INTEGRATED PEST MANAGEMENT

MU Guide

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Integrated Pest Management and Missouri's Agriculture

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Integrated pest management (IPM) has different meanings to everyone who works in the agricultural environment. It can be thought of as a systematic approach to solving pest problems by applying our knowledge about pests to prevent them from damaging crops. Beginning in 1972, the U.S. Department of Agriculture made funding available to the states to develop an IPM network through the extension system. The University of Missouri's IPM program has been in place since the mid-1970s. IPM programs originally focused mainly on insects and their control but today consider all categories of pests.

IPM programs take actions to manage pests when their numbers are likely to exceed acceptable levels; that is, a management measure is taken in consideration of the level of pest damage, revenue losses resulting from the damage, and the cost of treatment. This concept is known as the economic threshold — a cornerstone of the IPM process. Economic thresholds have been determined for many of the agricultural pests that occur regularly in Missouri. These actions are designed to reduce economic damage caused by pests, yet limit the negative effects on beneficial organisms and the environment. Strictly applying pesticides to crops is not IPM; however, pesticide use is recognized as a legitimate management tactic of IPM.

The importance of IPM

Economic importance. Agriculture plays a key role in Missouri's economy with over $4.6 billion in annual farm cash receipts. The state ranks second nationally with approximately 110,000 farms producing a diverse range of crop and livestock commodities. Missouri also produces significant minor crops such as apples, peaches, grapes, tobacco and cucurbits. According to the Missouri Agricultural Statistics Service, the state ranks in the nation's top ten in the production of hay, sorghum, soybeans, rice, grapes, watermelon, corn, cattle, turkeys, swine and broilers. Because of the state's geographical location and climate, agricultural production occurs in a diverse range of ecosystems. Management of weeds, insects and diseases is necessary for profitable production. Missouri agricultural producers report a heavy reliance on pesticides for managing major pests. Cotton producers in southeast Missouri indicate that 82 percent of their pest management decisions are based on actual field surveys. The surveyed fields showed a gain of 50 pounds per acre in cotton lint yield when compared with acreage that was not surveyed, resulting in a net benefit of $12.2 million for the state. With such economic incentives, Missouri's growers are encouraged to practice sound IPM measures.

Environmental and social importance. Missouri's citizens are concerned about pesticide and nutrient movement into surface water and groundwater, food safety, and effects on nontarget organisms and on the health of farm workers. A healthy environment sustains agricultural production and the livestock and humans living there. A degraded environment with depleted soil resources, poor water and air quality and destroyed wildlife habitat does not. IPM can help to resolve many of the issues associated with the interaction between Missouri's rural and urban populations and promises definite benefits for both.

IPM program goals

Four national objectives have been identified for the IPM program:

1. Safeguard human health and the environment through improved application of IPM strategies and systems.
2. Increase the range of benefits to enterprises and individuals through improved use of IPM strategies and systems.
3. Increase the supply and dissemination of information and knowledge about IPM strategies and systems.
4. Enhance collaboration between public, private and nonprofit stakeholders to foster improved use of IPM strategies and systems.

The University of Missouri's IPM program has specific objectives related to local agricultural interests:

1. Train and provide support for regional extension specialists to serve clientele on the local level.
2. Provide training for growers, consultants and IPM professionals in the private sector.
3. Develop educational materials to aid in the pest management decision-making process for commodities and pests relevant to Missouri.
4. Monitor and document changes in pest management practices.

Ultimately, meeting these objectives will be instrumental in increasing agricultural profitability while minimizing negative environmental effects.

Five steps of effective IPM

Putting a successful IPM program into action in the agricultural industries involves the following five steps:

1. Identify key pests and the damage they cause.
2. Monitor pest populations on a regular basis.
3. Determine the potential for economic loss or significant reduction of aesthetic value.
4. Choose the proper management tactic or combination of tactics.
5. Evaluate the effectiveness of the management plan.

Proper identification is critical

Proper identification of a pest is important for several reasons. It may not be an economically detrimental pest after all and no control measures will be necessary. Not all insects are pests; some are natural predators or parasites that help to control pest species. The proper selection of a pesticide depends on correct identification of the pest and in some cases its life stage.

Monitoring for pest outbreaks

Rather than calendar-based treatments, IPM stresses scouting practices to detect pests and determine if action is necessary. Time constraints and the lack of trained, competent personnel can be a major challenge to carry out a scouting program. If damage can be detected before a serious pest population becomes established, then several problems can be prevented. For example, research has shown that pesticide treatment of a soybean field is justified economically when an average of one soybean podworm per foot of row can be detected. Before pesticides are applied, scouting may show that lower than maximum registered rates can be applied to achieve acceptable levels of control of small insects.

Several practical considerations can save time in a scouting program. Knowing a pest's habits and habitat can save time in the monitoring program. For example, grain sorghum is most susceptible to corn earworm attack during the two-week period following pollination. Therefore scouting for this pest should begin about one week after pollination. Wheat planted adjacent to tall fescue pastures may be especially attractive to true armyworm infestation. Such areas can be watched more frequently and closely. The anticipated time of pest development can alert a pest manager to the most opportune times for scouting. Degree-day modeling is based on the number of days when average temperatures exceed the threshold for development and activity by a particular pest. By tracking degree-days, pest managers can predict when the pest will appear and damage will occur.

Establishing thresholds for control measures

In the original IPM models that were developed in agricultural environments, control measures were based on an economic threshold. To justify treatment, pest populations or pest damage had to exceed this threshold. For many of Missouri's common agronomic insect pests, thresholds have been developed as a result of many years of research. These thresholds are dynamic and often depend on crop and pest growth stage. For example, treatment of first-generation European corn borer is justified when 50 percent of corn plants show leaf feeding and larvae are present. For the second generation, treatment is justified when 50 percent of plants have larvae on the first leaf above and below the ear.

If there are health and safety threats or legal concerns associated with a certain pest, then thresholds are more clearly defined. For example, even in low numbers the striped blister beetle is lethal to horses. Therefore, its presence in alfalfa hay for horses is not tolerated. In some instances, pest acceptance levels may be greater because of social or cultural factors or because of concerns about the costs or hazards of pest management methods used.

IPM tactics

A variety of integrated pest management tactics are available:

- Regulatory — abiding by local, state and federal guidelines, such as quarantines, designed to prevent the spread of pests.
- Biological - using beneficial organisms, such as natural pest predators, parasites and diseases to suppress pest organisms. Alfalfa producers who have managed for greater numbers of beneficial insects are now experiencing fewer and less severe problems from the alfalfa weevil. Insecticidal control of aphids is rarely needed in Missouri cotton because beneficial insects normally control them.
- Cultural — using crop rotation, cultivation, sanitation and other farm practices that reduce persistent pest problems. Surveys indicate that crop rotation is the top cultural practice used to manage weed and insect pests.

- Physical — using barriers, traps, trap crops, adjusting planting location or timing to evade or diminish pest pressure. Planting wheat after the "Hessian fly free dates" is a classic method of avoiding damage from that pest.
- Genetic — choosing resistant plant materials to avoid pest problems. One of the most common and successful strategies in managing soybean cyst nematode is to select and incorporate resistant varieties into the crop rotation scheme.
- Chemical — using pesticides to prevent or suppress a pest outbreak. The selection of chemicals used in IPM programs considers that the pesticide is as specific to the pest as possible and is used at the lowest effective rate. The pesticide should be short-lived in the environment, least toxic to beneficial organisms, and alternated with other chemical modes of action to help prevent development of resistant pest populations.

Evaluation

The success of an integrated pest management program depends on evaluation of its results. What worked well, which aspects need improvement, and which should be eliminated? What are the benefits of the program in financial return and in environmental or social value?

IPM successes in Missouri

Black cutworm forecasting. In Missouri, the black cutworm is a migratory pest that can potentially cause economic damage to corn. Rather than apply preventive preplant insecticides to all corn fields, rescue treatments can be applied to fields that have active and damaging infestations. Using trap count data to determine the arrival of black cutworm moths in Missouri and degree-day modeling to calculate the predicted date of the damaging larval stage of this pest, corn producers and crop professionals are notified to scout fields. Using this timely scouting information and current economic thresholds, informed decisions can be made to treat or not to treat. The program avoids needless insecticide applications, producing both economical and environmental benefits.

Release of beneficial weevils to control musk thistle. Musk thistle is an introduced noxious weed infesting Missouri's pastures and forage crops (Figures 1 and 2). Moderate infestations of this weed pest are estimated to cause yield losses of nearly 25 percent. Specific natural enemies can aid in regulating the spread of musk thistle. The musk thistle weevil is one such natural enemy. The larvae feed in the receptacle of the developing flower, disrupting seed formation. A native of Europe, like musk thistle, the musk thistle weevil was studied extensively to ensure that it would not damage economic plants.

Figure 1. Musk thistle, *Carduus nutans L.*, in bloom.

Figure 2. Musk thistle is a noxious weed in Missouri pastures and forage crops.

Figure 3. MU researchers are studying the release of the musk thistle weevil as a natural means of controlling the thistle.

In 1975 entomologists with the USDA-ARS Biological Control of Insects Research Laboratory in Columbia, Missouri, released 490 musk thistle weevils near Marshfield in Webster County. Since then, the weevils have been found as far as 22 miles from the five-acre pasture where the original release was made (Figure 3). Extensive research at the release site shows the weevil can contribute to a 50 to 95 percent reduction in numbers of thistles. Thus, the importation and release of natural enemies offers another way to reduce infestations of musk thistles. The advantages of this biological control program are: (1) it is inexpensive; (2) it poses no threat to nontarget organisms; (3) once established, it allows weevils to move into adjoining infested areas; and (4) it requires little additional effort once the weevil is established, while other controls must be applied periodically.

Parasitic wasps for control of cereal leaf beetle. The cereal leaf beetle is an imported pest that arrived in Missouri in 1972. Two of the beetle's natural enemies were found in the mid-1990s: tiny parasitic wasps that attack the beetle's eggs and larvae. To promote the spread of these two beneficial organisms, populations have been reared in two field insectaries located on the property of the University of Missouri Agricultural Experiment Station. In recent years, parasitized host beetles have been relocated to several oat and wheat fields for release. It is estimated that cereal leaf beetle could potentially cause yield losses of 40 percent in wheat and 60 percent in oats if left unchecked.

Growers and consultants are increasingly aware that their ability to continue producing depends on favorable public perception of their practices. Part of the solution is to adopt IPM. It is important to consider that as knowledge and technology evolve, so will IPM programs.

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