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# APS Meeting Abstracts

and *Colpoda steinii* harbor WSSMV internally. Confocal microscopy of immunostained *Colpoda* cultures detected the presence of both structural and non-structural viral proteins within the protozoan. Direct sequencing of RT-PCR-amplified WSSMV RNA from six-month old monoxenic subcultures of *Colpoda* provided further evidence that WSSMV replicates in *Colpoda*. This is the first example of a plant virus able to replicate in a protozoan.

**Evolutionary history and intraspecific diversification of *Colletotrichum graminicola* lineages as reconstructed by Bayesian maximum likelihood analysis.** J. CROUCH, B. M. Glasheen, B. B. Clarke, and B. I. Hillman. Rutgers University, Dept. of Plant Biology and Pathology, New Brunswick, NJ 08901. Phytopathology 94:S164. Publication no. P-2004-0006-NEA.

The evolutionary history of *Colletotrichum graminicola*, the causal agent of anthracnose in turfgrass and maize, was reconstructed using molecular characters from multiple unlinked loci conducted under Bayesian maximum likelihood optimality criterion. Phylogenetic analysis generated two strongly supported clades that are generally concordant between gene trees and consistent with our transposon fingerprint profiles. Concordance among the gene trees from these loci suggests that each reflects the species phylogeny. Using these tree topologies as an evolutionary framework, we are examining the development of fungicide resistance in *C. graminicola* populations. We discuss differential fungicide sensitivity *in vitro* and present evidence for a parallel diversification and adaptive radiation of resistant phenotypes in lineages.

**Control of lupine anthracnose with strobilurin fungicides.** M. DAUGHTREY and M. Tobiasz. Cornell University, Long Island Horticultural Research and Extension Center, Riverhead, NY 11901. Phytopathology 94:S164. Publication no. P-2004-0007-NEA.

Anthracnose caused by *Colletotrichum gloeosporioides* on hybrid lupine (*Lupinus*) is currently problematic in nurseries. The disease occurs on seedlings in greenhouses as well as on mature plants outdoors. Infected lupines exhibit leaf spots and petiole cankers, and also twisting of petioles and pedicels. A greenhouse trial was conducted in May 2003 to evaluate strobilurin fungicides. Treatments began 16 May. Lupines were spray-inoculated on 16 and 21 May with a spore suspension. Symptoms were recorded 30 May, 12 and 24 June. Heritage 95 ME at 5.04 oz/100 gal (7-day interval) significantly reduced leaf spot incidence and outperformed Heritage WDG at 1 oz/100 gal. Heritage 95 ME was not effective when applied at a higher rate and longer interval. BAS 500 UK F 20 WG at 4 oz/100 gal (14-day) reduced disease at the first two ratings. Banner MAXX 14.3 percent EC at 5.2 oz/100 gal and A13705 at 1.33 oz/100 gal were not effective at the 14-day interval tested. Frequent applications of strobilurins and effective rotational fungicides are needed to manage lupine anthracnose and avoid strobilurin resistance in *C. gloeosporioides*.

**Development of *Gibberella zeae* perithecia under controlled temperature and moisture conditions.** N. S. DUFAULT (1), E. D. De Wolf (1), P. E. Lipps (2), and L. V. Madden (2). (1) Dept. Plant Pathology, Pennsylvania State University, University Park, PA 16801; (2) Dept. Plant Pathology, Ohio State University/OARDC, Wooster, OH 44691. Phytopathology 94:S164. Publication no. P-2004-0008-NEA.

Temperature and moisture are known to influence the development of *Gibberella zeae* perithecia, whose ascospores are a primary inoculum source for Fusarium head blight of wheat. Perithecial development was assessed through combinations of five temperatures (12, 16, 20, 24 and 28°C) and four moisture levels (0.0, 1.0, 2.4, 4.3 MPa) in growth chamber environments. After 20 days, the total number of perithecia produced at 20 or 24°C was significantly greater ($P = 0.01$) than numbers produced at 12, 16 or 28°C, with the least perithecia produced at 12 and 28°C. The number of perithecia produced was significantly ($P = 0.01$) increased in water compared to all other moisture treatments, and 4.3 MPa was significantly lower than the 1.0 and 2.4 MPa moisture treatments. Perithecial development of *G. zeae* appears to be reduced by low moisture and temperatures at or above 28°C and at or below 12°C. These results are being used to modify disease forecasting models for Fusarium head blight.

**Efficacy of using nonpathogenic isolates of *Fusarium oxysporum* and sodium chloride to re-establish asparagus in replanted fields.** W. H. Elmer. The Connecticut Agricultural Experiment Station, P.O. Box 1106, New Haven, CT 06504. Phytopathology 94:S164. Publication no. P-2004-0009-NEA.

Five strains of nonpathogenic *Fusarium oxysporum* (NPFO) were obtained from other laboratories and screened in the greenhouse for their ability to suppress Fusarium crown and root rot of asparagus in old asparagus soil. Half of the plants were treated with 100 ml of 1% NaCl, and untreated plants served as controls. Root weight was greater and root lesions were reduced when NaCl was applied. Strains CWB314, CWB318 and CS-20 had the most disease-suppressive potential and were selected for field studies. In 1999, asparagus crowns were inoculated with the three NPFO and planted in plots in abandoned asparagus fields in Hamden and Windsor, CT in 1999. Half of the plots received NaCl 280 kg/ha in 2000 and 560 kg/ha in 2001 & 2002. In Hamden, plots treated with the NPFO strain CWB318 had lower disease ratings than controls and more yield than plots treated with CS-20. Compared to controls, NaCl reduced the disease ratings, at both sites, but only significantly increased yield in Windsor. In both greenhouse and field the efficacy of the strain was associated with its ability to competitively colonize the asparagus roots.

**Evaluation of milk as a foliar spray for control of powdery mildew on pumpkin.** F. J. FERRANDINO, V. L. Smith, and R. Cecarelli. The Connecticut Agricultural Experiment Station, 123 Huntington St., P.O. Box 1106, New Haven, CT 06504. Phytopathology 94:S164. Publication no. P-2004-0010-NEA.

Seeds of pumpkin (cv. 'Howden') were sown four to a hill spaced 1.2 m within rows and 5.4 m between rows in plots at Lockwood Farm, Hamden, CT. There were 5 replicates (containing 3 or 4 hills) for each of 5 different treatments arranged in a 5 × 5 latin square. The treatments were: no spray, 1% baking soda ($NaHCO_3$), 50% whole milk (3.8% milkfat), 50% skim milk (0.5% milkfat), and a fungicide control consisting of an alternating tank mix of chlorothalonil (1.8 kg/ha Bravo 90DG) and either azoxystrobin (0.4 kg ai/ha Quadris), benomyl (0.9 kg ai/ha Benlate 50WP), or no systemic fungicide. Disease severity was monitored weekly over the course of the season. In general, the whole milk treatment and skim milk treatment were not significantly different, and both were slightly less effective than the fungicide treatment. On the last evaluation date, both fungicide control and the milk treatments had significantly less chlorotic tissue than the unsprayed control.

**Selection of antagonist microorganisms against *Pythium ultimum* and *Pythium aphanidermatum*, two causal agents of damping-off of greenhouse tomato seedlings.** V. GRAVEL (1), C. Martinez (1), H. Antoun (2), and R. Tweddell (1). (1) Centre de recherche en horticulture, Université Laval, Québec, Qc G1K 7P4 Canada; (2) Dépt. des sols et génie agro-alimentaire, Université Laval, Québec, Qc G1K 7P4 Canada. Phytopathology 94:S164. Publication no. P-2004-0011-NEA.

Damping-off, caused by *Pythium ultimum* and *Pythium aphanidermatum*, is an important disease of many crops, including greenhouse tomato. The objective of this study was to isolate, from different tomato growing media, antagonist microorganisms against these pathogens. A total of 237 microorganisms (160 bacteria and 77 fungi) were isolated from different growing media. An *in vitro* assay allowed to identify 40 different microorganisms that reduced the mycelial growth of both pathogens. Of those microorganisms, three bacteria, *Pseudomonas fluorescens* subgroup G, *Pseudomonas corrugata* and *Pseudomonas marginalis*, significantly reduced damping-off of tomato seedlings caused by either one of the two pathogens. These bacteria may be of some interest as biocontrol agents of the disease.

**Anthracnose as influenced by nitrogen, growth regulators, pre-emergence herbicides, and verticutting.** J. C. INGUAGIATO, J. A. Murphy, T. J. Lawson, J. Crouch, and B. B. Clarke. Dept. Plant Biology & Pathology, Rutgers University, New Brunswick, NJ 08901. Phytopathology 94:S164. Publication no. P-2004-0012-NEA.

Due to an increase in the occurrence of anthracnose, caused by *Colletotrichum graminicola*, on putting greens in the United States, the effect of nitrogen (N), the growth regulators mefluidide (ME) and trinexapac-ethyl (TE), and verticutting (VC), on disease severity was assessed on two *Poa annua* greens mowed at 3.2 mm. The study was arranged as a 2 × 2 × 2 × 2 factorial design with four replications: N (4.9 kg $ha^{-1}$ N as $NH_4NO_3$ every 7 or 28 d; May to October), ME (2.2 L $ha^{-1}$ on 14 and 28 April), TE (0.4 L $ha^{-1}$ every 14 d; April to October), and VC (3 mm deep by 13 mm spacing every two weeks June through July). Turf receiving high N had 37 to 65% less disease than turf maintained at low N. ME enhanced disease in June, compared to turf not treated with ME. Later in July, TE reduced anthracnose severity, compared to non-TE treated turf. In a non-factorial part of the study, the pre-emergence herbicides (PEH) dithiopyr and bensulide increased disease when applied once (28 April) to turf receiving VC and high N, compared to similarly maintained turf without PEH. In some cases, VC appeared to affect disease.

**Evidence of resistance in *Pinus contorta* to *Gremmeniella abietina*, European race.** G. LAFLAMME, M. Simard, and D. Rioux. NRCan, CFS,

Laurentian Forestry Centre, P.O. Box 3800, Sainte-Foy, QC, Canada G1V 4C7. Phytopathology 94:S165. Publication no. P-2004-0013-NEA.

We have recently demonstrated that *Pinus banksiana* (Pb) is resistant to the European race of *G. abietina* and a defense mechanism has been described. *P. contorta* (Pc), located in western North America, is genetically close to Pb with which it hybridizes at the junction of the two populations in Yukon, Canada. Our objective was to verify if Pc shows any resistance to *G. abietina*, European race. A field trial was conducted with Pc seedlings planted inside a 20-year-old *P. resinosa* (Pr) plantation infested with the disease. Pb and Pr seedlings were used respectively as controls for resistant and sensitive species. After two seasons, all Pr seedlings had died of the disease while all Pb and all but one Pc had survived. There were similarities between the resistant Pc seedlings and Pb: the infection was limited to a 2-3 cm long tip blight. A suberized defensive zone was initiated at the base of healthy needles. This zone reached the vascular cambium before proceeding downward. Tissue regeneration, formation of traumatic resin canals and accumulation of phenols are also associated with the defense system of Pc against this disease.

**Integrated management of rusty spot of peach.** N. LALANCETTE, L. A. Furman, and J. F. White. Dept. of Plant Biology and Pathology, Rutgers University, New Brunswick, NJ 08901. Phytopathology 94:S165. Publication no. P-2004-0014-NEA.

Two biorational fungicides, *Bacillus subtilis* and potassium bicarbonate, were examined in integrated programs with the standard myclobutanil for management of rusty spot on 'Jerseyglo' peach in 2002. Based on past epidemiological research, four fungicide applications beginning at petal fall and ending at endocarp sclerification were necessary for effective management. Thus, integrated treatments consisted of the biorational (B) and standard (S) fungicides applied in alternation (SBSB), block (SSBB), reverse block (BBSS), and mixture programs. Treatments were arranged in a RCBD with four replicates. Seven disease assessments were conducted during the progressive phase of the epidemic. Analysis of areas under the disease progress curves indicated that all integrations except the block program with *B. subtilis* were as effective as the standard. Disease control ranged from 79.8 to 87.3% for successful treatments versus 88.6% for the standard. These results demonstrated that the integration of reduced-risk fungicides in disease management programs can reduce usage of conventional fungicides by 50% without any significant loss of control.

**Evaluation of drift from helicopter-applied fungicides.** J. A. LAMONDIA (1), F. J. Ferrandino (1), and M. J. Incorvia-Mattina (2). (1) Dept. of Plant Pathology and Ecology and (2) Dept. of Analytical Chemistry, CT Agricultural Experiment Station, Windsor, CT 06095. Phytopathology 94:S165. Publication no. P-2004-0015-NEA.

Acrobat MZ fungicide (dimethomorph and mancozeb) was applied by helicopter to a 1.8 ha commercial shade tobacco tent on ten dates over two years. Samples were collected from 100 sites above and inside the tent and outside at distances of 7.6, 15.2, 30.5, 61.0, 152.4 and 304.8 m on each spray date. Samples consisted of filter paper discs for active ingredient (ai) analyses and water sensitive papers for spray droplet analyses. Samples were analyzed for dimethomorph by HPLC and ultra violet detection. Mancozeb was analyzed indirectly using ICP analysis. Average spray droplet diameter at the tent was greater than 225 microns; droplets collected at 30.5 or 61.0 m averaged less than 25 to 30 microns. Large droplets contain more ai, deposit quickly and are less affected by air movement. The dimethomorph deposited outside the tent was below the quantifiable limit of 0.016 micrograms ai/cm$^2$ for all samples but one (0.21 micrograms ai/cm$^2$ at 7.6 m). On average, 93.6% of the ai was deposited within the tent, 99.1% within 7.6 m, 99.3% within 15.2 m, 99.4% within 30.5 m and 99.6% within 61.0 m.

**Managing powdery mildew in winter squash with genetic control and chemical control.** M. T. MCGRATH. Dept. Plant Pathology, Cornell Univ., Riverhead, NY 11901. Phytopathology 94:S165. Publication no. P-2004-0016-NEA.

Field experiments were conducted in 2002 and 2003 to evaluate new powdery mildew resistant (PMR) cultivars of acorn and butternut squashes. There is a single codominant gene source of PMR in squash and pumpkin. The fungicide program was azoxystrobin applied in alternation with myclobutanil plus chlorothalonil in 2002 and trifloxystrobin plus chlorothalonil alternated with triflumizole plus sulfur in 2003. Treatments were started after observing symptoms for each cultivar. Powdery mildew was controlled best by growing a cultivar homozygous for PMR. Chemical control was not as effective as expected, possibly due to resistance to strobilurin fungicides. Applying fungicides to a susceptible cultivar provided better control than growing a cultivar heterozygous for PMR. Control similar to weekly fungicides was obtained when applications were made every 14 days to resistant cultivars as every 7 days. Seed prices of the resistant cultivars varied. Thus cost of an integrated control program (fungicides applied on a 14-day interval to a resistant cultivar) ranged in 2002 from $99/A less to $17/A more than applying fungicides weekly to a susceptible cultivar.

**Quantitative Real-time RT-PCR expression analysis of an endochtinase gene during mycoparasitism.** D. C. MORISSETTE (1), B. T. Driscoll (2), and S. Jabaji-Hare (1). (1) Dept. Plant Science, Macdonald Campus, McGill University, Ste-Anne-de-Bellevue, Qc, CANADA H9X 3V9; (2) Microbiology Unit, Dept. Natural Resource Sciences, Macdonald Campus, McGill University, Ste-Anne-de-Bellevue, Qc, CANADA H9X 3V9. Phytopathology 94:S165. Publication no. P-2004-0017-NEA.

We have shown in previous studies that the mycoparasite *Stachybotrys elegans* produces different cell wall degrading enzymes (CWDEs) during its interaction with the soilborne pathogen *Rhizoctonia solani*. Recently, we cloned a gene encoding a CWDE, an endochitinase designated as *sechi44*, from *S. elegans*. In order to confirm that *sechi44* is differentially expressed during dual interaction between the mycoparasite and its host, the expression of *sechi44* was analysed quantitatively by Real-time RT-PCR. Both fungi were grown in dual culture, and RNA was extracted, and retrotranscripted into cDNAs, from the intermingled hyphae at different time periods, after and before contact of both fungi. Real-time RT-PCR analysis showed that the expression of *sechi44* increased after 2 days of contact reaching a 10-fold increase after 9 days, followed by a decrease to basic expression level at 12 days. Interestingly, the expression of the gene was down regulated when *S. elegans* hyphae were in close proximity with *R. solani* hyphae. These results confirm that *sechi44* plays a role during mycoparasitism.

**A fast apple scab technique to evaluate resistance (FASTER).** V. PHILION. IRDA, St-Hyacinthe, Qc J2S 7B8. Phytopathology 94:S165. Publication no. P-2004-0018-NEA.

For the last 40 years, growers have used apple scab fungicides prone to the development of resistance. Routine resistance monitoring is currently too costly, and growers using these products are at risk of facing crop failure when resistance occurs. We developed a simple and cost effective in vitro test to evaluate the population EC50 of *Venturia inaequalis* for cyprodinil, flusilazole, dodine, thiophanate-methyl, and kresoxim-methyl based on ascospore growth. Spores were incubated for 48 hours in a liquid suspension containing fungicide. Mycelial growth for each fungicide concentration was evaluated using a modified line-intercept method. Results showed that the method can reliably detect shifts in EC50 between baseline sites and commercial orchards. In certain commercial orchards, shifts in EC50 were recorded for more than one fungicide. Preliminary results show that the method can also be used with conidia to establish the distribution of sensitivity among clonal isolates. Although the threshold EC50 for practical field resistance still needs to be established for all fungicides, the method can already be used for routine monitoring. This technique is patent pending in the USA.

**The protective effects of silicon in powdery mildew-infected wheat.** W. RÉMUS-BOREL (1), S. Grégoire Valentini (1), J. G. Menzies (2), and R. R. Bélanger (1). (1) Département de Phytologie, Université Laval, Sainte-Foy, Québec, G1K 7P4, Canada; (2) Cereal Research Centre, 195 Dafoe Road, Winnipeg, Manitoba R3T 2M9, Canada. Phytopathology 94:S165. Publication no. P-2004-0019-NEA.

Most plants can defend themselves against fungal infections by natural means, which can be elicited by a number of biotic and abiotic elicitors. Recently, soluble silicon (Si) has been shown to induce resistance in a number of plant species. Microscopic and ultrastructural observations have highlighted the presence of phenolic-like material associated with degraded powdery mildew haustoria. Since phytoalexins have never been reported in wheat, we sought to clarify the chemical nature of the fungitoxic compounds produced within the leaves of Si-treated wheat plants infected with *Blumeria graminis* f. sp. *tritici* (Bgt). TLC analyses coupled with a bioassay have revealed the differential presence of fungitoxic aglycones between Si-treated and control plants. Furthermore, HPLC analysis has confirmed that Si-treated plants infected with Bgt produced larger amounts of yet to be identified aglycones. These results would indicate that wheat could potentially produce phytoalexins in response to powdery mildew infection.

**Effects of calcium on wood degradation and oxalate dynamics in agar-block tests of two brown-rot fungi.** J. S. SCHILLING and J. Jellison. Dept. of Biological Sciences, Univ. of Maine, Orono, ME 04469. Phytopathology 94:S165. Publication no. P-2004-0020-NEA.