

**Joint Meeting of the**

**Northeastern  
and  
Potomac  
Divisions**

**American  
Phytopathological  
Society**

**October 17-19, 2001**

**Radisson Hotel & Conference Center  
Cromwell, Connecticut**

Abstracts

***Colletotrichum gloeosporioides* causes severe anthracnose disease on pepper in Virginia.** S. A. ALEXANDER, and J. K. Marvel. Dept. Plant Pathology, Physiology & Weed Science, Eastern Shore AREC, Virginia Polytechnic Institute & State University, Painter, VA 23420.

In the past few years, anthracnose disease has caused losses of 35% to 70% in sweet and hot peppers. Isolates collected from the diseased fields were identified as *Colletotrichum gloeosporioides*. Although several different species of *Colletotrichum* may cause anthracnose disease on pepper, *C. gloeosporioides* is generally the most difficult to control. An experiment to determine the efficacy of selected fungicides for the control of this pathogen was initiated in 2001. Bell peppers of the Paladin variety were planted and the treatments established in a randomized complete block design with four replications. Treatments were initiated either before or during flowering, and applied on a 7-14 day schedule. Fruit were harvested and rated for anthracnose infection. The treatments with the most effective disease control consisted of the strobilurin group of fungicides either alone or in combination with maneb or acibenzolar-S-methyl. Plant activators alone were less effective in controlling *C. gloeosporioides*.

**Factors affecting photosynthesis reduction after oil application to grapevine.** A. BAUDOIN(1) and T. K. Wolf(2). (1)Dept. Plant Pathology, Virginia Tech, Blacksburg, VA 24061; (2)Va Tech Research Center, 595 Laurel Grove Rd., Winchester, VA 22602.

Oil treatments are thought to have potential for eradicating powdery mildew outbreaks in grape clusters, but also have led to delays in fruit maturity. Significant reductions in net assimilation rate (NAR) followed treatment of abaxial (lower) or both leaf surfaces, but not treatment of upper leaf surfaces. NAR of *Vitis labrusca* 'Catawba' leaves treated with 1.5% JMS Stylet-Oil was reduced by 50-60%, with recovery in 3-4 weeks, whereas reduction for *V. vinifera* 'Chardonnay' was 20-30%, with recovery in less than a week. Neither rainfall nor washing of lower leaf surfaces with water and detergent immediately alleviated NAR depression. NAR depression appeared to be partially related to amount of oil emulsion retained by 11 grape cultivars. Field applications of oil, followed by sulfur, reduced fruit soluble solids in 9 of 23 cultivars, with only a weak correlation between visible injury and soluble solids. JMS Stylet-Oil, potassium bicarbonate (Armicarb), and sulfur had similar effectiveness in reducing harmful effects of existing powdery mildew in clusters.

**Acidic Electrolyzed Water (AEW) for Surface Sterilization of Teliospores.** M.R. BONDE and S.E. Nester, USDA-ARS-FDWSRU, 1301 Ditto Ave., Fort Detrick, MD 221702-5023.

AEW is a germicidal product of electrolysis of a weak (e.g. 0.3M) solution of sodium chloride. It was first tested as a sanitizer in 1967 by Wilk et al. (as reported in 1987 in *Sci. Total Environ.* 63:191-197) and has received wide attention in Asia and Eastern Europe in the field of medicine (*Plant Dis.* 83:627-632). We use AEW to surface sterilize teliospores of *Tilletia indica*, causal agent of Karnal bunt of wheat, from wheat samples prior to plating on germination media. In our studies, AEW at pH 2.5, oxidation/reduction potential (ORP) 1130 mV, and free chlorine content 15 ppm reduced contaminating bacteria and fungi by 6-7 log(10) units. The low pH of AEW accounted for a 99% reduction in bacteria and a 46-87% reduction in the number of fungi. The very high ORP also contributed to its effectiveness. AEW could be stored up to 15 days prior to use without a significant reduction in its effectiveness.

**Pathogenicity of *Phytophthora* species isolated from a recycled water irrigation system in Virginia.** E. A. BUSH (1), C. Hong (1,2), E.L. Stromberg (1). (1) Dept. PPWS, VPI & SU, Blacksburg, VA 24061. (2) VPI & SU, Hampton Roads AREC, Virginia Beach, VA 23455.

Members of the genus *Phytophthora* are generally considered pathogenic on plants, and individual species may be parasitic on quite narrow or very broad ranges of host species. However, the disease-causing ability of *Phytophthora* species isolated from irrigation systems in Virginia is unknown. Isolates of *Phytophthora* species collected from recycled irrigation water from a nursery in Virginia were tested for pathogenicity on sage (*Salvia officinalis*). In greenhouse tests, plants were inoculated with zoospore suspensions (10,000; 5,000; or 2,500 zoospores per plant). *P. cactorum*, *P. capsici*, *P. citrophthora*, and *P. nicotianae* demonstrated pathogenicity on sage, while *P. cryptogea* and *P. drechsleri* did not. Additional isolates of *P. citrophthora* and *P. drechsleri* are being evaluated for pathogenicity on sage. These data complement data from water assays used to characterize *Phytophthora* species in irrigation water.

**Preliminary host range studies of *Colletotrichum gloeosporioides* for biological control of Russian thistle.** C. Cavin and W. L. BRUCKART. USDA-ARS, Ft. Detrick, MD 21702.

Evaluation of *Colletotrichum gloeosporioides* (*C.g.*) from Hungary for biological control of Russian thistle (*Salsola tragus*) revealed that *C.g.* caused significant damage only to one of the two “types” (Ryan & Ayres, Can. J. Bot. 78:59) of *S. tragus* from the US. Relative to uninoculated controls in three experiments, reductions in dry weight after inoculations with *C.g.* ranged from 42.8 to 94.8% for *S. tragus* Type A, compared to reductions of 5.0 to 41.9% for *S. tragus* Type B, 9.1 and 18.5% for two cultivars of spinach, 0 - 28% for six cultivars of beet, 8.3% for swiss chard, and 0% for *Chenopodium quinoa*. Except for one cultivar of beet, differences in dry weights of non-target species were not significantly different from controls. Effects of inoculation on dry weight of Type A all were significant ( $P = 0.05$ ). Future studies will involve comparisons of spinach, at different phenological growth stages, on susceptibility to *C.g.* from Hungary and *C. dematium*, a spinach pathogen from the USA.

**Development of a SCAR-PCR assay to detect *Colletotrichum coccodes*, a biological control agent of velvetleaf.** A.L. DAUCH, A.K. Watson and S.H. Jabaji-Hare. Dept. of Plant Science, McGill University, 21,111 Lakeshore, QC, CANADA H9X 3V9.

*Colletotrichum coccodes*, registered under the name Velgo, is considered a potential bioherbicide for velvetleaf (*Abutilon theophrasti*), a devastating weed in corn and soybean cropping systems in North America. We are currently developing a sequence characterized amplified region (SCAR) marker to detect *C. coccodes* in different biological samples. The methodology consisted of screening 16 random amplified polymorphic DNA (RAPD) primers in PCR assays on DNA extracted from a large collection of *Colletotrichum*, heterogeneous fungi, bacteria and plant species. The primer OPN-08 detected a 336 bp amplicon in the biocontrol isolate only. New primers designated as Cc323F/R were designed from the SCAR region and tested for their specificity to *C. coccodes*. They detected a 323bp fragment not only in the biocontrol isolate but also in 5 other isolates of *C. coccodes* and in one isolate of *C. gloeosporioides*. Current experiments are underway to increase the specificity of the designed markers to the biocontrol isolate in the hope to use them in real-time PCR assays on field samples.

**Reservoirs of *Colletotrichum acutatum* in dormant and growing highbush blueberry.** A. DeMARSAY and P.V. Oudemans. Dept. of Plant Biology and Pathology, Rutgers University Blueberry and Cranberry Research and Extension Center, Chatsworth, NJ 08019.

*Colletotrichum acutatum*, the causal agent of anthracnose fruit rot of highbush blueberry, has been observed to overwinter in or on both blighted twigs and live buds, but there have been no systematic studies of the pathogen's primary reservoirs. Tissue samples were taken from a commercial blueberry field in New Jersey before budbreak and at green fruit stage and incubated in moist chambers. Emerging spore masses were tallied to identify the primary reservoirs of the pathogen and whether its distribution among tissue types changed over time. In the dormant sample, canes with at least one dead tip were significantly more likely to harbor *C. acutatum* than canes with live tips only. Dead tips were significantly more likely to be infected than flower buds, although flower buds on canes with at least one dead tip were in turn more likely to be infected than those on canes with only live tips. In the later sample, the infection rate of dead tips was lower and did not significantly differ from that of fruit clusters corresponding to the earlier flower buds. *C. acutatum* can be found in or on dead and live dormant blueberry tissue, but its primary reservoir is dead tips: fruit spurs and other blighted twigs. After sporulation, the pathogen does not live long in dead tissue but survives as latent infections on green fruit.

**Detection of the arbuscular mycorrhizal fungus *Glomus intraradices* using species-specific PCR primers.** B. DUVAL (1), M. Fillion (1), Y. Dalpé (2), M. St-Arnaud (3), C. Hamel (4), S.H. Jabaji-Hare (1). (1, 4) Depts. Plant Science and Natural Resource Sciences, McGill University, Montréal, QC, Canada; (2) ECORC, Ottawa, ON, Canada; (3) I.R.B.V., Jardin Botanique de Montréal, Montréal, QC, Canada.

PCR assays facilitate reliable and specific detection of fungi, including arbuscular mycorrhizal fungi (AMF). However, most of the species-specific primers that are designed to detect AMF require the use of nested PCR to obtain sufficient amplification. This approach can be laborious and is non-compatible with quantitative PCR. To overcome this limitation, species-specific primers (GiFOR/GiREV) were designed to amplify a single 362 bp fragment from the 18S rDNA region of *Glomus intraradices* in a single conventional PCR amplification run. According to the BLAST algorithm, GiFOR/GiREV primers did not share significant homology with other known DNA sequences. When tested against total genomic DNA extracted from a wide range of organisms (6 plants, 7 bacteria, 24 fungi including 14 AMF), only DNA from *G. intraradices* isolates amplified, confirming the specificity of the primers.

**Preliminary greenhouse evaluation of *Ramularia crupinae* for biological control of *Crupina vulgaris*.** F. ESKANDARI and W. L. Bruckart. USDA-ARS, Ft. Detrick, MD 21702.

An isolate of *Ramularia crupinae* from France is being evaluated in containment for biological control of *Crupina vulgaris*. Inoculum was produced on potato dextrose agar at 20 degrees C for 1 week and the mixture of mycelial fragments and spores (not quantifiable) was filtered through two layers of cheesecloth. A single inoculation of 4-week-old plants with *R. crupinae* resulted in the reduction of plant top dry weights by 29.2% and of roots by 65.7%, compared to controls. Seed production was reduced by infection, resulting in significantly fewer seeds per plant (by 18.9%) and significantly lower seed weight per plant (by 19.6%), compared to controls. Five *Centaurea* spp., *Acroptilon repens*, *Cynara scolymus*, *Taraxacum officinale*, *Carduus acanthoides*, and *Cirsium vulgare*, all relatives of *C. vulgaris* in the Asteraceae, were not susceptible to infection, but a limited number of small, necrotic lesions developed only on the older leaves of *Carthamus tinctorius* (safflower). Future research includes completion of the host range determination and studies on damage to *C. vulgaris* from multiple inoculations of *R. crupinae*.

**Use of quantitative real-time PCR to monitor fungal populations in soil.** M. FILION (1), M. St-Arnaud (2), C. Hamel (3), S.H. Jabaji-Hare (1). (1, 3) Plant Science and Natural Resource Sciences Depts., McGill University, Montréal, Qc, Canada; (2) I.R.B.V., Jardin Botanique de Montréal, Montréal, Qc, Canada.

Quantitative detection of fungi in complex substrates like soil can be laborious and non-specific. A novel molecular approach was adapted for rapid quantification of fungi in soil. Detection and quantification of two fungi belonging to different taxonomical and ecological groups was accomplished using species-specific primers in real-time PCR assays. Sterile and non-sterile soils were inoculated with different amounts of conidia ( $10e^{^6}$ ,  $10e^{^5}$ ,  $10e^{^4}$  conidia/g soil) of the plant pathogen *Fusarium solani* f. sp. *phaseoli* or spores ( $10e^{^4}$ ,  $10e^{^3}$ ,  $10e^{^2}$  spores/g soil) of the arbuscular mycorrhizal fungus *Glomus intraradices*. DNA was extracted from soil, and sequences specific to *G. intraradices* (362 bp) and *F. solani* f. sp. *phaseoli* (562 bp) were quantified in real-time assays by measuring the fluorescence of SYBR Green I dye. The detection efficiency allowed accurate quantification of both organisms over a broad range of DNA concentrations with a detection limit ranging from 1 to 5 pg of DNA.

**Evaluation of mefenoxam application methods and timing intervals for control of Phytophthora blight of pepper.** M.L. FOGG & S.A. Johnston. Rutgers Agricultural Research & Extension Center, Rutgers University, Bridgeton, NJ 08302.

Mefenoxam is a systemic fungicide used for protection of pepper plants against the crown rot phase of *Phytophthora blight* caused by *Phytophthora capsici*. Effectiveness in controlling *Phytophthora blight* of pepper with mefenoxam has recently declined in New Jersey. Commercially, mefenoxam is injected via drip irrigation every 4 weeks. To begin to examine the correlation between mefenoxam concentration in planta and disease reduction, various application methods and timing intervals were evaluated. Following transplanting, mefenoxam was injected through drip irrigation at 2, 3, and 4 week schedules or by drenching at a 2 week schedule. The bases of plants were drenched weekly with a zoospore suspension of *P. capsici*. Disease was assessed by determining the number of days from inoculation to crown rot symptoms. Drenching on a 2-week schedule resulted in a significantly longer period of time between inoculation and crown rot (14 days) than any of the drip injection schedules. However, one month post-transplant, applications through drip irrigation every 2 or 3 weeks resulted in a significantly longer period of time between inoculation and crown rot than the drench method (3 days).

**Accumulation of defense gene transcripts in mycorrhizal bean plants infected with *Rhizoctonia solani*.** C. GUILLON (1), M. St-Arnaud (2), C. Hamel (3), S.H. Jabaji-Hare (1). (1, 3) Depts. of Plant Science, and Natural Resource Sciences, McGill University, Montréal, Qc, Canada; (2) I.R.B.V., Montréal, Qc, Canada.

A time course study was conducted to monitor disease development and the accumulation of defense-related gene transcripts (PAL, CHS, CHI and HRGP) in bean plants (*Phaseolus vulgaris*) colonized by the arbuscular mycorrhizal fungi (AMF) *Glomus intraradices* and post-infected with the pathogen *Rhizoctonia solani*. Pre-colonization of bean plants by the AMF did not significantly reduce the severity of rot symptoms. In response to *R. solani* infection there was a systemic increase in transcript levels of the four defense-related genes. Pre-colonization of bean plants with the AMF elicited no change in PAL, CHS and CHI transcripts, but an increase in HRGP transcripts in leaves was detected. A differential and systemic alteration in the expression of all four defense genes was observed in AM beans post-infected with *R. solani*. Depending on the time after infection with *R. solani* and the tissue examined, varying responses from stimulation to suppression of transcript levels were detected.

**Epidemiological significance of *Phytophthora* species present in recycled irrigation water to ornamental production.** C. X. HONG, P. Kong, P. A. Richardson, Virginia Tech, Hampton Roads AREC, Virginia Beach, VA 23455

*Phytophthora* species are frequently isolated from recycled nursery irrigation water but the epidemiological significance of waterborne pathogens remains undetermined. Field plots consisting of two treatments were established in June 2001: test plants irrigated with (i) nonchlorinated, recycled water at a local nursery and (ii) well water at the Hampton Roads AREC. Test plants include *Abelia* × Edward Goucher, annual vinca, azalea, forsythia, nandina, and pansy. Fifteen containers of individual test plants were added to each of the two plots and were managed following standard cultural practices for commercial crops in the nursery. Plants were assessed monthly for disease symptoms. Diseased plants were then examined through isolation to confirm the pathogen identification. ‘Pacifica Red Dot’ vinca was added to the plots on June 19. On August 22, *Phytophthora blight* was observed on a few plants in 11 of 15 containers receiving nonchlorinated irrigation water. The disease spread over all the plants and branches in the same plot by September 7. In contrast, no disease symptoms were observed on any plants irrigated with well water at HRAREC. These data suggest that pathogen monitoring programs and disinfections of contaminated water are warranted in nurseries that use recycling irrigation systems.

**Evaluation of varietal resistance for control of Phytophthora blight of peppers.** S.A. JOHNSTON, M.L. Fogg, W.L. Kline, S.A. Garrison. Rutgers Agricultural Research & Extension Center, Rutgers University, Bridgeton, NJ 08302.

Phytophthora blight caused by *Phytophthora capsici* is the most important disease of peppers in New Jersey. Cultural control measures are the primary method of control utilized in commercial production; yet, high soil moisture conditions can result in high disease incidence even with cultural control methods. Chemical control is only marginally effective when high soil moisture conditions occur. Therefore, the need for the availability of varietal resistance is important for successful disease management. Commercial varieties and experimental breeding lines were evaluated over a three year period in *P. capsici* infested fields on a commercial farm and at the Rutgers Agricultural Research & Extension Center. Both the crown rot and the stem lesion phases of the disease developed each year at both sites. The commercial variety, 'Paladin', was the only variety of 28 varieties and lines evaluated to consistently result in significantly less crown rot phase of the disease and marketable yield than the standard commercial varieties. 'Paladin' was susceptible to the aerial phase of the disease. 'Paladin' produced commercially acceptable yields and acceptable horticultural characteristics necessary to be used for commercial production in NJ.

**Isolation of plant defense genes exclusive to the arbuscular mycorrhizal symbiosis.** J.M. LERNER and R.L. Wick. Department of Microbiology, University of Massachusetts, Amherst, MA 01003.

Arbuscular mycorrhizae, found in 80-90% of plants, form when ubiquitous soil-borne Glomalean fungi colonize roots and establish a symbiotic relationship. Mycorrhizae benefit plants by improving growth, vigor and stress and disease resistance. This investigation aims to isolate symbiosis-related plant genes, particularly those involved in pathogen defense. Mycorrhizal and non-mycorrhizal Ri T-DNA- transformed in-vitro carrot roots and roots from pot-grown plants were cultured and inoculated with *Pythium* and *Phytophthora*. Several symbiosis-related plant genes were isolated by subtractive hybridization of cDNA libraries from mycorrhizal and non-mycorrhizal root tissue. Defense genes expressed exclusively by mycorrhizal roots during pathogen invasion will be isolated by subtractive hybridization and differential display. Symbiosis-related genes were cloned and will be sequenced and analyzed. Data regarding their possible role in the mycorrhizal symbiosis and in symbiosis-related defense responses will be presented.

**Quorum sensing regulation effects surface attachment and dissemination in *Pantoea stewartii* subsp. *stewartii*.** T. MINOGUE., N. Koutsoudis M. and S. Beck von Bodman Dept. of Plant Science, University of Connecticut, USA

*Pantoea stewartii* subsp. *stewartii* (*Ps*) is the causative agent of Stewart's wilt on sweet corn. EsaR, a LuxR homologue, regulates synthesis of the capsular polysaccharide (CPS) virulence determinant in a quorum sensing-specific manner. Genetic data indicate that EsaR functions as a negative regulator, which depends on inducing levels of acyl-homoserine lactone (AHL) synthesized by EsaI for derepression. ESN51, *esaI*(CPS)<sup>-</sup>, and ES IR, *esaIesaR*(CPS)<sup>++</sup>, mutant strains are attenuated for virulence due to the loss of the quorum sensing system. We show that surface attachment is enhanced in ESN51 while it is reduced in ES IR as compared to wild type *Ps*. These strains, when expressing GFP constitutively, showed differential microcolony formation and colony morphology when visualized by fluorescence microscopy. In addition, dissemination of the mutant strains are attenuated *in planta*. We discuss the direct and indirect role of *esaR/esaI* quorum sensing system in overall disease biology of the bacterium.

**Molecular cloning of the gene encoding chitinase from the mycoparasite *Stachybotrys elegans*.** D. MORISSETTE, G. Taylor, S. Jabaji-Hare. Plant Science, McGill University, Ste-Anne-de-Bellevue, QC, H9X 3V9, CANADA.

Improved resistance to fungal diseases can be achieved by transforming crops with fungal genes encoding cell wall degrading enzymes such as chitinases and beta-glucanases. *Stachybotrys elegans* is a mycoparasite of the soilborne pathogen *Rhizoctonia solani*. It releases several chitinases and beta-glucanases during mycoparasitism. Three chitinases have been characterized from *S. elegans* but none have been cloned so far. To clone these enzymes, primers have been designed based on alignment of 4 other chitinase gene sequences from *Trichoderma* and *Aphanocladium* species, both well known mycoparasites of higher fungi. PCR was performed and a product of 900 bp was sequenced (SECHI) showing over 80% similarity with chitinase gene and protein sequences from other higher fungi. Experiments are currently being conducted to obtain the entire sequence of SECHI. The methodology used will consist of designing gene-specific primers based on PCR products for Rapid Amplification of cDNA Ends (RACE)-PCR. To our knowledge, the application of RACE-PCR to isolate genes encoding for cell wall hydrolytic enzymes from mycoparasites is unique.

**Fungicidal control of powdery mildew of flowering dogwood in Delaware.** R.P. MULROONEY, and N.F. Gregory. Plant and Soil Sciences Dept., Univ. of Delaware, Newark, DE 19717. Powdery mildew of flowering dogwood has been increasing in both occurrence and severity in Delaware and the region. Chemical control studies for the control of powdery mildew, *Microspheera* sp., of flowering dogwood, *Cornus florida*, were conducted in Newark, DE from 1998 to 2001. Generic field run trees of *Cornus florida* were utilized in the tests. Treatments were arranged in a randomized complete block design. Treatments were replicated either 4 or 5 times and a plot consisted of a single tree 8-10 ft tall. Fungicide programs were initiated each season (May 15 to June 2) when powdery mildew was first seen on the test trees or on trees near the site. A variety of fungicides at two and three week spray intervals were tested including biorational (green) fungicides such as 1% horticultural oil, 1% neem oil and potassium bicarbonate in 2001. Fungicide treatments were terminated in early August. All the fungicides tested provided control of powdery mildew compared to untreated trees. Aesthetic ratings were made at the end of the season and were also significantly higher for treated trees.

**Molecular phylogenetic analysis of *Fusarium avenaceum* from lisianthus.** F.A. NALIM (1), D.M. Geiser (1), W.H. Elmer (2), R.J. McGovern (3) and B.K. Harbaugh (4). (1) Dept. Plant Pathology, Penn State University, University Park, PA 16802; (2) Dept. Plant Pathology and Ecology, The Connecticut Agricultural Experiment Station, New Haven, CT 06504; (3) Plant Pathology Dept., University of Florida, Gainesville, FL 32611; (4) Environmental Hort. Dept., University of Florida, Gainesville, FL 32611.

Recent severe outbreaks of crown and stem rot of lisianthus (*Eustoma grandiflorum*) have been attributed to *F. avenaceum*. *F. avenaceum* isolates have previously been identified based only on morphology. Our goal was to characterize *F. avenaceum* isolates from lisianthus based on phylogenetics and to generate a database of *F. avenaceum* sequences useful for purposes of taxonomy, management and control. Sixty isolates of *Fusarium* were included in the study. These were from many hosts including lisianthus and from diverse localities. We sequenced portions of two protein coding genes, translation elongation factor 1-alpha and beta-tubulin, and carried out a phylogenetic analysis using PAUP. Analysis of both genes showed *F. avenaceum* isolates to be monophyletic with no significant incongruence among gene genealogies. A bootstrap analysis showed a hundred percent support for the *F. avenaceum* clade. Isolates from lisianthus were scattered within this clade and did not form a separate group, suggesting the possibility that any *F. avenaceum* isolate may be pathogenic on lisianthus regardless of its phylogenetic origin.

**Effect of leaf wetness frequency and duration during spring on the total ascospore productivity of *Venturia inaequalis*.** V. PHILION, IRDA, St-Hyacinthe, Qc J2S 7B8.

In many parts of the world, most fungicide applications on apple trees are directed against primary infections of apple scab which are caused by ascospores that are released in the spring. In this context, it is important to understand the factors that influence ascospore availability. In this experiment, the effects of spring leaf wetness frequency and duration on the ascospore productivity were determined. In the spring of 1998, 1999, 2000 and 2001, leaf samples that overwintered in different sites were artificially wetted at fixed intervals and the ascospore production was measured. Based on ANOVA, only the duration of leaf wetness events affected the overall seasonal ascospore productivity. Ascospore release was higher in treatments with longer wetness duration. It is possible that the potential ascospore dose (PAD) is reduced under dry spring conditions because a portion of the ascospore supply cannot be ejected. This finding could help determine the PAD fraction actually released in the orchard and the risk associated with each rain event.

**Spatial and temporal distributions of *Phytophthora*, soil properties, and yield within a commercial cranberry bed in New Jersey.** L. POZDNYAKOVA and P.V. Oudemans, Rutgers University Blue/Cranberry Research Center, Chatsworth, NJ

Spatial distributions of soil properties, *Phytophthora* Root Rot (PRR) infection, and yield were monitored on a cranberry bed during 1999-2001 using GIS, GPS, geostatistics, and remote sensing. Soil, pathogen, crop, and spectral data from the 216 locations within a single 8.23-acre bed were incorporated in a GIS to study relationships among the factors. Low yielding areas were consistent through three years with  $r=0.55$  between yields of 1999 and 2000. Those areas were also prone to recurrent PRR infections ( $r=0.15-0.65$  between different isolation dates, subject to climatic conditions and management practices). The problems usually arise in low, poorly drained areas ( $r=0.27$  for yield vs. elevation and  $r=0.20$  for PRR vs. soil water content). Soil electrical conductivity and temperature measured in-situ as well as remotely sensed spectral characteristics demonstrated good correlations with yield and PRR. The results of the study were used to quantify chronic impacts of PRR on cranberry and to determine the soil factors that enhance root infection.

**Quinone reduction systems of the brown rot fungus *Gloeophyllum trabeum*.** WEIHONG QI, Jody Jellison. Department of Biological Sciences, University of Maine, Orono, ME 04469.

Quinone reduction systems may play multiple roles in the metabolism of brown rot fungi. These roles include the detoxification of quinones and reactive oxygen species. Quinone reduction systems may also play a role along with mineralization processes, in a quinone redox cycle of phenolate biochelators implicated in the brown rot process. In the present study, intact mycelia and the intracellular enzyme extract of *Gloeophyllum trabeum* could reduce 1,4-benzoquinone, but showed different kinetic constants. The *G. trabeum* plasma membrane redox system was characterized based on its ferricyanide reduction kinetics. An intracellular NADH dependent 1,4-benzoquinone reductase was purified from *G. trabeum* and was characterized. The native enzyme contained flavin mononucleotide, and had a molecular weight of 44KD and a pI of 4.2. The enzyme had a subunit molecular weight of 22KD. The quinone reductase was highly inducible by 2,6-dimethoxy-1,4-benzoquinone and showed high apparent  $K_{cat}$  values for multiple quinones, which indicates it can function efficiently in quinone metabolism.

**Isolates of *Phytophthora infestans* that infect *Petunia x hybrida* and *Nicotiana benthamiana* also produce INF1.** M. C. RATHBONE, C. D. Smart, W. E. Fry. Dept. Plant Pathology, Cornell University, Ithaca, NY 14853.

Many species of *Phytophthora*, including *P. infestans*, produce 10 kDa secreted protein elicitors (elicitins), the most abundant of which in *P. infestans* is INF1. Previous work in which production of INF1 was silenced in one isolate of *P. infestans* suggested that the presence of INF1 prevented late blight infection on *Nicotiana benthamiana*. However recent laboratory and greenhouse investigations have shown that *Petunia x hybrida* and *N. benthamiana* can be hosts for *P. infestans*. We report here that these species are also hosts in field tests. Additionally, we assayed isolates that infected *P. x hybrida* and *N. benthamiana* for *inf1* via Southern and northern analysis and also for 10kDa protein production. Isolates that infected potatoes, tomatoes, *P. x hybrida* and *N. benthamiana* in field tests and greenhouse tests all produced 10kDa proteins, had sequences that hybridized to *inf1* probes in Southern analyses and expressed RNA that hybridized to *inf1* in northern analyses. It appears that INF1 is not a pathogenicity determinant in all isolates of *P. infestans*.

**How inoculum cycling has contributed to re-emergence of *Penicillium expansum* as a significant postharvest problem in apples.** D.A. ROSENBERGER, C.A. Ahlers, F.W. Meyer, and K.L. Van Camp. Dept. Plant Pathology, NY Agric. Exp. Stn. (Geneva), Cornell University's Hudson Valley Lab, Highland, NY 12528.

Grocery store displays of bagged Empire and McIntosh apples were evaluated for decays on eight dates in February, March and April over two years. Blue mold decay was visible in 37% of 131 Empire displays and in 21% of 141 McIntosh displays. The inoculum cycle that contributes to postharvest losses was deduced from results of numerous experiments conducted over 5 years. Benzimidazole-resistant strains of *P. expansum* recycle on apple field bins, are dispersed to stems of freshly harvested apples via postharvest drenches, and invade fruit through the stems during long-term controlled atmosphere storage. Decayed apples re-contaminate bins, thereby providing inoculum for the next crop. A single bin may carry  $2 \times 10^9$  spores. Airborne spores from decayed fruit contaminate apples on the packing lines and contribute to development of decays in packed fruit. Airborne inoculum concentrations in some packinghouses exceeded 500 spores/liter of air during winter. Improved bin sanitation is needed to reduce inoculum cycling.

**Controlling *Penicillium expansum* in apples with postharvest applications of fludioxonil.** D.A. ROSENBERGER, F.W. Meyer, C.A. Ahlers, and K.L. Van Camp. Dept. Plant Pathology, NY Agric. Exp. Stn. (Geneva), Cornell University's Hudson Valley Lab, Highland, NY 12528.

Fludioxonil (Scholar 50W, Syngenta Corp.) was evaluated in five trials over 3 years to determine its effectiveness for controlling *P. expansum* in stored apples. Wounded Empire fruit inoculated with spore suspensions of *P. expansum* were treated with varying concentrations of fludioxonil or thiabendazole (TBZ). Fludioxonil at 300 ug/ml a.i. controlled decay as well as or slightly better than TBZ at 530 ug/ml in three trials with TBZ-sensitive *P. expansum*. Fludioxonil also controlled TBZ-resistant *P. expansum*. Fludioxonil was equally effective for protecting fruit exposed to inoculum suspensions containing 5,000, 10,000 and 20,000 spores/ml. Effectiveness was not reduced when fludioxonil treatment solutions were amended with 4% (w/w) of soil or soil-plus-organic debris and held for 90 h at 15 degrees C prior to use. Fludioxonil at 150 and 75 ug/ml controlled decay through 148 days of cold storage, but fruit treated at those low rates developed significantly more decay during a subsequent 7-day shelf life test than did fruit treated with 300 ug/ml.

**Integrating trifloxystrobin and kresoxim-methyl into apple disease control programs.** D.A. ROSENBERGER, F.W. Meyer, C.A. Ahlers, and K.L. Van Camp. Dept. Plant Pathology, NY Agric. Exp. Stn. (Geneva), Cornell University's Hudson Valley Lab, Highland, NY 12528.

The new fungicides kresoxim-methyl (KM) and trifloxystrobin (TR) were compared with older fungicides to determine the best uses for these fungicides in apple spray programs. Nine field trials were conducted over 4 years. Dilute sprays of KM at 50 ug/ml or TR at 25 ug/ml a.i. provided protectant and post-infection activity against apple scab equal to that of a myclobutanil/mancozeb (45 and 900 ug/ml) mixture. KM and TR did not provide adequate control of rust diseases when used in consecutive sprays, but they were effective when alternated with fenarimol/mancozeb or myclobutanil/mancozeb. KM and TR controlled powdery mildew when applications were initiated before bloom, but they acted more slowly than myclobutanil when applied to a running mildew epidemic. TR provided slightly better mildew control than KM. KM at 50 ug/ml provided better protectant activity against flyspeck than TR at 25 ug/ml. Both KM at 45 ug/ml and TR at 30 ug/ml provided better post-infection activity against flyspeck than did thiophanate-methyl plus captan (157 and 600 ug/ml).

**Sampling oomycetes from various substrates and hosts in flower production greenhouses.** N. SHISHKOFF, J. Knoedler and M. Daughtrey. Cornell Univ., LIHREC, Riverhead, NY, 11901.

A baiting technique was used to collect oomycete isolates from benches and soil in 12 greenhouses in NY and New England. Isolates were also collected from symptomatic plants submitted for diagnosis. Of over 700 isolates collected so far, 145 have been studied for identification and/or pathogenicity. Although results are preliminary, certain patterns are observable. First, diverse oomycetes can be collected from a single greenhouse complex: among 30 isolates collected from one site, at least 9 spp. of *Pythium* were found. Second, different plants can host different oomycete floras: *P. irregulare* was common on geranium and *Pythium aphanidermatum* and *Phytophthora drechsleri* were common on poinsettias. Some plants were hosts to many oomycetes: calibrachoa, a new greenhouse crop, hosted at least 3 species of *Pythium* and two species of *Phytophthora*. Finally, *Pythium* spp. isolated from soil and debris in greenhouses included the pathogenic species *P. aphanidermatum* and *P. irregulare* and some of these isolates were pathogenic in seedling and cutting assays.

**Formation and survival of ascomata of the cucurbit powdery mildew.** N. SHISHKOFF, and M.T. McGrath. Cornell Univ., LIHREC, Riverhead, NY, 11901.

Under laboratory conditions, only temperature influenced the development of ascomata of the cucurbit powdery mildew, *Podosphaera xanthii*; relative humidity and photoperiod had no effect. Temperatures over 24 C inhibited ascomatal development. Continuous 24 C incubation interrupted by short periods of 26 C temperature reduced ascomatal formation, while continuous incubation at 26 C interrupted by short periods of 24 C resulted in ascomata only if the interruption occurred at 8-11 days after inoculation, and then only in small numbers. When pumpkin leaves bearing ascomata were placed in nylon mesh bags, buried in soil, and sampled monthly from November through the following June, cytoplasm-filled contents were present in 2-18% of ascomata through May. Some contained undifferentiated cytoplasm, while others contained spores in various stages of development. Despite the strong correlation of temperature and ascomatal formation, the proper conditions for formation could not be predicted from weather data.

**Purification and partial characterization of a beta-N-acetyl-hexosaminidase from the mycoparasite *Stachybotrys elegans*.** G.A. TAYLOR (1), P.M. Charest (2), S. Jabaji-Hare (3). (1,3) Plant Science Dept., Macdonald Campus, McGill University, 2111 Lakeshore, Ste-Anne-de-Bellevue, Qc., Canada H9X 3V9. (2) Dept. of Phytology, Laval University, Ste.-Foy, Qc., Canada

*Stachybotrys elegans*, a mycoparasite of *Rhizoctonia solani*, produces two beta-1, 4-N-acetylglucosaminidases, and one endochitinase, when grown on minimal synthetic medium (MSM) supplemented with chitin as the sole carbon source. A 68 kDa, beta-N-acetylhexosaminidase (NAG-68) was purified to homogeneity using ammonium sulfate precipitation, ion-exchange and size exclusion chromatographies, and native polyacrylamide gel electrophoresis. NAG-68 had pH and temperature optima of 5.0 and 40 degrees C, respectively. Metal ions and nitrogen sources had little effect on NAG-68 activity, except for Fe(<sup>2+</sup>) that showed a minor stimulating effect and asparagin, which produced 61 percent of the relative activity when compared to the standard MSM formulation. The  $K_m$  and  $V_{max}$  calculated on p-nitrophenyl-N-acetyl-beta-D-glucosaminide were 62.5 mmol and 0.89 mmol/hr, respectively. Polyclonal antibodies raised against NAG-68, showed high affinity to the purified NAG-68 protein. NAG-68 was also detected in proteins extracted from *R. solani*-*S. elegans* dual culture plates that were amended with cell wall as carbon source.

**Impact of liming and nitrogen on the severity of summer patch in Kentucky bluegrass.** G. TOWERS, W. Hill, J. Heckman, B. Clarke, and J. Murphy. Department of Plant Biology and Pathology, Rutgers University, New Brunswick, NJ 08901.

The effect of lime (99, 198, and 396 kg CCE ha<sup>-1</sup>) in combination with the acidifying fertilizer ammonium sulfate (AS; 196 kg N ha<sup>-1</sup> season<sup>-1</sup>) or the alkalizing fertilizer calcium nitrate (CN; 196 kg N ha<sup>-1</sup> season<sup>-1</sup>) on the severity of summer patch (*Magnaporthe poae*) in 'Georgetown' Kentucky bluegrass was evaluated in the field from 1995 to 1998. Fertilizers were applied alone and in combination with lime or elemental sulfur (845 kg S ha<sup>-1</sup>). Disease severity was greater on turf that received CN than AS. Compared to CN alone, CN plus lime (396 kg CCE ha<sup>-1</sup>) enhanced symptom expression, while the addition of sulfur to CN reduced symptom development in 1998. Although turf treated with AS plus sulfur sustained low levels of summer patch in 1998, the combination resulted in extremely poor turf quality. Compared to AS alone, the application of AS plus lime raised soil pH but did not increase disease severity. Thus, lime may be applied with AS, to maintain acceptable soil pH levels, without reducing the effectiveness of AS for the control of summer patch in Kentucky bluegrass.

**Resistance of bentgrass cultivars to dollar spot under different cultural and chemical management practices.** J.N. VAICIUNAS, J.A. Murphy, B.B. Clarke. Dept. Plant Biology and Pathology, Rutgers University, New Brunswick, NJ 08901.

The susceptibility of bentgrass cultivars (CVS) to dollar spot (*Sclerotinia homoeocarpa*) and brown patch (*Rhizoctonia solani*) was assessed to identify factors that can be used to reduce fungicide inputs while maintaining acceptable turf quality. Eight bentgrass CVS were evaluated under field conditions. All CVS were maintained at two cutting heights: 0.356 cm (greens height) and 0.953 cm (fairway height), and two nitrogen levels: 0.012 kg m<sup>-2</sup> and 0.031 kg m<sup>-2</sup> year<sup>-1</sup>. CV treatments were subdivided into six fungicide application schedules (untreated, 7, 14, 28, or 56 day intervals, or an economic threshold of 0.3% disease) using the contact fungicide chlorothalonil. For most CVS, dollar spot was least severe on turf receiving the high rate of nitrogen. CVS Penn G2, SR 7200 and L-93 were least susceptible to dollar spot under most nitrogen and cutting height treatments. In general, brown patch was most severe on turf maintained at greens height and high nitrogen. In 2000, CVS SR 7200, L93, and Penn G2 required the fewest fungicide applications to control dollar spot.

**The current status of mummy berry on blueberry in North America.** L. A. WASILWA (1), P. V. Oudemans (1), and J. S. Lehman (2). (1) Rutgers University Blueberry Cranberry Research Center and (2) Otterbein College, Westerville, Ohio.

The fungus *Monilinia vaccinii-corymbosi* is the causal agent of the blueberry disease, mummy berry. The fungus is widespread in NA and is found in most blueberry growing regions. The phenology of apothecium development must be closely coordinated with host development for infection to occur. A comparison of ten NJ populations showed a good correspondence between mean apothecial development time of a population and AFLP band frequencies. However, approximately 60% of the total AFLP variation was found at the population level indicating significant genetic exchange between populations. Since most populations were mixed but differed in mean development time (different proportions of early and late phenologies) this result was not surprising. Samples from 17 populations across North America were tested for genetic variability using AFLPs and for vegetative compatibility using nit mutants. These mummy berry populations from highbush, lowbush and rabbiteye blueberries in NA were subdivided into two large clusters that correlate with two vegetative compatibility groups. Tight clusters representing the state or province of origin were found. Surprisingly, clusters representing the different blueberry species were not found.

**Impact of temperature and fungal isolate on the susceptibility of bentgrass cultivars to take-all patch.** E.N. WEIBEL(1), L.P. Tredway(2), B.B. Clarke(1). (1)Dept. of Plant Pathology and Biology, Rutgers Univ., New Brunswick, NJ 08901; (2)Dept. of Plant Pathology, Univ. of Georgia, Athens, GA 30602.

Susceptibility of 18 bentgrass cultivars to take-all patch was assessed in the growth chamber. Bentgrass was grown at a seeding rate of 20 g m<sup>-2</sup>. Six weeks after seeding, cultivars were inoculated with one of three isolates of *Gaeumannomyces graminis* var. *avenae* by placing one infested rye grain below the soil surface on opposite sides of each pot. Inoculated plants were incubated at either 15 or 20 degrees C using a 12 hr light/dark cycle. Disease susceptibility was determined by measuring the percent surface area exhibiting foliar symptoms. Cultivars SR7200, Penn A-1, Seaside II, SR1020, Providence, Putter, and Penn G-2 were least susceptible to take-all, whereas Penncross, Penneagle, and Penn A-4 were most susceptible to the disease. All first- and second-order interactions among temperature, cultivar, and isolate were statistically significant. Therefore, the susceptibility of bentgrass cultivars to take-all patch may vary among locations according to the fungal isolate and environmental conditions present.

**Sensitivity of *Pythium* isolates to metalaxyl.** R.L. WICK and M. B. Dicklow. Department of Microbiology, University of Massachusetts, Amherst, MA 01003.

Isolates of *Pythium* recovered from specimens submitted to the Plant Disease Diagnostic Clinic at the University of Massachusetts were subjected to a metalaxyl sensitivity assay. A total of sixty isolates were collected. The number of isolates recovered from crops were as follows: geranium 14, poinsettia 13, verbena 6, various vegetable crops 6, and the remainder from calibrachoa, dahlia, chrysanth-emum, a soilless medium, and irrigation water from an ebb and flow system. Isolates were tested on corn meal agar modified with 0, 50 and 100 mg/l active ingredient metalaxyl. Thirty-one isolates (52%) did not grow in the presence of 50 or 100 mg/l metalaxyl. Twenty-five isolates (42%) grew as well or nearly as well in 100 mg/l metalaxyl as they did in culture medium with no fungicide. Four (6%) grew well at 50 mg/l metalaxyl but not at 100 mg/l. Damping off of squash seedlings in the greenhouse was not controlled by metalaxyl when a metalaxyl-resistant (100 mg/l) strain was introduced into the growing medium.

**Effectiveness of prohexadione-Ca (Apogee 27.5DF) for fire blight shoot blight suppression in commercial apple orchards.** K.S. YODER (1), A.R. Biggs (2), J.L. Norelli (3). (1) VPI&SU, Winchester, VA 22602; (2), WVU, Kearneysville, WV, 25430; (3) USDA-ARS, AFRS, Kearneysville, WV.

Prohexadione-Ca (P-Ca) test plots were established in commercial orchards with recent history of fire blight infection in susceptible cultivars. The P-Ca rate, 125 mg/L, was adjusted, based on tree size, for airblast application at 935 L/ha to deliver 0.345 kg ai/ha in orchard #1 (O1) and 0.462 kg ai/ha in orchard #2 (O2). A surfactant (LI-700, 0.125% v/v) and a water-conditioning agent (Choice, 0.25% v/v, a 50% blend of salts of organic acids, phosphate ester and NH<sub>4</sub>SO<sub>4</sub>) were included. P-Ca was applied at late bloom 1 May in O1 (cv. 'York') and 2 May in O2 (cvs. 'York' and 'NW Greening'). Hail injury and rain in both orchards 26 May resulted in secondary spread of bacteria from blossoms to shoots. Due to renewed shoot growth, P-Ca was re-applied 29 June in O1 and 2 July in O2. In both orchards, similar amounts of blossom blight indicated that primary inoculum levels were uniform on treated and non-treated trees. In O1, P-Ca reduced shoot blight strikes by 88-94% in counts 8 June, 21 June or 9 Aug, and reduced shoot lengths by 18 May, 17 d after treatment. The second application reduced water sprout infection evident 9 Aug. At O2, P-Ca gave 94% control of shoot blight on 'York' 9 June and 96% on 'Greening' 13 June. On 'Greening', P-Ca also reduced by 76% the frequency of canker blight strikes (shoots with orange tips close to overwintered cankers).

**Early blight resistance in an F1 diploid hybrid potato population of *Solanum Phureja* × *S. Stenotomum*.** R. ZHANG (1), B. J. Christ (1), K.G. Haynes (2). (1) Dept. Plant Pathology, The Pennsylvania State University, State College, PA 16802; (2) USDA/ARS Vegetable Lab, Beltsville, MD 20705.

Early blight, caused by *Alternaria solani* Sorauer, is a serious disease of potato foliage and tubers that occurs in most potato growing regions worldwide. An F1 diploid out-cross mapping population was developed and evaluated for two years for early blight resistance. There were significant differences among the F1 clones for early blight resistance. Resistance, based on area under the disease progress curve (AUDPC), with continuous distribution, ranged from 361 to 2460 and from 614 to 2858 for 1999 and 2000, respectively. The average AUDPCs for the two parents were 1331 and 1989, as well as 1128 and 1584 for 1999 and 2000, respectively. There were F1 clones showing high levels of early blight resistance. The data will be used to identify and map early blight resistance genes in potato using DNA markers. This will improve our understanding of the genetics of disease resistance and facilitate our breeding program through marker-assisted selection.