

**Pennsylvania Department  
Of  
Agriculture**

**Final Performance Report**

**Specialty Crop Block Grant  
Program**

**12-25-B-0829**

*High Risk Pathogens & Orchard, Vineyard Survey*

**October, 2008- September 30, 2009**

**Project title:****Protection of Specialty Crops in Pennsylvania from High Risk Pathogens****Project Summary:**

The goal of this project was to enhance the Pennsylvania Department of Agriculture's (PDA) preparedness against high-risk pathogens threatening specialty crops in Pennsylvania by generating necessary scientific knowledge and tools. Specialty crop block grant funding of \$93,590 provided the monetary support for project work.

**Project Approach:**

The project utilized a highly trained scientist who has training to evaluate samples brought to the PDA laboratory and perform specific tests in the area of genotypic and phenotypic. The correct identification of pathogen provides critical information to grower; enabling proper and effective action to be taken to prevent further damage from identified pathogen. Upon identifying pathogen it is classified and added to the database for future reference and development of diagnosis tools.

**Outcomes Achieved:**

As of September 2009, project efforts identified 144 fungal and bacterial pathogens on 757 samples that comprised of 209 different hosts largely collected by PDA plant inspectors and Penn State Extension specialists. Detection is broken down into the following categories: Rhododendron (13%), tomato (12%), conifers (8%), geranium (7%), chrysanthemum (5%), dianthus (2%), and impatiens (2%) amounted 49% of the hosts collected and examined.

High-risk diseases (and causal pathogens) detected in 2009 in Pennsylvania included Phytophthora diseases on rhododendrons (*Phytophthora* spp.), late blight of tomato (*P. infestans*), bacterial spot of tomato (*Xanthomonas* spp.), bacterial canker of tomato (*Clavibacter michiganense* subsp. *michiganensis*), bacterial blight of geranium (*Xanthomonas pelargonii*), chrysanthemum white rust (*Puccinia horiana*), and dianthus Fusarium root rot (*Fusarium* spp.). Among the viral diseases, impatiens necrotic spot virus (INSV) was detected in 23% of virus suspected samples; the most frequently infected hosts were lobelia, impatiens, nemesia, and begonia.

During the project, pathogen findings were monitored and documented; to include the occurrence of high-risk pathogens threatening specialty crops in Pennsylvania. Bacterial spot of tomato and pepper caused by *Xanthomonas* spp. has been a chronic bacterial disease in Pennsylvania. J. Jones et al. reclassified bacterial spot xanthomonads into four species, including *X. euvesicatoria*, *X. vesicatoria*, *X. perforans*, and *X. gardneri*; *X. gardneri* has a limited geographical distribution without a reported occurrence in the United States (2). Characterization of historical and contemporary bacterial spot xanthomonad cultures at the Pennsylvania Department of Agriculture

(PDA) revealed the presence of *X. gardneri*. Species identity of these cultures was determined using a combination of approaches, including the sequencing of 16S ribosomal RNA gene, rep-PCR (1, 4), profiles of carbon source utilization (3), amyolytic and pectolytic activities (2), and pathogenicity tests on tomatoes and peppers. Based on the survey of historical cultures, the first isolation of *X. gardneri* was determined to occur in a tomato field in 1995 (PD-11-09-0761-PDN, accepted with revision to Plant Disease). To our knowledge, this is the first report of bacterial spot outbreak on tomato plants caused by *X. gardneri* in Pennsylvania and the United States. We also analyzed 154 tomato and 31 pepper samples submitted to the PDA Plant Disease Diagnostic Laboratory in 2008-9 by PDA plant inspectors, Penn State Extension specialists, IPM specialists, and field representatives of processing, fresh market and greenhouse industries. From those samples, we have detected nine tomato samples with *X. gardneri*, 11 tomato samples with *X. perforans*, and three pepper samples with *X. perforans*. This survey indicates that *X. gardneri* has been posing a stealthy threat to tomato and pepper in Pennsylvania and the U.S., underscoring the need for a focus survey of this species.

*References:* (1) D. A. Cuppels et al. Plant Dis. 90:451-458, 2006. (2) J. B. Jones et al. System. Appl. Microbiol. 27: 255-762, 2004 [Validation No. 109. *Int. J. Syst. Evol. Microbiol.*, 2006, 56, 925-927]. (3) A. M. Quezado-Duval et al. Plant Dis. 88:157-161, 2004. (4) D. J. Versalovic et al. Methods Mol. Cell Biol. 5:25-40, 1994.

Another goal of the project was to continuously develop and implement highly sensitive diagnostic methods for such pathogens. At this time, highly reliable molecular diagnostic methods are not available for the detection of bacterial spot causing xanthomonads: *X. euvesicatoria*, *X. vesicatoria*, *X. perforans*, and *X. gardneri*. We are currently evaluating the following genes and primers to develop such methods:

#	PCR primers	Sequences, 5'-3'	Specificity
1	XdnaK1F	GGT GGA AGA CCT GGT CAA GA	dnaK
2	XdnaK1R	TCC TTG ACY TCG GTG AAC TC	
3	XfyuA1F	AGC TAC GAY GTG CGY TAC G A	fyuA
4	XfyuA1R	GTT CAC GCC RAA CTG GTA G	
5	XgyrB1F	ACG AGT ACA ACC CGG ACA A	gyrB
6	XgyrB1R	CCC ATC ARG GTG CTG AAG AT	
7	XrpoD1F	TGG AAC AGG GCT ATC TGA CC	rpoD
8	XrpoD1R	CAT TCY AGG TTG GTC TGR TT	
9	<i>iaaH</i> geneF	TCC GTG ATG GCG ATG CAG	<i>iaaH</i> gene
10	<i>iaaH</i> gene R	CCA ACG ACC TGT GGT CGG	
	C-152	CTG GCG GCT G	

Project results were shared at five specific venues. They were presented at workshops, scientific journals, as printed material and offered on line at website. See list below for specific detail description of outreach.

S. H. Kim, E. V. Nikolaeva, S. Kang, T. N. Olson, N. D. Pepper, and S. Park. 2009. Newly Emerging Bacterial Spot of Tomato Caused by *Xanthomonas gardneri* in Pennsylvania. Poster presentation during the 2009 NPDN meeting (The abstract and poster to be published through the NPDN website.)

- S. H. Kim, T. N. Olson, and N. D. Pepper, E. V. Nikolaeva, S. Park, and S. Kang. 2010. First Report of Bacterial Spot of Tomato Caused by *Xanthomonas gardneri* in Pennsylvania. *Plant Dis.* 94:xxx, 2010 (In process. Accepted for publication with revision)
- S. H. Kim, S. Kang, and E. Nikolaeva. 2009. Occurrence of *Xanthomonas* spp. on tomato and pepper in Pennsylvania. The 24th Annual Tomato Disease Workshop PSU, State College, PA. November 4-5, 2009. (~70 attendants).
- S. H. Kim. Newly emerging and chronic *Xanthomonas* spp. on tomato and pepper in Pennsylvania. (Scheduled to present at the Department of Plant Pathology Seminar, the Pennsylvania State University on Feb 22, 2010).
- The sequence data derived from characterizing various *Phytophthora* species contributed to establishing a very comprehensive forensic database for the whole genus ([www.phytophthoradb.org](http://www.phytophthoradb.org)). This database now has more than 400 registered users from 40 different countries. The sequence data have also helped us develop and validate new molecular diagnostic tools.

### **Beneficiaries:**

The project's primary beneficiaries are Pennsylvania's specialty crop industry and individual growers. The knowledge and experience generated from this project also benefited PDA by supporting its mission of safeguarding the economic security of agriculture in the state. Specific examples of benefits include:

Early detection and accurate identification of potentially highly destructive pathogens enable rapid deployment of regulatory and/or management actions, which will lead to eradication of such pathogens at affected sites, implementation of appropriate disease control measures, and/or prevention of further spread.

A database that contains genotypic and phenotypic data from pathogen collections analyzed through this project will serve PDA in a way similar to what the forensic DNA database does for the federal and state law enforcement agencies. It will permit a rapid risk assessment of a newly isolated pathogen and will also assist in recognizing patterns of pathogen movement/change. Especially, the data derived from various *Phytophthora* species archived at PDA contributed to establishing a very comprehensive database for the whole genus ([www.phytophthoradb.org](http://www.phytophthoradb.org)). This database now has more than 400 registered users from 40 different countries. The sequence data have also helped us develop and validate new molecular diagnostic tools.

This project enhanced the capability of PDA to regulate and manage threats from high-risk pathogens by establishing highly sensitive diagnostic tools and streamlined sample processing procedures.

### **Lessons Learned through the Project:**

Many high-risk pathogens detected this year are associated with propagation materials that are in transit such as seeds, transplants, rooted cuttings, or container-grown plants, highlighting the importance of paying close attention to plant materials imported to the state.

The detection of *Xanthomonas gardneri* in the historical culture collection of *Xanthomonas* isolates at PDA indicates the importance of using molecular genetic markers to differentiate closely related species.

Identification of several potentially novel *Phytophthora* species from limited surveys is indicative of our limited understanding of the ecology and diversity of *Phytophthora* in nature and strongly supports the need for continuous survey of nurseries and surrounding areas for *Phytophthora* and for evaluating the risk of these new species. Especially, the ecology and pathogenic traits of such novel *Phytophthora* species need to be studied to evaluate their potential as pathogens.

Considering that new disease threats will frequently emerge, we need to continuously monitor the nature and changing profiles of pathogens introduced to the state. It is also critical to archive the genotypes and phenotypes of previously characterized pathogen isolated in an easily accessible manner so that that these reference data can provide a critical insight into how pathogen communities are structured and have changed.

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## **Project 2**

### **Project Title**

**Orchard and Vineyard Survey, United States Department of Agriculture, Agricultural Statistics (NASS)**

### **Project Summary:**

This comprehensive study was conducted by National Agricultural Statistics Service office at the Pennsylvania Department of Agriculture (PDA). Stakeholders have expressed the economic importance of this project for determining future workforce needs, emerging trends in varieties and rootstocks grown, organic production and country statistics. Survey findings will assist in developing industry policies and measuring the industry's economic impact. The goal of the Orchard and Vineyard survey is to publish statistics about the Fruit Tree and Grape industries in Pennsylvania. Nationally, Pennsylvania ranks fourth in apple and peach production and fifth in grape production. Specialty crop block grant funding of \$65,000 along with a match from USDA provided the monetary support for project work.

### **Project Approach:**

This is the twelfth time Pennsylvania has conducted an orchard & vineyard survey. The first one done in 1953, every 5 years up to 2002; it has been six years since the last survey. A great deal has changed and it is critical to update the procedures and findings. The study defined a commercial fruit farm as one having at least one hundred fruit trees of one fruit or one acre of grapes.

The Orchard & Vineyard survey was mailed to 1632 known fruit growers in Pennsylvania beginning in December, 2008 (an increase of 15% compared to 2002). Additional outreach was conducted by direct mail post card reminders, telephone calls, and farm visits through May, 2009. The goal was to achieve a high response rate for deriving high quality data. The statistics will include summaries of acres and trees/vines, rootstock information for three crops, intentions for plantings and removal over the next five years. The published tables will show aggregated data by county, variety and age of trees/vines. Grape tabulations will also show types of training systems in use by growers, yields and prices received by variety.

The work plan for conducting the survey was completed according to proposed timelines. Surveys were sent, collected timely. A completed study was planned and had been communicated to the grant administrator that it would be delivered by stated deadlines; with a publish date of November, 2009 for hard copy. Therefore, an extension was not requested. However, due to unexpected series of events, to include: delay in state budget passage, a number of staff members furloughed and new director of Pennsylvania office, the finalization of the survey results is still in progress.

**Project Goals:**

The orchard & vineyard survey is critical in capturing an accurate perspective of Pennsylvania tree fruit and vineyard production. The survey is intended to provide current acreage, stock varieties, and other pertinent information to developing policies, marketing programs and workforce needs. The expectation is to have 95% participation by all known fruit producers in this production area.

**Outcome Achieved:**

One thousand six hundred and thirty-two (1632) surveys were mailed to all know commercial fruit farms in Pennsylvania. A commercial fruit farm is defined as one having at least one hundred fruit trees of one fruit or one acre of grapes. (USDA-NASS definition)

Participation in survey reported the following as number of farms with commercial fruit business per specific tree fruit classification. It is as follows: apples 566 (92% increase from 2002); tart cherries 52(a 30% increase); nectarines 76(nearly a 25% increase); peaches 322 (nearly a 41% increase); and pear 92 (a 13% increase). And with regards to vineyards, a 49% increase occurred in the number of farms from 2002 to 358 operations in 2008. Final percentage rate for participation in survey has not yet been published. However, it is evident from the preliminary survey numbers a positive trend in the tree fruit and vineyard industry is occurring as far as number of farm operations. It should be noted, the survey was conducted according to grant proposal timeline and the work plan of activities has occurred as planned with the exception of the publishing of the final results.

Also, an increase in the total number of fruit trees per acre has increased since 2002. According to 2008 survey data there is additional 65 apple trees being planted per acre; additional 4 tart cherry trees per acre, 12 nectarine trees per acre, 38 peach trees per acre and 12 pears trees per acre. This suggests new varieties being planted, along with new style of block arrangement and possibility harvest methods.

Next the study surveyed the number of total acres including bearing and non bearing trees. Again, the survey's data indicate an increase of 629 tree fruit acres have been added since 2002 and 1,324 acres of grapes have been introduced to Pennsylvania. The additional acreage of tree fruit plantings is a 2.5% increase, while the grape acreage is 12% increase in six years. See attached summary sheet. This is a brief summary of survey results currently available on the USDA-NASS (PA) website.

**Lessons learned:**

The study was conducted as planned; but the data input, summarization and analysis have been delayed due to a considerable reduction in staff as a result of state furloughs and budgetary cuts. A final report will be printed and distributed in the near future. Had the grant administrator been aware of the complications and difficulties in meeting the deadline for completion an extension would have been requested. However, the survey was completed as stated in the proposal, and the results are imminent.

The study results will be shared with industry stakeholders, policy makers and other related parties at various winter meetings scheduled throughout the state. For example: The Mid-Atlantic Fruit & Vegetable Conference, Women in Agriculture meeting, a variety of county and state PSU extension meetings. The survey results will also be shared both in hard copy and electronically. The hard copy of the study is available upon request. The electronic link for accessing the study results electronically is:

[http://www.nass.usda.gov/Statistics\\_by\\_State/Pennsylvania/Publications/Orchard\\_and\\_Vineyard/index.asp](http://www.nass.usda.gov/Statistics_by_State/Pennsylvania/Publications/Orchard_and_Vineyard/index.asp)

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