Soil Microbes Can Suppress Plant Disease

It has long been known (more than 100 years) that certain soils can provide protection to plants from specific soil-borne diseases. These soils are referred to as disease-suppressive soils. Inhibitory effects from beneficial soil microbes against a particular pathogen contributes to disease suppression in these soils. In addition, chemical and physical attributes of soil such as organic matter, pH and clay content can directly or indirectly affect soil microbial activity, which in turn can impact crop health. Recent advancements in DNA sequencing technologies and data analyses enable us to identify the soil microbes that can contribute to disease suppression.

The soil-borne fungal pathogen Phymatotrichopsis omnivora is prevalent in the southwestern United States and is known to cause root rot disease in cotton and alfalfa, as well as numerous other important crops. The fungus grows actively from spring through fall, causing the disease. Then it hibernates in winter by forming fungal resting structures deep in the soil. The hot, dry summer months are conducive for this disease. The pathogen is extremely persistent in the field, and genetic, biological and chemical control methods have been ineffective until recently when the fungicide TopGuard® was shown to control the disease in cotton. The effectiveness of TopGuard® in controlling the disease in alfalfa is still being explored. Although using a fungicide may provide effective disease control, we have wondered if there are other options such as harnessing the power of soil microbes to protect against this disease.

There are regions in southern Oklahoma with persistent stands of alfalfa that do not show signs of cotton root rot (CRR) disease. In addition, some plants are able to survive in a CRR-infected field. It is not clear if the lack of disease in regions with healthy alfalfa plants is due to disease-suppressive soil or from a lack of pathogen in that...
area. By studying the microbial populations in the soils associated with diseased and healthy plants, we will be able to determine the role of these populations in CRR disease occurrences. Can we detect a microbial signature that can differentiate between the soil found in healthy and diseased regions? Additionally, are we able to identify microbes that might help protect the plants from succumbing to the disease?

Over the last few years, we have been studying CRR disease progression in an alfalfa production field. Samples have been collected from the roots and soil of CRR-diseased alfalfa plants, healthy alfalfa plants, and plants that survived the disease in a heavily infested field. The samples were collected throughout the active months of the fungal life cycle (spring, summer and fall) to identify the seasonal effect on the soil microbes and disease occurrence. We are currently cataloging all the bacteria and fungi in these samples. Our goal is to identify indigenous microbes that will help reduce the disease.

Identifying the microbes that help plants develop either immunity or tolerance to CRR disease and developing methods to enrich them in the field would provide an environmentally safe, durable and economical method to prevent production losses from the disease in the field. In addition to CRR disease, beneficial microbes can also help protect crop plants from other harmful diseases.