survive/overwinter in citron melon seeds for at least 7 years and may serve as a local source of inoculum for BFB epidemic in the field.

Emergence and characterization of powdery mildew on hop cultivars with R6-based resistance

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Phytopathology 103(Suppl. 2):S2.38

Podosphaera macularis, causal agent of powdery mildew on hop, is endemic to the hop growing areas of Oregon, Washington and Idaho. The disease reduces cone quality and can lead to crop rejection. Powdery mildew on hop is managed largely through fungicide application and major gene resistance. In summer 2011, powdery mildew was observed in two hop yards planted to cultivars with the commonly deployed R6-based resistance. The purpose of this study was to characterize the spread and severity of powdery mildew on formerly resistant cultivars and virulent isolates of *P. macularis*. In 2012, 31 yards planted to cultivars possessing R6 were surveyed for powdery mildew. Incidence of powdery mildew varied among geographic regions in Washington, but was not observed in Oregon. Significant differences also were found in the incidence of powdery mildew among cultivars, suggesting that background resistance traits may affect susceptibility. Among 183 *P. macularis* isolates collected from Idaho, Oregon, and Washington, all were found to be of one mating type and no v6 isolates were recovered from non-R6 cultivars. Surveys will be repeated in the summer of 2013 and 2014 to more fully characterize the distribution of powdery mildew on cultivars with R6 and their susceptibility to the disease. Additional research is ongoing to assess fitness penalties associated with R6 virulence.

Importance of potato volunteers as a source of '*Candidatus* Liberibacter solanacearum' in the Columbia Basin of Oregon and Washington

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Phytopathology 103(Suppl. 2):S2.38

Zebra chip (ZC) disease caused by '*C.* Liberibacter solanacearum' (Lso) was first reported in OR and WA in 2011. The importance of Lso infected potato volunteers as pathogen sources in OR and WA is untested. Potato cultivars Umatilla and Ranger fields heavily infected with ZC in 2011 were surveyed 11 May 2012 for symptomatic volunteers. Symptomatic plants were tested by PCR to confirm the presence of Lso. Of the tested symptomatic plants, 48.6% of the Ranger and 53.3% of the Umatilla were positive. The percent plants per acre that were both ZC symptomatic and Lso positive were 4% (Umatilla) and 7% (Ranger). To determine if seed tubers from Lso infected plants could be a source of the bacterium, naturally infected tubers from 6 potato cultivars were collected fall 2011, stored in a potato storage facility and planted, with healthy seed (control), in a screen house in the spring of 2012. Symptomatic plants were tested for the presence of Lso. ZC incidence and severity in seed tubers was determined for each cultivar. Overall emergence was 53% for tubers from infected fields and 99% from healthy seed. Of the emerged test plants, 10.3% showed ZC symptoms, and 58% of these plants were positive for Lso. ZC symptomatic plants emerged faster, were smaller, and died earlier than asymptomatic and healthy controls. Although plants emerged with Lso from infected tubers, they are not likely to be a significant source of Lso in OR and WA due to mitigating factors.

Biocontrol potential of endophytic fluorescent *Pseudomonas* isolated from *Salvadora* species

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Phytopathology 103(Suppl. 2):S2.38

The *Salvadora* species have a number of proven medicinal applications and almost all parts of this plant have pharmacological importance. Plants are able to tolerate dry environment and high soil salinity. In the present study 62 isolates of endophytic fluorescent *Pseudomonas* were isolated from roots, shoots and leaves of two species of *Salvadora* i.e. *S. persica* and *S. oleoides.* Most of these isolates were identified as *P. aeruginosa*. *In vitro* test several isolates showed strong antifungal activity against root rotting fungi *Macrophomina phaseolina*, *Rhizoctonia solani*, *Fusarium solani* and *F. oxysporum.* Cell free culture filtrates of these isolates also showed significant nematicidal activity by killing the 2nd stage juveniles of root knot nematode (*Meloidogyne javanica*), at varying degrees. Application of potential isolates of *P. aeruginosa* as soil drench significantly prevented the attack of root rotting fungi and root knot nematode on mungbean, sunflower and cotton plants both in screen house and field experiments by reducing the fungal root infection and nematode's penetration in roots. Endophytic fluorescent *Pseudomonas* also caused a positive impact on plant growth by producing taller plants and healthy roots with increased in fresh shoot weight. Endophytic fluorescent *Pseudomonas* offer a non-chemical means of plant diseases control.

Mutations in the *Potato leafroll virus* non-structural protein p17 impair aphid transmission but do not affect virion assembly

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Phytopathology 103(Suppl. 2):S2.38

Potato leafroll virus (PLRV) is a phloem-limited positive-strand RNA virus transmitted in a persistent manner (circulative, non propagative) by aphids. A non-structural, p17 protein encoded by the ORF 4, contained within CP gene in a different reading frame, was previously identified as a host-dependent movement protein of PLRV. Twelve point mutations were generated in p17 without changing the overlapping CP amino acid sequence. These p17 mutant viruses were able to replicate and move systemically in *Nicotiana benthamiana* although they accumulated at different rates in systemically infected tissues. Efficiency of transmission of these PLRV-p17 mutant viruses from *N. benthamiana* to *N. benthamiana* by aphids was null or greatly impaired compared to the wild type PLRV. Virions purified from plants infected with these PLRV mutants were found to contain the same composition of structural proteins as the wild type PLRV. The p17 protein was not found in virions of the wild type PLRV and most of the mutants. The involvement of p17 in virus transmission, thus, occurs at other stages of PLRV life cycle, distinct from virion assembly.

Operational warning for Septoria leaf blotch and leaf rust in winter wheat: Importance of fungicide dosage, formulation, and spray time

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Phytopathology 103(Suppl. 2):S2.38

Field experiments were conducted in 2010 to investigate the effect of fungicide commercial formulation, timing and dosages on the severity of these two diseases in winter wheat in Luxembourg. Different types of fungicides and fungicide combinations containing active ingredients such as triazoles and strobilurins were used in field trials including susceptible cultivars to Septoria leaf blotch (SLB, caused by *Septoria tritici*) and wheat leaf rust (WLR, caused by *Puccinia triticina*). The three formulations of fungicides tested were: (i) a mix of triazole and amine (Prothioconazole 250 g/l + Spiroxamine 500 g/l) associated with chlorothalonil 500 g/l, (ii) sole strobilurin (Azoxystrobine 250 g/l), and (iii) a mix of strobilurin and triazole (Epoxiconazole 125 g/l; Azoxystrobine 250 g/l). The optimum time of fungicide spray was assessed through the mechanistic model PROCULTURE and a stochastic model based on night favourable weather conditions conducive to WLR development. The results showed that for plots treated with fungicide formulation containing either a triazole or a strobilurin, the grain yield earned was not significantly different from the untreated plots ($P > 0.05$). Whereas single fungicide treatment involving a mixture of triazole and strobilurin at the optimum time gave an earning (on average 7 dt ha^{-1}) compare to the control and a yield similar to that obtained with the double or triple fungicide treatments.

Profitability of using warning system for foliar disease of wheat in the Grand-Duchy of Luxembourg

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Phytopathology 103(Suppl. 2):S2.38

Although small grain cereals (i.e. winter wheat) are routinely protected with two or three foliar treatments in the Grand-Duchy of Luxembourg (GDL), environmental concerns and changes in the cost-benefit ratio are likely to increase the demand for more accurate identification of spraying needs. A

warning system assessing in real time the risk of progression of fungal diseases on winter wheat (*Triticum aestivum* L.) was tested in the GDL over the 2009-2012 period in four-replicated field experiments located in three representative villages of the different agro-climatological zones. The fungicide treatments recommended by the warning system during this period have ensured economic profitability equivalent to or even better than double and triple treatments. In 2010 and 2011, weather conditions impeded fungal infections of wheat and no warning was issued, reducing fungicide use. The study also highlighted that multiple fungicide applications were not better than a single application. In 2009 and 2012, although the weather conditions were very favourable for fungal wheat diseases, the single recommended fungicide application resulted in an additional yield of 30% compared to untreated plots. This study shows the importance of the positioning of fungicide treatment in such a warning system and in strategies aiming at reducing the spread fungicide molecules in the environment.

The population dynamics of *Phytophthora infestans* in Egypt

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Phytopathology 103(Suppl. 2):S2.39

For understanding the structure and dynamics of the Egyptian *Phytophthora infestans* population, 205 *P. infestans* isolates were collected from commercial potato fields in Egypt during the 3-year period 2010-12. Mating type for each isolate was determined. The test showed that 57% of the isolates were belonged to mating type A1, 35% were belonged to mating type A2 and the rest 8% were self-fertile. Genotyping of 85 Egyptian isolates as well as 15 references isolates represented the United Kingdom population was performed using 12 highly informative microsatellite (SSR) markers. Structure analysis grouped the 84 identified genotypes into two main clonal lineages. The first clonal linage was comprised 21 isolates belonged to A2 mating type and 8 self-fertile isolates. This clone was identified as Blue_13 or 13_A2. Within the 13_A2 clone, 3 distinct sub-clonal lineages were also identified i.e. 13_A2_5, 13_A2_43 and 13_A2_84. The second main clonal lineage was comprised 55 isolates. This clone was identified as 23_A1. Worldwide, 19 sub-clonal lineages were identified within 23_A1. Ten out of 19 were found in the Egyptian population. They are known as: 23_A1_4, 23_A1_10, 23_A_12, 23_A1_13, 23_A1_14, 23_A1_15, 23_A1_16, 23_A1_17, 23_A1_18 and 23_A1_19. In addition, 18 Egyptian isolates were screened for the presence or absence of 5 effector genes which trigger the host susceptibility or immunity. The present gene was sequenced to determine of its function.

Armillaria root disease in peach orchards of the state of Mexico, Mexico: Characterization of *Armillaria* species and assessment of disease impact

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Phytopathology 103(Suppl. 2):S2.39

Armillaria root disease is causing extensive mortality of peach (*Prunus persica*) trees within orchards in the State of Mexico, Mexico. Within 15 monitored orchards, average tree mortality was 9.7, 15.3, and 20.3% and disease-impacted area was 23.2, 24.7, and 28.3% during 2009, 2010, and 2011, respectively. Both rootstocks (cultivars of 'Nemaguard' and 'Criollo of La Goleta') used in the region were susceptible to the disease. Pathogenic *Armillaria* spp. were identified by DNA sequencing of two rDNA regions (partial 5.8S-ITS2-LSU D-domains and partial 3' LSU-IGS1) and the translation elongation factor-1α (*tef-1a*) gene, accompanied by phylogenetic analyses. Analyses of 49 *Armillaria* isolates revealed that five isolates (10.2%) were *A. mellea*, eight isolates (16.3%) were *A. gallica*, and 36 closely related isolates (73.5%) showed no close similarity to *Armillaria* sequences in GenBank, and apparently represent an undescribed *Armillaria* species. This undescribed Mexican *Armillaria* species is phylogenetically quite distinct from other North American *Armillaria* spp., and efforts are underway to formally describe this undescribed species. Accurate identification of *Armillaria* pathogens in peach orchards is a critical first step toward developing disease management practices, such as resistant rootstock.

Morphological and molecular characterization of *Fusarium* isolates collected from date palm in Saudi Arabia

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Phytopathology 103(Suppl. 2):S2.39

Fusarium is one of the most destructive fungal genera and it causes many diseases for plants, animals, and humans. We have collected 71 *Fusarium* isolates from date palm (DP) trees from seven locations in Saudi Arabia. We have single-spored these isolates and kept in 15% glycerol in -80C for long term preservation. These fungal isolates have been morphologically characterized by using appropriate media, e.g. SNA and PDA media. At the molecular level, three genes (translation elongation factor 1 α, b-tubulin, and rDNA-ITS) have been amplified and sequenced to confirm the identity of these fusaria. Morphological and phylogenetic analyses showed that there are five main *Fusarium* species recovered from DP tissues in Saudi Arabia. *Fusarium proliferatum* was the most dominant species (51%), followed by *F. solani* (11%) and *F. phaseoli* (8%). Moreover, five *F. oxysporum* were identified and we are checking if they are belonging to f. sp. *albedinis*. Based on the DNA sequence, same haplotypes were recovered from different DP-growing locations suggesting that DP offshoots or other plant materials could be moved or transported among the Kingdom leading to the dispersal of *Fusarium* pathogens. Efforts should be paid to restrict the movement of diseased DP materials among different locations within the kingdom to avoid the spread of pathogenic fungi. Also, the potential toxin risks of these toxigenic *Fusarium* isolates should be evaluated.

Efficay of foliar applications of a phosphite fungicide for control of apple scab, caused by *Venturia inaequalis*

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Phytopathology 103(Suppl. 2):S2.39

Phosphite fungicides have been shown to be effective in controlling diseases caused by oomycetes, as well some fungal plant pathogens. We have studied the efficacy of foliar applications of the phosphite fungicide AGRI-FOS for control of apple scab, caused by *Venturia inequalis*. Dilute foliar applications of the product were made with a hand gun to McIntosh and Delicious apple trees at the rate of 1.89 L per 378.5 L of water. Trees were sprayed until foliage was wet. Treatments were applied in a 7-day standard protectant program, in a curative program applied at 24, 48 and 72 hours after the initiation of an infection period, and in an extended protectant program in combination with Captec fungicide at 0.95 L per 378.5 L of water. Treatments were applied from 12.7 mm (0.5 inch) green through first cover. All treatments received cover sprays of Captec at 7 L per ha on a 14-day schedule starting at second cover for the remainder of each season. All treatments and programs provided good to excellent control of apple scab compared to the non-treated control. Incidence of primary scab for the foliar application in 2008, 2009 and 2010 on McIntosh was 3, 2, and 2% for treated trees, and 96, 92 and 79% for the untreated control. Curative treatments provided a significant level of scab control when applied up to 72 hours after infection. The extended protectant program also provided excellent control of primary scab in 2 years of testing.

Genotypic and phenotypic characterization of isolates in the *Fusarium oxysporum* species complex from soybean roots

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Phytopathology 103(Suppl. 2):S2.39

The *Fusarium oxysporum* species complex (FOSC) includes economically important pathogens to many hosts. In Iowa, *F. oxysporum* is the most frequent *Fusarium* species isolated from soybean roots, and isolates range from aggressive seedling and root rot pathogens to non-pathogenic isolates. The objective of this research was to characterize the genotype and phenotype of isolates within the FOSC from soybean roots. Sequence analyses of the elongation factor 1-α (TEF) gene and the mitochondrial small subunit (MtSSU), identification of mating type loci, and vegetative compatibility (VC) tests were used to genotypically characterize 102 soybean isolates from Iowa. Pathogenicity was tested using a rolled towel assay in which soybean seed was inoculated with 100 µl of $1x10^6$ conidia/ml. Phylogenetic analysis of the TEF and MtSSU identified four previously described clades, including *F. commune*. Mating type loci MAT1-1 and MAT1-2 were present in isolates from all clades. Isolates differed in aggressiveness within and among clades; one clade had many isolates that were significantly less aggressive ($P < 0.0001$) when compared to isolates from the other *F. oxysporum* clades and *F. commune*. Current data indicate that aggressiveness may correspond to VC