

## Agricultural Insect Pest Management

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Cereal aphids (greenbugs) are a major pest of winter wheat in the Great Plains. Effectively dealing with infestations first involves determining if the loss due to the pests warrants the costs of control measures. If control measures are to be applied, various factors determine the best methods to use and which should be avoided. The USDA ARS Plant Science Research Laboratory used Exsys Corvid<sup>®</sup> to build two knowledge automation systems to provide advice in these areas. The systems combine expert knowledge with detailed historical climate and weather data to provide precise advice tailored to the individual situation and location. The selection of a control method also considers regulatory and other factors in making a recommendation.

Approximately 18 million acres of winter wheat are planted in the southern and central Great Plains of the United States each year. Greenbugs commonly infest winter wheat in much of the region, and is a particularly tenacious pest in Texas, Oklahoma, and Kansas. In some years, the economic losses it causes in the region exceed \$100 million. Crop consultants, extension personnel, and wheat producers attempt to manage greenbugs with minimal economic loss. However, environmental conditions, control costs, and grain value vary widely over time and alter the optimum treatment threshold.

**Economic Threshold Calculator.** This system developed with Exsys Corvid, uses standard economic evaluation functions, a simple model for simulating population growth of greenbugs and a model for wheat yield loss resulting from infestation. These are combined with a 30-year historical database of monthly average minimum and maximum air temperatures obtained from selected NOAA weather stations in the southern and central Great Plains. Many factors contribute to greenbug population growth, but temperature often predominates. The average minimum and maximum daily air temperatures serve as input to the greenbug population growth model, and are accessed by clicking the mouse on the approximate location of the field on a map of the state in which it is located. NOAA weather data for the station nearest the location are used to run the greenbug population growth model.

The system determines the population density of greenbugs that would reduce yield enough to equal the cost of insecticide treatment, i.e., the economic injury level. This estimate of population density is then projected backwards in time four days using the population growth model. The resulting population density is the economic threshold for the field. Four days represents a reasonable time frame for a grower to treat a field with insecticide once a treatment decision is made.

**Insecticide Selection Module.** This Exsys Corvid system was designed to help managers choose an appropriate insecticide for specific circumstances, and eliminates insecticides that would violate particular regulations. For example, if the insecticide were to be applied using ground equipment, the system would eliminate any product which the U.S. Environmental Protection Agency regulations require aircraft application. Also included are guidelines on environmental conditions that affect insecticide efficacy.

The combination of the two systems provides wheat growers with immediate online access to top expert knowledge and advice tailored to their specific location. As new information becomes available on control methods, they can be incorporated into the system and immediately made available to the growers that need the information. This is an ideal application of Exsys knowledge automation technology to make a complex decision involving many factors easily available to end users online.

For more details and to run the full Greenbug system:

<http://entopl.okstate.edu/gbweb/index.htm>