Ohio Agricultural Research and Development Center
College of Food, Agricultural, and Environmental Sciences

OARDC Research Enhancement Competitive Grants Program

SEEDS
Seeds 30

Induced Pest and Disease Resistance in Austrian Pine

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A 2002 Ohio State University Extension study estimated that the value of overall sales by certified nursery stock dealers and producers in Ohio was $2.79 billion for 2001, while sales in landscape services accounted for another $1.16 billion. Pines are the fourth largest selling nursery crop in the United States with approximately 30 million plants produced annually with a value exceeding $100 million. Once pines reach the ages of 15 to 18 years in the landscape (considered "mature"), their value exceeds $200 per tree for an estimated value of at least $6 billion.

One of the major economic limitations on the ornamental plant industry is the impact of pests — the sale of even lightly infested plants is problematic because they are considered undesirable by consumers.

Pines are affected by numerous fungal pathogens and insects that often severely limit their ecological, environmental, and commercial value. A better understanding of the interactions between trees, pathogens, and insects will contribute significantly to management programs. Such information will be used to formulate biologically based pest-management programs for pines and other ornamental species for natural, plantation, and urban forests, as well as nurseries and Christmas tree farms. Biologically based management strategies are becoming increasingly important as pesticide use in landscapes and nurseries is being dramatically restricted by the Food Quality Protection Act.

Austrian pine, an important ornamental species in Ohio and the Midwest, and the common fungal disease Sphaeropsis (Diplodia) shoot blight and canker were chosen as a model to increase our knowledge of disease resistance mechanisms in conifers.

The work for this project was based on the fact that conifers respond to disease in a way that is similar to how people respond to the introduction of disease through vaccination — by increasing the natural defenses used to fight the disease. This phenomenon in trees has been known for some time, but the mechanisms by which this happens are not known. It may become possible to prevent this disease in ornamentals without the use of pesticides if the disease process is first well defined.

OBJECTIVES

The objective of this project was to identify the biochemical and molecular processes that may enable Austrian pine to resist infection from Sphaeropsis shoot blight and canker.

The long-term goal of this research is to exploit the inherent natural basis of disease resistance and use that resistance to develop novel and efficient disease management strategies.

CHALLENGES

Pines and ornamental plants in general have a significant impact on Ohio's economy and are of great esthetic value to Ohio's citizens. Producing healthy ornamental trees and maintaining their health while in the landscape in an efficient, environmentally friendly way is becoming increasingly important to everyone from producers and landscapers to consumers, their pets, and wildlife populations.

ACHIEVEMENTS

The resistance of Austrian pine to a pathogen and the expression of several defense responses were studied to determine which responses are instrumental in resistance. First, it was verified that trees infected with a pathogen actually became more resistant to subsequent infections with the same pathogens. Second, several defensive chemicals were identified in this whole-tree (systemic) response. Third, it was shown that the trees produced up to eight times more resin (pitch) when inoculated. This is important because increased resin production is linked to resistance to pathogens and insects.

THE FUTURE

Using data collected on this RECGP-supported project allowed the writing of a successful grant to USDA in the amount of $382,000. The USDA funding will be used to further investigate how infection with a pathogen might make the same tree more or less resistant to subsequent attacks and identify the signaling molecules that trigger systemic resistance responses. It is possible that once identified, these signaling molecules may be used, rather than the pathogen, to produce systemic resistance to a variety of diseases and insects. In addition, this funding will allow investigators to conduct experiments on how soil fertility may influence these interactions.

These studies will provide significant advancements in our understanding of how trees defend themselves and provide new insights on how to best manage diseases and insect pests in the landscape.

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