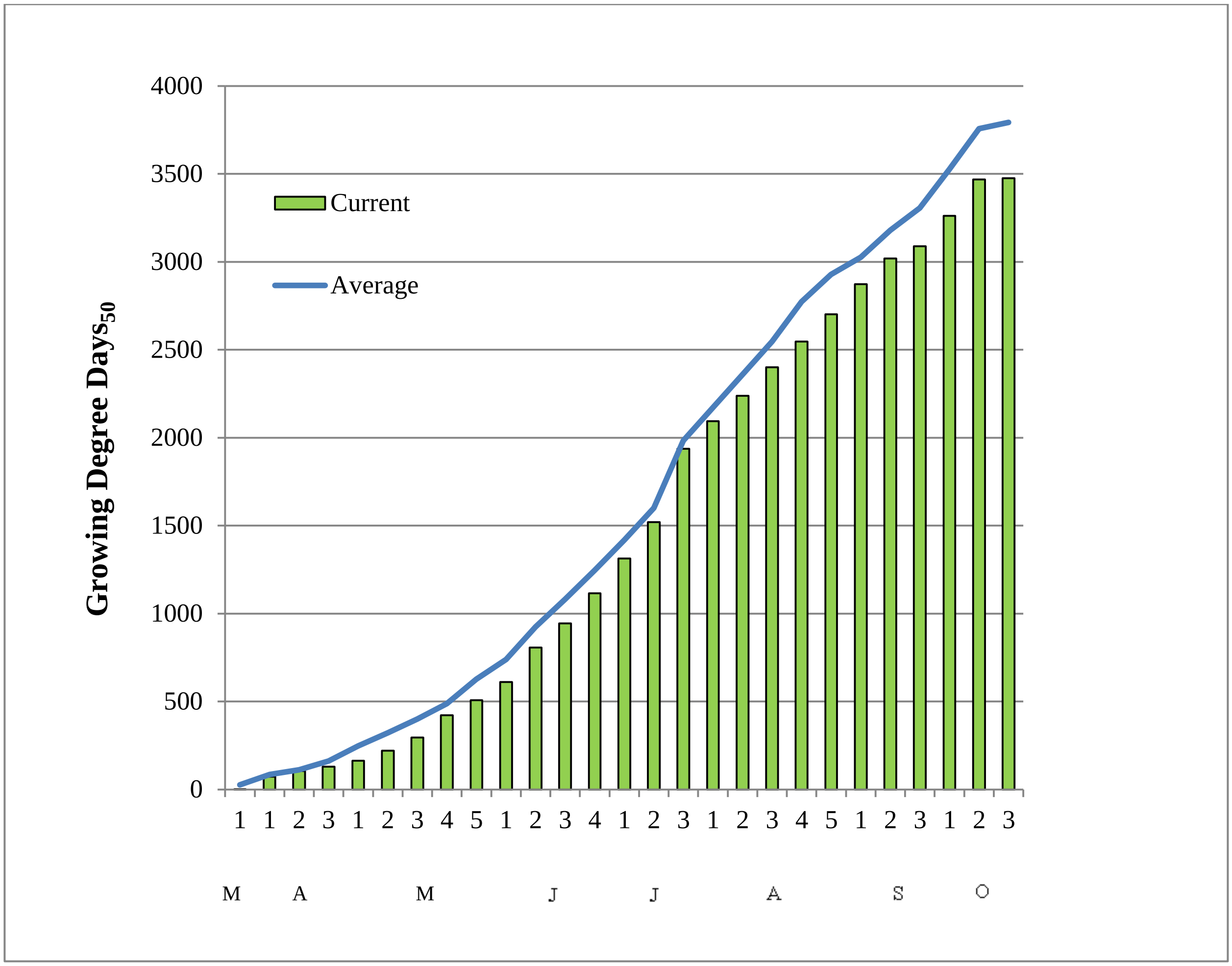
The abundance of rainy days provided challenges for managing pests because there were fewer opportunities to make applications during key times in the growing season (Table 2).

Temperatures were below historical averages throughout the state as illustrated in the graph below using accumulated growing degree days (GDD_{50}) starting on 1 March 2013 in New Castle County (Fig. 1). March through early June saw GDD about a week to ten days behind the average and after approaching normal GDD around mid-July, the year remained cool and behind a week or so.

Table 2. Spring – Summer precipitation for 2013 (March – August)

County	Precipitation (inches)	Departure from Normal
New Castle	31.1	~30% above
Kent	30.8	~30% above
Sussex	31.6	~30% above

Figure 1. GDD_{50} for 2013 compared against historical average GDD_{50} (2006 – 2011)



Insect and Disease Highlights:

Insects

This year was a fantastic year for many non-pest caterpillar species such as: *Actias luna* (**Luna moth**), *Acharia stimulea* (**Saddleback moth**), *Hemaris diffinis* (**Snowberry clearwing**), *Hemaris thysbe* (**Hummingbird clearwing**), *Orgyia leucostigma* (**White-marked tussock moth**), *Pyrrharctia isabella* (**Isabella Tiger moth**; larvae called **woolly bears**), and *Eumorpha pandorus* (**Pandorus sphinx**). Caterpillar pests such as *Malacosoma americanum* (**Eastern tent caterpillars**) and *Hyphantria cunea (F*all webworms**)** were not as common as the past few years. *Podosesia syringae* (**Lilac**/**Ash borer**) emergence holes were confused to be emerald ash borer attacks on ash trees (New Castle and Sussex counties). We still have not found emerald ash borer in Delaware. **Bagworms**, *Thyridopteryx ephemeraeformis, and Manduca quinquemaculata (Five-spotted hawk moth; larvae called tomato hornworms) were commonly found this past growing season in all counties.*

Soft scales such as *Ceroplastes ceriferus* (**Indian wax scale**), *Toumeyella liriodendri* (**Tuliptree scale**), and *Pulvinaria* scales (**Cottony Taxus/Camellia Scale, Cottony Maple Scale**), *Parthenolecanium corni*, *P. fletcheri*, and *P. quercifex* (**European fruit lecanium**, **Fletcher**, and **oak lecanium** respectively) were sent to the lab for identification this year. *Ceroplastes* spp. and *Pulvinaria* spp. scales were submitted as late as early November this year. We are uncertain if this is an increase in abundance or if professionals are finally recognizing which hosts they are most frequently found. Samples brought into the diagnostic lab, extension offices or phone calls, suggested scale activity was later than previous years for most scale species and was probably the result of cooler temperatures.

Many armored scale samples were diagnosed this summer including *Chionaspis pinifoliae* (**pine needle)**, *Fiorinia externa* (**elongate hemlock**), *Aspidiotus cryptomeriae* (**cryptomeria**), *Pseudaulacaspis prunicola* (**white prunicola**), *Lepidosaphes pallida* (**Maskell**), *Pseudaulacaspis pentagona* (**white peach**), *Carulaspis juniperi* (**juniper**), and *Lopholeucaspis japonica* (**Japanese maple**) scales. Landscape companies continue to report white prunicola scale and Japanese maple scale are among their most common and difficult pests to manage.

Other sucking insect pests such as **whiteflies**, **aphids** and **mealy bugs** were minor problems reported during the year. Greenhouse managers still encounter high populations of *Frankliniella occidentalis* (**Western flower thrips**). **Apple mealybug** continues to be a challenge to manage on native azaleas, *Kalmia* and *Fothergilla*, especially when these hosts are planted near streams or are located in low lying areas with high water tables.

Nurseries in the mid-Atlantic continue to struggle with **redheaded flea beetle** control; however this year beetle populations decreased sharply after mid-July and may be related to abundant rainfall. *Atomacera decepta*, **hibiscus sawfly**, *Macremphytus tarsatus* (**dogwood sawflies) and roseslug sawflies** were very common in landscapes this year causing considerable damage on their respective hosts. Other minor pests encountered this year include, **boxwood leafminer**, and **carpenter bees**. Bark beetles were reported at various times during the year throughout Delaware. **Bark beetles** included *Xylosandrus germanus*, *X. crassiusculus*, *Ips* among others. **Japanese beetle** populations were more abundant this summer and emerged about seven to 10 days earlier than previous years. **White grub** management was of greater concern this year for landscape contractors and homeowners.

Select Invasive species

Scouting for **emerald ash borer** continues in Delaware and none have been found to date. **Brown Marmorated Stink Bug** (*Halyomorpha halys*) populations were very low until mid-August.

Diseases

Ornamentals constituted over 50 % of the total of approximately 675 samples. Of the 370 ornamental plant samples, **physiological** or **environmental stress** was a factor in 170 samples, while insects were the problem or a factor in 68 samples. Many landscape ornamentals newly planted in the past 2 or 3 years suffered from environmental stress, often leading to further issues with disease organisms and insects. Excessive rains in the spring and early summer led to **saturated soils** and problems with **root rot** and **establishment of good root systems**. Holly and juniper with ***Pythium*** or **Phytophthora** root rot were common. **Anthracnose** was common on hardwoods in the spring, but trees leafed out again in a few weeks. **Gymnosporangium** rusts were severe on Rosaceous hosts such as hawthorn and serviceberry.

New Reports – Numerous boxwood samples were submitted. **Boxwood blight** caused by *Cylindrocladium* was positively confirmed, first in a nursery site where all plants were destroyed, but later in a residential setting. **Impatiens downy mildew** continued to be a problem on *Impatiens walleriana* and *Impatiens balsamina*. A **downy mildew** was confirmed on *Viburnum*, caused by a *Plasmopara sp*. **Stigmima lautii** was confirmed on spruce.

Pathogens of regulatory significance – **Chrysanthemum white rust** was identified in two retail locations in Dealware and plants were destroyed. Several plants sampled as a part of two trace forwards for ***Phytophthora ramorum*** were tested serologically and were negative for *P. ramorum*.

Swiss needlecast has become a predominant problem on Douglas fir in Christmas tree and landscape plantings. **Phytophthora root rots** have been widespread due to excessive rains and saturated soils in the spring and summer. **Rose rosette disease** continues to spread to cultivated and hybrid rose plantings.

Some common turf diseases included **red thread** and **brown patch** during the summer. Other diseases reported during the growing season included: **Forsythia blight**, ***Phomopsis*** and ***Kabatina* tip blights**, ***Monolinia* blight**, **fairy ring**, **daylily leaf streak**, **azalea leaf gall** and **bacteria leaf scorch**.

2012-2013 Publications & Notables

Kunkel and Gregory contributed weekly columns on insects and diseases to *Ornamentals Hotline*, a grower newsletter published and distributed by University Delaware Cooperative Extension to over 150 subscribers. Kunkel was interviewed by local newspapers about various insect pests. Kunkel and Gregory continue to work on updating and creating new fact sheets for professionals in the mid-Atlantic region.

The Ornamentals Task Force at the University of Delaware continues to offer training sessions for green industry professionals at their business. The disease and entomology workshops are provided to Delaware green industry professionals in addition to “pest walk” tours in New Castle and Sussex counties. Kunkel and Gregory continue to work with Delaware Christmas tree growers on a project evaluating new Christmas tree variety susceptibility to insects and diseases of the area. Guest speakers were brought to a spring workshop for additional perspective on common Christmas diseases.

Master Gardener training was also conducted by Kunkel and Gregory.

2012 -2013 Research Highlights:

Summary of Brown marmorated stink bug (BMSB; *Halyomorpha halys*) project:

- Searched herbaceous perennials nurseries and production areas at public gardens in DE, MD, and PA for BMSB eggs, nymphs and adults

- BMSB populations were seldom encountered until mid-July; populations on plants after mid-July were still very low (average < 5/plant inspected)
- Observed native and non-native plants for BMSB populations this year
- Little evidence of predation or parasitism on the few egg masses or nymphs found on herbaceous perennials this summer

2012-13 Impact statements

About 40% of professionals attending a recent ornamentals workshop stated they learned more about reduced risk products and the new product labels being released regarding bee health.

Turf professionals (~12%) attending a recent turf workshop stated they intended to begin incorporating IPM practices into their business model as a result of the new information. Another 20% claimed to already utilize IPM practices for turf, and still found new useful information regarding beneficial arthropods and cultural practices.

All Christmas tree workshop attendees answering a post-workshop survey felt they learned a great deal about Christmas tree diseases and would like to receive a greater in depth review of insects important to Christmas trees. About 80% of survey respondents stated they intended to change some of their management practices based upon information provided at the workshop.

The University of Delaware Plant Diagnostic Clinic and the National Plant Diagnostic Network
Impact Statement December 2013, Nancy F. Gregory

Issue: Delaware preparedness for detecting new plant pests and pathogens, and capability to providing a rapid response, in order to safeguard Delaware's agricultural industries and landscapes.

Response: The National Plant Diagnostic Network is a part of the Food and Agriculture Defense Initiative within USDA-NIFA, and the UD Plant Diagnostic Clinic is the Delaware NPDN lab. The NPDN provides a nationwide network of agricultural institutions (Land Grant Universities and State labs), a cohesive system to quickly and accurately detect high consequence pests and pathogens, identify them using best methods, and rapidly communicate and report to appropriate responders and decision makers. The mission of the NPDN requires response to agricultural security emergencies and diagnostic data security and consistency.

As a Land Grant NPDN lab, cooperating with the Delaware Department of Agriculture, the UD Plant Diagnostic Clinic plays a major role in detecting and diagnosing important plant pathogens, arthropod pests, nematodes, and weeds. The Clinic is called upon to test samples collected in delimiting or tracing Federal surveys (USDA APHIS CAPS). In addition to the role with NPDN, the UD Plant Diagnostic Clinic has a primary mission to provide testing services and education for agricultural clients in Delaware and the region through Cooperative Extension.

Program Impacts 2013:

1. Over 750 samples were processed in 2013 and data uploaded to the National Repository. Five (5) first occurrences of pests, pathogens or weeds were reported to USDA/APHIS PPQ in the annual permit report. Regulatory detections included chrysanthemum white rust and boxwood blight.
2. A trace forward survey of the nursery stock for *Phytophthora ramorum* resulted in testing of 10 specimens received from positive nurseries on the west coast, all of which proved negative for the pathogen, thus ensuring the safety of nursery stock received in Delaware for planting.
3. A USDA APHIS survey of Delaware wheat grain for the karnal bunt pathogen was negative for all grain examined. Testing of composite grain samples from all facilities in Delaware ensures the ability of Delaware producers to market their grain domestically and abroad.
4. Recipient of a second year Farm Bill award (2013-2014) for the continuation of work on fungal nomenclature for national databases for NPDN, NAPIS, and other safeguarding entities. The nomenclature work ensures that data is accurate for all laboratory management systems across the U. S. and the territories. The work is 80% completed, offering consistency between NPDN, NAPIS, USDA APHIS and USDA ARS.
5. Communication and outreach included First Detector training of 30 new Master Gardeners, web site and social media updates, pest alerts, Ornamentals Hotline, news articles, and face to face interactions. Professional development through national webinars was communicated back to Extension personnel and other stakeholders, ensuring that all stakeholders received sampling and identification information regarding new pests.

a. A Master Gardener submitted the first state detection of boxwood blight, based on training she received through Cooperative Extension.
b. Delaware Cooperative Extension promoted the Ask an Expert feature of eXtension at the DE State Fair. Nancy answered 43 questions, out of a total of 251 for 2013, increasing dialog with the general public. Close to 50% of total questions involve troubleshooting of plant problems.
c. Qualtrix survey responses from the Delaware Christmas Tree Workshop, Ornamentals Short Course indicated that all attendees increased their knowledge and 80% plan to change practices based on information presented.

2013 Delaware Plant Diagnostic Clinic Report
Department of Plant and Soil Sciences
University of Delaware

Nancy F. Gregory, Plant Diagnostician
Nathan Kleczewski, Extension Plant Pathologist
Brian A. Kunkel, Ornamentals IPM Specialist

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, crop consultants, nurserymen, landscapers, public gardens, and private homeowners. Samples are also received through 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 one full-time staff, the Plant Diagnostician, cooperating with the Extension Plant Pathologist and the Ornamentals IPM Specialist in Entomology, and two part time employees.

During 2013, the Plant Diagnostic Clinic processed over 700 non-survey samples. There were 754 routine clinic samples processed, which included ten from Delaware Department of Agriculture that were *Phytophthora ramorum* trace forward samples from nurseries on the west coast. Other samples were diagnosed in field situations, and not brought in for analysis. Phone inquiries and e-mail requests for information accounted for undocumented samples in addition to physical specimens submitted to the lab. Delaware Cooperative Extension launched an online Ask an Expert service through eXtension.org, that generated 42 questions answered via e-mail. Over 20 % of the total 245 questions answered via Ask an Expert for Delaware involved trouble-shooting possible disease or cultural issues with plants. Soil samples for nematode assays were also processed in the lab, but are not included in this report.

Dry periods in 2010 through 2012 contributed to plant stress, favored pathogens on many hosts, and affected establishment of new plantings. Conditions during most of 2013 included above normal rainfall totals, and saturated soils. Adding to root stress was a dry period for approximately five weeks during September. Adequate moisture benefited many agronomic crops such as corn and soybeans, although rainfall in the spring and fall made access to fields difficult. Moisture stress and compromised root systems was, however, an issue for many landscape plantings, especially in Sussex County, and will continue to lead to problems in the spring of 2014. Rainfall totals were compiled from the Delaware Environmental Observation System (DEOS), as follows:

DEOS Summary 2013 – Rainfall in inches – Normal for Delaware is 40 inches/yr

2013	Newark	Dover	Georgetown	Harbeson
April	2.31	4.24	4.19	
June	13.23	10.15	10.60	
August	6.41	3.47	5.71	
September	1.66	0.97	0.73	
December	4.29	5.16	4.69	
Yearly total	49.69	50.74	52.89	(54.93 in Harbeson DE)

Of the 754 routine samples received, the majority (630) were from within Delaware (85 %). Others were received from Maryland and Pennsylvania, totaling 119 samples, or 16 % from out of state. Almost all were physical samples (99 %), although several were digital images only. Maryland received several samples from Delaware, mostly turfgrass samples from golf courses. A few samples were processed for Delaware clients through Bartlett Tree Labs in North Carolina. Commercial samples received through Cooperative Extension accounted for 53 % of samples.

There were many different diagnoses, from different crop areas, and 93 % of samples were submitted for Disease ID. The crop sources for those were, in order of predominance: Ornamentals (55 %), Field Crops, Vegetables, Fruit, Turf, Insect ID, and Christmas trees. Other categories included Mushroom/Mold/Fungal ID, Forage, and Groundcovers. The 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 for diagnoses, due to multiple diagnoses for many samples. For example, insect damage and fungal dieback were common on physiologically stressed trees. Numbers show that physiological and environmental stresses are primary or play a role in over 30% of samples received. The diagnosis of environmental stress, when communicated, can save growers and landscapers money and time when they avoid unnecessary spray treatments. Accurate diagnosis is central to maintaining good plant health. The most common specific diagnoses were environmental stress, root rot, and crown rot.

One USDA quarantine pest was detected, that being chrysanthemum white rust, which is under review by USDA/APHIS PPQ for a change in actionable status. Rhododendron, camellia, and viburnum were collected by DE Department of Agriculture as part of a trace forward for *P. ramorum*, and all ten samples were negative when tested using ELISA for *Phytophthora*.

New reports for the year 2013 included:

1) Boxwood blight on English boxwood, caused by *Cylindrocladium pseudonaviculatum*, submitted by a retail nursery in June and then a Delaware homeowner/Master Gardener on 6/18/13, in Sussex County Delaware.
2) *Stigmina lautii*, needlecast fungus was confirmed on spruce, although suspected to be in Delaware for several years.
3) Hairy crabweed, also known as mulberry weed, *Fatoua villosa*, was identified in Kent County, DE
4) Phytophthora root rot on yellow wood (*Cladrastis lutea*).
5) Downy mildew (*Plasmopara viburni*) on cranberry bush (*Viburnum opulus*)
6) *Cercospora beticola* on swiss chard.
7) *Plasmopara halstedii* on tickseed Coreopsis.

Two samples were confirmed for soybean vein necrosis (SVNV), a thrips vectored virus disease of soybean, causing diffuse leaf spots that eventually follow the veins and result in necrosis of the leaves. SVNV was widespread throughout the state in 2011, not problematic in 2012, and observed in a few fields in 2013. Soybean sudden death syndrome caused by *Fusarium virguliforme* was confirmed in fields in Kent County and Maryland. Soybean plants with stunting due to root knot nematode were also noted, especially in Sussex County in sandy soils. Foliage diseases such as downy mildew, Septoria brown spot, bacterial blight, Phyllosticta leaf spot, frogeye leaf spot and Cercospora blight were seen on soybean during the season but were not yield-limiting.

Weather conditions in the spring of 2013 were favorable for seedling diseases such as damping off and Pythium root rot in agronomic crops. Mesocotyl rot of corn seedlings caused by a complex of *Fusarium*, *Pythium*, and bacteria was diagnosed in several fields. Barley yellow dwarf was observed in wheat and barley, with the severe strain of BYDV-PAV prevalent. There were numerous samples of head scab on wheat and barley, along with a great deal of sooty mold due to the moisture and humidity. Southern corn leaf blight was confirmed on sweet corn for the first time in many years. There was a low incidence of leaf rust, northern corn leaf blight (NCLB), and a lot of gray leaf spot on corn. Late season lodging was observed in some corn stalks, from poor root systems that did not establish well in saturated soils in the spring.

Pythium, *Fusarium*, and *Phytophthora* from crown, root and stem rots were recovered from pepper, tomato, snap bean, spinach, squash, and a number of annual bedding plants such as begonia, phlox, pansy, petunia, and periwinkle. Bacterial pith necrosis of tomato caused by *Pseudomonas corrugata* was diagnosed for the fifth year in a row. Bacterial leaf spot or blight was confirmed on tomato and pepper. Late blight was found on one tomato sample in September of 2013 in nearby Chester County, PA, and *Phytophthora nicotianae* was confirmed causing a foliar symptom that looked like late blight on potato in Kent County, DE in July. Weather was conducive for spread, but there was no further disease development of *Phytophthora* on potato and tomato. Downy mildew on cucumber appeared in June, but was later reported on other cucurbits. *Phytophthora capsici* was wide spread on watermelon fruit in Sussex County and led to severe losses. Bacterial fruit blotch caused by *Acidovorax* did not cause widespread disease in watermelon fields. Downy mildew, pod rot, anthracnose, root knot nematode, and stink bug injury were diagnosed on lima beans and pole limas.

Notable diseases on fruit included downy mildew, Botrytis blight, and Phomopsis twig and cane dieback on grape, and Monilinia blight on peach twigs and fruit. Phytophthora root rot was confirmed on several blueberry samples. Strawberry plants were diagnosed with Fusarium crown rot, Botrytis blight, Phomopsis blight, cold injury, and unidentified virus infections.

The most noteworthy disease on ornamental plantings was the detection of boxwood blight in a retail nursery and a residential planting in Sussex County Delaware. New nursery stock that was presumably infected with *Cylindrocladium pseudonaviculatum* was inter-planted with existing established boxwood in the landscape. Several weeks later, dieback and defoliation was noted and boxwood blight was confirmed. Eradication efforts are continuing on the residential site. Nursery stock was inspected and affected plants eradicated.

Excessive water and saturated soil led to root death and root rot on many ornamental plants, resulting in dieback on evergreens, and an odd leaf scorch symptom on red maples. Evergreen ornamentals suffered tip and twig dieback, often found in association with environmental stress or on newly established plantings, and *Diplodia*, *Phomopsis* and *Pestalotiopsis* were among the pathogens found. Seiridium canker continues to affect Leyland cypress, as over-crowded trees mature. Carryover herbicide damage on evergreens in areas that had been treated with Imprelis (aminocyclopyrachlor) was seen on white pine. Unusual symptoms of abnormal growth and knotted twigs on hardwood species have also been associated with that herbicide. Phytophthora root rot was diagnosed on yellow wood, lilac, arborvitae, holly, concolor fir, Douglas fir, rhododendron, spruce, and white pine, mostly in areas with poor drainage. Gymnosporangium rusts appear to be on the increase, in pear, hawthorn, serviceberry, and other Rosaeceous hosts. The rust on callery pear is presumed to be pear trellis rust caused by *G. sabinae*. Pear trellis rust has been detected in other states in the northeast. Monilinia blight was problematic on flowering cherry for the second year in a row.

Other ornamental pathogens of note included downy mildew of impatiens and balsam, although the decreased planting of impatiens appears to have slowed the recent epidemic. Hosta virus X was confirmed, but it is unknown how much of this virus is present in the landscape. Heterosporium leaf spot was common on iris, and late season fungal leaf spots were common on privet, hydrangea, and other hosts. Bacterial leaf scorch was noticeable in the landscape on northern red oak and pin oak, and was confirmed on flowering dogwood.

The UD Plant Diagnostic Clinic gratefully acknowledges the following colleagues who assisted with diagnoses and identifications as Advisory Consultants for samples in 2013: Entomology and Applied Ecology Dept., Joanne Whalen, and Charles Bartlett; Plant and Soil Science Dept., Tom Pizzolato, John Frett, Caroline Golt, Tom Evans, and Richard Taylor; USDA APHIS National Identifier John McKemy; Michael Dobres of Novaflora; and retired DSU botanist Art Tucker.