Endophytes and tree health: Disease anatomy and microbial ecology of the *Neonectria ditissima* pathosystem (European apple canker)
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The fungus *Neonectria ditissima*, the causal agent of European apple canker, may cause asymptomatic infections of plant tissues that can lay dormant up to three years. This hinders the effective management of cankers. During the asymptomatic stage, *N. ditissima* is speculated to behave inside trees like an endophyte, colonizing plant tissues at a distance from the initial infection/entry site. The extent of its potential internal colonization and its interactions with other apple endophytes have not been investigated, but could have an impact on disease management. Answering these questions could help to develop sampling strategies for diagnostics, or to exploit endophytes for biological control. In this study we first quantified the extent of internal colonization prior to visual symptoms. Using real time qPCR it was possible to track the spread of *N. ditissima* in the host, and we found that the pathogen does not extensively colonize plant tissues, being predominantly localized at the entry site. Currently, we are using high-throughput next generation sequencing techniques to characterize the endophytic species profiles associated with different apple cultivars, either resistant or susceptible to canker. Our aim is to assess whether the cultivar response to canker is related to its endophytes, and if so how different endophytic species correlate with disease resistance.

Anaerobic soil disinfestation: Manipulating the Florida soil microbiome
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Anaerobic soil disinfestation (ASD) is a pre-plant, non-fumigant soil treatment, used to manage soil-borne pathogens, nematodes and weeds. The primary mechanism behind ASD is the manipulation of the microbiome by creating an anaerobic environment and providing labile carbon. In Florida, feed grade molasses, the carbon, and composted broiler litter are incorporated into the soil, which is then covered with a plastic mulch and watered to field capacity. ASD has been applied in both annual and perennial crops including: tomato, pepper, cucumber, strawberry, fresh cut flowers, and citrus. Plants are transplanted three-weeks post application. By combining molecular techniques and temporal sampling, shifts in the microbiome were observed during ASD treatment. Within 24 hrs. of ASD application, the microbiome shifts to an anaerobic population and the pH decreases. Throughout the treatment the microbial population is in flux. Changes in the microbiome are highly correlated to the ebb and flow of organic acids detected in ASD treated soil. ASD has an expeditious and long-term effect on the microbiome. An ASD experiment on citrus, consisted of planting three different rootstocks in ASD treated and non-treated soil. Two years post ASD application, the soil bacterial populations were significantly influenced by the non-treated rootstocks. However, rootstock had little to no influence in the ASD treated soil. While all the citrus trees tested positive for Huanglongbing, ASD treated trees had greater trunk and stem diameters, canopy, and yield compared to the non-treated trees.

Weather-based epidemiological models for Alternaria blight of oilseed brassicas in India
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Alternaria blight is the most widespread and destructive disease of oilseed *Brassica* across the globe. In India, it is mainly caused by *Alternaria brassicae* (Berk.) Sacc. which infects all aboveground part of crop and produces grey color spots. Although total destruction of crop due to disease is rare, yet yield loss can reach up to 47% with reduction in seed quality *viz.,* seed size and viability. The knowledge of probable attack of disease in advance may be very useful to farmer to take timely and appropriate protection measure to reduce the loss. Weather plays an important role in disease development. A well-tested weather-based model can be an effective tool for disease forewarning. In this study, weather-based forewarning model was developed for crop age at peak severity and maximum severity (%) of the disease on leaf and pod (used as dependent variable) for three location in India *viz.,* New Delhi, Hisar (Haryana) and Mohanpur (West Bengal). Historical disease data (2004–14) and weather data (Temp., RH, rainfall and bright sunshine hours) were utilized as independent variable for model development and their validation for two subsequent year (2014–16). Validation of the prediction model for crop age at peak severity and maximum severity (%) of the disease proved the efficiency of the targeted forecasts. On this basis, advisory to farmers could be issued at least 2–3 week in advance with information for timely application of fungicide to manage *Alternaria* blight

Machine learning-based early rice disease detection using spectral profiles
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Local and landscape-level detection of plant diseases can be a laborious and time-consuming process. Once disease symptoms are widespread, options for management may be limited, particularly in developing countries that lack resources. Therefore, methods capable of detecting diseases before the onset of symptoms, and in a relatively inexpensive manner, would be useful for more proactive and targeted disease management. The objective of this study was to evaluate the applicability of near-infrared (NIR) and Raman spectroscopy, combined with machine learning, for early detection of rice sheath blight (ShB), a devastating disease affecting rice production. To test this approach, we collected NIR and Raman spectra from leaves of the ShB-susceptible rice cultivar, Lemont, and inoculated the base of the stems with agar blocks containing the fungus *Rhizoctonia solani*, the causal agent of ShB. Spectra were