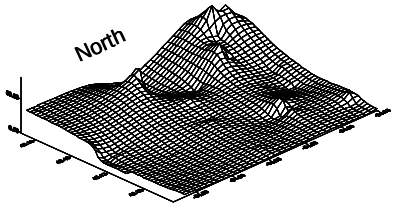
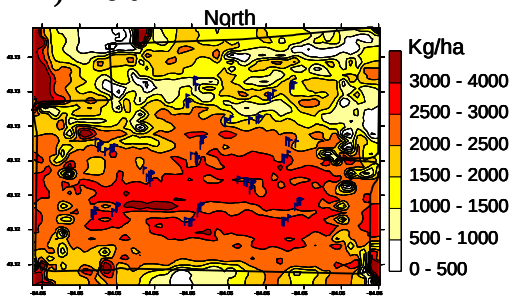
CASE STUDIES FOR CROSS-DISCIPLINARY APPROACHES TO SOLVING AGRICULTURAL PROBLEMS

1) *Application of site-specific management (SSM) to address yield-limiting factors:* Provided cause-and-effect relationships are established, nematodes' limited mobility and patchy distribution make them ideal candidates for SSM application. In collaboration with colleagues from Corp and Soil Sciences, my group has identified integrated cause-and-effect relationship analysis that improves the application of SSM in agronomically, biologically, ecologically, and economically sustainable ways. For example, my team has demonstrated the correlations between soybean cyst nematode (SCN, A) and yield (B) distribution in a field, suggesting to a nematologist that it is an SCN problem and the obvious recommendation for which is the use of resistant cultivars in a rotation system. The same yield data correlated with soil conditions would suggest to an agronomist/soil scientist that it is a soil problem. Both may be right from the disciplinary point of view. As we gradually found out through analysis of USGS soil maps (C), however, the low yield and high SCN population density were over nutritionally depleted and poorly drained Berville loam (BVL) and Newaygo sandy loam (NSL) close to a deep drainage ditch; whereas the high yield and low SCN population density occurred over richer Brookston loam (BSL). If we conservatively assume that SCN and abiotic soil problems (structural, texture or physio-chemical) cause yield loss of 40 bushels/acre in 1% of the highly heterogeneous US soybean production acreage and where SCN continues to spread (see below), it comes to 10,000 acres per million and equals to 400,000 bushels. Imagine the economic and/or environmental implications if pesticides were to be applied to fields with similar yield-limiting problems? The most notable impacts of such findings are: ***i)*** the problem cannot be solved without simultaneous consideration of the soil conditions and SCN and ***ii)*** the potential for SSM to fall into the "*Tried but did not last*" category of innovations would be high without addressing both problems.

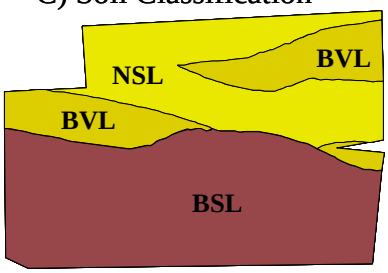
A) SCN cysts/100 ml of soil



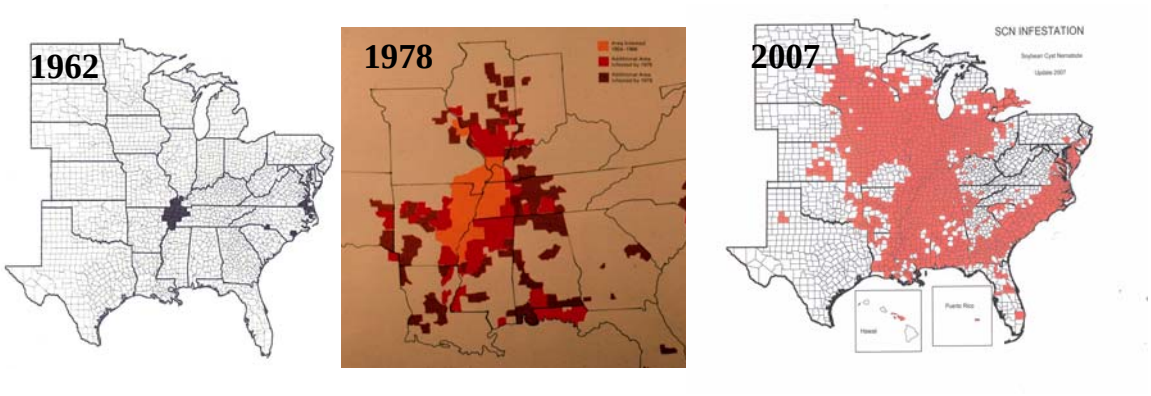
B) Yield



C) Soil Classification



For extended description and references, see Melakeberhan and Avendaño (2008).



Spatio-temporal distribution of SCN in North America despite the availability of about 800 resistant cultivars (http://www.ag.uiuc.edu/~wardt/cover.htm). SCN causes an estimated $1.4 billion of crop loss annually in the USA. One can imagine what yield losses would have been without resistant cultivars. Maps provided by R.D. Riggs (University of Arkansas) and G. R. Noel (USDA/ARS, University of Illinois).

2) *Sweet cherry tree decline*:
The Michigan cherry tree decline, believed to have been caused by the interactions of bacterial canker (*Pseudomonas syringae pv. syringae*) and ring nematode (*Criconomella xenoplax*), was found to be driven by low soil pH, in part due to NH_4 than NO_3 nitrogen source fertilizers. The growers appreciated the findings and have readily adopted the liming-based solution. This work was done in collaboration with colleagues from Plant Pathology, Entomology and Horticulture. *In addition to the economic benefits for the industry and the cherry industry recognizing Dr. G. W. Bird (Entomology) with an award in 2000, this work is being used as a case study in Nature and Practice of Science classes at MSU.*

For more descriptions, see below:
Melakeberhan, H., A.L. Jones, P. Sobiczewski and G.W. Bird (1993). *Plant Disease*, 77: 266-271.
Melakeberhan, H., A.L. Jones, E. Hanson and G.W. Bird (1995). *Plant Disease*, 79: 886-892.
Melakeberhan, H., A.L. Jones and G.W. Bird. (2000). *Canadian Journal of Plant Pathology*, 22: 131-137.