VCG4B isolate infected oat as an endophyte and potato as a pathogen in a rotational cropping system. We will discuss implications of these results in disease management and population biology of *Vd*.

Survey for grapevine leafroll viruses in Pennsylvania

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Grapevine leafroll disease, caused by grapevine leafroll associated viruses (GLRaVs), is a serious disease of cultivated *Vitis* species. Determining the incidence of these viruses across Pennsylvania and their impact on yield and fruit quality are essential for quantifying the potential economic impact of GLRaVs and best management practices. Therefore, a two-year statewide survey was conducted among commercial vineyards for GLRaV-1 and 3, the most important GLRaV species in grapevines. Sixty-three vineyard blocks of *Vitis vinifera* 'Cabernet franc' (18), 'Pinot noir' (10), 'Chardonnay' (16), and 'Riesling' (8) and *Vitis* interspecific hybrid 'Chambourcin' (11) were sampled from 24 sites. Leaf petiole samples from symptomatic and a-symptomatic vines (30 vines/block) were collected between veraison and harvest and analyzed via ELISA. GLRaV-1 and/or 3 was present in a third of the blocks examined; one of 11 Chambourcin blocks sampled (9%), and 20 of 52 *V. vinifera* blocks sampled (38.5%) contained vines that tested positive for GLRaV-1 and/or 3. In the second year of the study, two vineyards of Cabernet franc with a low incidence of the virus were selected to evaluate the effects of GLRaV-1 and/or 3 on yield and fruit chemistry at harvest, as well as bud freeze tolerance during the dormant season. Vines testing positive for the virus(es) had lower fruit soluble solids in one vineyard, and higher titratable acidity in the other. There were no significant effects on yield.

Nanoparticles of Cu for suppression of Fusarium root diseases

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The micronutrient Cu promotes defense mechanisms in plant roots. For example, phenols are enzymatically produced by polyphenol oxidase (PPO) which is activated by Cu. However, obtaining sufficient levels of Cu in susceptible roots can be compromised by their poor availability in slightly acid-neutral soils and by their poor mobility in plants. However, when Cu is applied as CuO or $Cu_3(PO4)_2$ nanoparticles (NP) (1-100 nm), they provide more disease suppression than their larger bulk or ionic equivalents. We exposed young seedlings of begonia, chrysanthemum, cyclamen, soybeans, tomatoes, and watermelon to NP of Cu (500 µg/ml) and observed that Fusarium wilt and root rot were suppressed and growth were enhanced. Many times a single application resulted in season long suppression. In tomato and watermelon, analyses of gene expression (by RT-qPCR) in Fusarium infected tomatoes and watermelon revealed upregulation of PPO and pathogenicity-related genes (PR1) in plants treated with NP Cu. In tomato up regulation was within a week of treatment and before the onset of symptoms. These findings suggest that NP CuO may serve as a highly effective delivery agent for Cu and that when applied to seedlings at a young age can promote root health and impact yield. NP of Cu could help sustain food production as climate changes increase the threat of drought, stress, and disease.

Antifungal activity of new quinolone and acridone-derivatives

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Development of fungal resistance decreases fungicide effectiveness and leads to spoilage and potential contamination of food and feed products with mycotoxins. Chemical synthesis is the most common way to develop new antifungal agents. The goal of this study was to assess the antifungal activity of newly synthesized 3-hydroxy-quinolones and amides of acridone-carboxylic acid derivatives. Many triazole-based, synthetic fungicides initially interfere with ergosterol and melanin synthesis. The primary targets of quinolone and acridone derivatives are enzymes in the biosynthesis pathway of nucleic acids (polymerases and/or topoisomerases). In our experiments, both groups of the newly synthesized compounds demonstrated growth inhibition, affected the development of hyphae and conidia, and caused colony discoloration of the plant pathogens, *Fusarium* spp., suggesting activity towards ergosterol and melanin synthesis. The compounds studied also demonstrated effective inhibition of the *in vitro* model transcription assays, based on bacteriophage T7 DNA-dependent RNA polymerase. Molecular docking also revealed the formation of a nonproductive, enzyme-inhibitor-DNA complex that leads to a loss of catalytic activity of the polymerase. The results from this study demonstrate that the 3-hydroxy-quinolones and amides of acridone-carboxylic acid derivatives appear to have several cellular targets responsible for the antifungal properties.

Field efficacy of SDHI active ingredients on multiple SDHI mutations of *Sclerotinia homoeocarpa*

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