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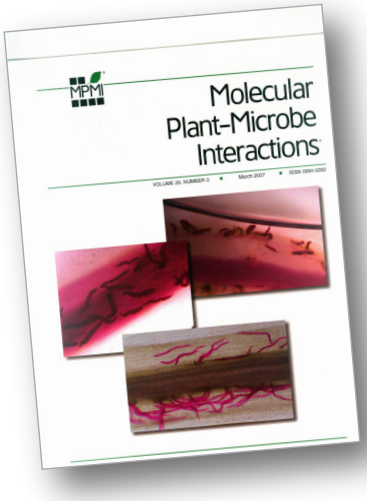
Cooperative State Research, Education, and Extension Service

National Research Initiative (NRI)

Researchers Unmask How Harmful Soybean Parasite Operates

by Stacy Kish, CSREES

Cyst nematodes are menacing, microscopic roundworms that infect and feed on the root cells of many important agricultural crops. One species of cyst nematode, *Heterodera glycines*, feeds on soybean crops, resulting in up to $1 billion in crop loss in the United States each year. >>



Above: This research was featured on the cover of Molecular Plant-Microbe Interactions Volume 20, Number 3.

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Recent research, funded by USDA's Cooperative State Research, Education, and Extension Service (CSREES) is uncovering the mechanisms used by this nematode to weaken the plant's defense system.

Recent work by scientists at the University of Missouri (UM) and Iowa State University (ISU) is featured on the cover of the March issue of the journal *Molecular Plant-Microbe Interactions*. The results from their studies may lead to more effective management tools to combat the agricultural pest and protect this vital U.S. crop.

Nematodes have developed a highly evolved relationship with the host plant. During the juvenile stage, cyst nematodes penetrate the roots of the soybean plant and travel to the vascular tissue. Here the juvenile nematode stops to feed. During the feeding process, the nematode injects secretions that modify the root cells, creating specialized feeding cells called syncytia that provide nutrients to the nematode necessary for growth and development, as well as maintain the host-parasite relationship. In essence, the plant cell is reprogrammed by these secretions to support the feeding nematode rather than support and benefit the plant. Without a functioning syncytium, the nematode will die.

Lead scientist Melissa Mitchum and colleagues at UM and ISU examined the molecular mechanisms that lead to the development of the syncytia cells. The scientists examined 35,611 soybean genes and obtained the first comprehensive gene expression profile of the developing syncytium during very early stages of the plant-nematode interaction. Their work shows that within two days after syncytium formation over 1,765 soybean genes changed expression.

This team found that genes for proteins involved in plant cell wall formation are compromised by interplay between plant hormones, called phytohormones. In addition, a decrease in the production of jasmonic acid may suppress the plant defense response, which allows the nematode to survive and thrive.

The results from this study provide the most comprehensive picture of gene expression changes within developing syncytia to date. These findings may provide scientists the key to decipher which genes play essential

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roles in the induction, formation, and function of the syncytium for the survival and growth of cyst nematodes. Future work in this area may lead to new management techniques through the use of biotechnology to better control these important agricultural pests.

Current nematode management strategies focus on reduction and control of pest population levels below the damage thresholds. Field eradication of this pest is rarely a feasible option. Crop rotation using non-host crops (e.g., corn) or planting nematode resistant soybean varieties are the most efficient management strategies to date. Chemicals, like nematicides, are available, but rarely have the necessary long-term effect on nematode populations and are not cost-effective for the grower.

Cyst nematode-induced damage is difficult to diagnose, because the symptoms are nondescript and often contribute to other factors, such as compaction, nutrient deficiencies, drought stress, herbicide injury, or other plant diseases.

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The USDA's Cooperative State Research, Education, and Extension Service (CSREES) funded this research project through the NRI Functional Genomics of Arthropods and Nematodes program. CSREES advances knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education and extension programs in the Land-Grant University System and other partner organizations. For more information, visit www.csrees.usda.gov. ■

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