Project: Plant and Soil Nematode Interactions

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Background:
Soil-inhabiting nematodes are the largest group of subterranean invertebrates. These microscopic animals form a community comprised of: 1) nematode bacteriovores and fungivores that help regulate nutrient cycling process in the soil food web; 2) predators of other nematodes and similar-sized microfauna; 3) insect parasites and pathogens; and 4) parasites and pathogens of plants. In soils with active plant growth, healthy food web activity and/or those containing high levels of organic matter, plant-parasitic nematodes typically make up about one third of the total nematode community. The remaining two thirds help maintain and stabilize the soil ecosystem. Nematode community diversity and trophic characteristics change dramatically due to soil disturbance from environmental factors, agriculture practices or pollution.

Under standard agricultural practices in the arid, low organic matter soils found in irrigated regions throughout New Mexico, plant-parasitic nematodes result in substantial damage to many crops if left unmanaged. Examples of agricultural constraints include:

- Reduced crop yield and quality: average losses of 40% in chile; 25% in cotton; sporadic losses in bean, corn, lettuce, melon, onion, potato, sorghum, and turf.
- Localized severe stunting and decline in perennials: alfalfa; grape; pecan
- Enhancement of annual and perennial weed populations
- Enhancement of certain fungal disease problems

Mission:
The principle mission of the program is to research the impacts (direct and in conjunction with other pests and pathogens) of plant-parasitic nematodes on plants of economic or aesthetic importance to the citizens of New Mexico and develop or identify management practices that reduce the negative impacts from the parasites. A secondary mission is to investigate the impact of soil nematode communities in New Mexico ecosystems.

Current research:

- We collaborate with Dr. Jill Schroeder and Cheryl Fiore in developing effective, sustainable systems to manage interactions involving southern root-knot nematode (SRKN) and annual and perennial weeds. Because currently available nematicides and herbicides are ineffective at managing the mutually beneficial relationship between SRKN and yellow nutsedge and/or purple nutsedge, we are investigating the economic and biological efficacy of cropping sequences that utilize SRKN-resistant annual crops that are also competitive against nutsedges (or for which herbicides effective against nutsedges are available) for suppression of the pest complex. Previous work demonstrated that RKN-resistant alfalfa was highly effective at such suppression, but water requirements and length of rotation between crops like chile or onion greatly limit the desirability of alfalfa to many producers. We are also investigating the nature of interactions between SRKN and several major annual weeds. In late 2010 we concluded a 3-year investigation of the 3-way interaction involving SRKN, annual weeds, and

Verticillium dahliae relative to chile production. Dr. Soum Sanogo and Linda Liess contributed their scientific expertise with the fungal pathogen to this collaboration.

- We are endeavoring to develop management practices for use in established vineyards to reduce injury from SRKN. These efforts involve evaluating the SRKN host status of summer and winter cover crops planted in vineyards, and have identified one variety of oilseed radish that is highly suppressive to the nematode. We are also examining the efficacy of Cordon® (a special formulation for 1,3-dichloropropene) for use in pest suppression and yield improvement.
- Collaborative efforts with Dr. Steve Hanson are directed at evaluating the efficacy of certain microbial agents for reducing SRKN reproduction in plants. Our labs have also been collaborating to develop a more rapid, reliable method for obtaining DNA sequences from soil nematodes and coupling DNA profiles with high-resolution digital images for use in characterizing soil nematode communities. The method has been tested throughout a continuum from native grassland to desertified mesquite dunes on the USDA-ARS Jornada Experimental Range in conjunction with Jeremy Klass, a PhD student in soil science.
- We are culminating several years of research characterizing the seasonal phenology of the recently-discovered pecan root-knot nematode (*Meloidogyne partityla*), developing species-specific PCR primers for rapid DNA identification of the parasite (former graduate student Rio Stamler), characterized the DNA profile of *M. partityla* populations from all states reporting the parasite, and conducted a multi-year microplot study to determine effects of the nematode on growth, nutrient accumulation, and water stress in the two predominant pecan rootstocks utilized in NM. In collaboration with Dr. Richard Heerema, Extension Pecan Specialist, we are preparing a manuscript addressing results from the microplot experiment.
- In collaboration with Dr. Paul Bosland, chile breeder and geneticist, we are working to resurrect a cayenne chile variety with strong resistance SRKN. The cultivar, originally released as 'NuMex Nematador', lost utility under commercial use and two revived lines will be tested under microplot conditions in 2011 to determine seasonal durability against continuous SRKN pressure.
- We are initiating a collaborative effort with soil scientists to sample and characterize the soil nematode communities associated with plants and carbon sequestration processes in the gypsum dunes at White Sands National Monument and Guadalupe National Park.