Integrated Pest Management

What the term "integrated" adds to the concept of pest management has been articulated by Zalom et al.: "all appropriate methods from multiple scientific disciplines are combined into a systematic approach for optimizing pest control." There are a large number of conceptual definitions of IPM (Bawjda and Kogan developed a compendium with nearly 70 definitions). Most definitions include using natural or ecologically sound principles or techniques, preventing pests from reaching the economically damaging levels, and using multiple tactics, including cultural, biological, and chemical.

The Objectives of IPM

While there is general agreement about the multiple objectives of IPM, how people rank these objectives varies with their background, interests, and local needs. Thus, growers, researchers, input producers, environmental activists, and the public may have different legitimate viewpoints on the relative importance of a particular objective. For example, a large sample of U.S. farmers ranked the most important IPM goals as follows: first, improved pest control; second, increased crop yield and quality; third, increased returns; fourth, protection of personal and public health; and fifth, reduced environmental damage (VCES, p. 77). Extension personnel working in the implementation of IPM programs ranked IPM goals as follows: first, reduced costs; second, reduced risk of output loss; third, reduced chemical use; fourth, improved environment; and fifth, improved onfarm health and safety (VCES, p. 51).

Recent focus group sessions among agricultural suppliers (including basic agrichemical manufacturers and retail input supply businesses) and independent crop and pest management consultants in Pennsylvania (Rajotte et al., p. 32) ranked the selling points for their IPM services as follows:

- For agricultural suppliers, the most important goal was profitability, followed by increased options based on increased information, reliability and company reputation, and environmental safety.

- For consultants, the most important selling points were increased options and benefits followed by profitability, reduced chemical use, and reliability.

Moreover, the relative importance among the goals of IPM may be shifting (and will likely continue to shift depending on local need) from the early emphasis on farm-level profitability to the current emphasis on reduction of pesticide use, a goal more in line with the public's desire to reduce risks associated with pesticide use. The public, Steffey observed, currently is focusing on the use of pesticides. Thus, Staffey believes, the success or failure of IPM programs will usually be measured by "a change in the amount of pesticide use."

While there are differences about IPM goals among the different economic agents, most IPM programs address at least one of the following goals: (i) to improve farmers' profitability, (ii) to minimize the risk of pesticide use to human health and the environment, and (iii) to minimize pest resistance to pesticides.

Measuring IPM Adoption

Just as pests are specific to particular crops and locations, IPM programs are specific to the crop and region for which they are designed. Because the development of IPM programs has not been uniform across pest classes (insects, plant pathogens, weeds), crops, and regions, it is difficult to provide a general measure of IPM use.

A measure of IPM use needs to be related to objectives established by the groups involved in the program. The measure also should allow analysts, with a reasonable amount of survey data, to ascertain the progress in farmers' adoption of IPM. Also, while the measure is defined locally, its aggregation to State and national levels should be tractable.

Finally, because IPM components may vary with the crop, region, time, and other factors, a measure of IPM use should be dynamic and flexible.

Most earlier studies of IPM used scouting as the basis for their operational definition of IPM (Burrows; McNamara et al.; VCES, pp. 55-56). The 1987 National Evaluation of Extension IPM programs used an economically derived decision rule in its operational definition of IPM, and considered three levels of adoption: nonadoption, low adoption, and high adoption (Napit et al.). Similarly, the National Research Council (NRC) reported the extent of IPM adoption in major crops by defining IPM to "include all acres where basic scouting and economic thresholds are reportedly used" (NRC, 1989, p. 178). The use of scouting and economic thresholds, or other equivalent intervention criteria, are considered basic elements of IPM and should, therefore, be included in any measure of IPM use. As Pedigo observed: "without question, pest population assessment and decision making are among the most basic elements of any integrated pest management (IPM) program. In fact, these activities characterize state of the art approaches in pest technology and differentiate IPM from other strategies."

Most economic studies did not specify the type(s) of pest(s) (insects, diseases, weeds) managed or controlled. While there is merit in using a general definition of IPM, additional understanding, particularly regarding the effects of IPM, is obtained by further classifying IPM into three groups: insect IPM, disease IPM, and weed IPM. USDA's report on the extent of IPM adoption provides separate measures of IPM for insects, diseases, and weeds. In addition, three levels of IPM adoption are defined: low-level IPM—if the farmer used both scouting for pests and economic thresholds in making pesticide treatment decisions; medium level—one or two additional IPM practices are used; and high level—three or more additional practices are used (Vandeman et al.). Fernandez-Cornejo (1996, 1998) and Fernandez-Cornejo and Jans (1996), in their studies of the impact of IPM, defined IPM to manage insects (diseases) as follows: a farmer is said to have adopted IPM to manage insects (diseases) if the farmer reports having used both scouting for insects (diseases) and economic thresholds in making insecticide (fungicide) treatment decisions; and the farmer reports having used one or more additional insect (disease) management practices among those commonly considered to be IPM techniques.

The World Wildlife Fund (with the help of a consultant) developed a complex method for measuring IPM adoption based on the ratio of preventive practice points to dose-adjusted acre-treatments. The preventive practices variable is the sum of "ecologically based practices that either reduce pest pressure, increase the number and role of beneficial organisms, or enhance a crop's ability to overcome a degree of pest pressure" (Hoppin; Benbrook and Groth).

Hollingsworth et al. (1992) developed a point system for Massachusetts in which each IPM practice is given a maximum number of points or weight.[7] This method, originally developed for apples, was later extended to eight other fruits and vegetables (Hollingsworth et al., 1995). In this system, higher weights are assigned to "practices considered essential to IPM." Growers gain points for each practice, up to the maximum, based on its level of completion. Growers who reach 70 percent of the total possible points are considered IPM practitioners. While the method improves upon previous subjective definitions of IPM, it is still subjective since the weights (maximum number of points assigned to each practice) are determined by expert judgment.

As Benbrook and Groth suggest, the point systems are a major improvement over "just count practices" systems, but they fail to take into account the levels of pest pressure and fail to "capture whether using IPM practices leads to significantly less pesticides than not using the practices."

In 1997, the National Potato Council (NPC) created a national protocol for potato IPM based on the results of advice from a team of industry representa-

[7]Earlier, Boutwell and Smith developed a weighting system to measure IPM adoption for cotton.

tives and researchers funded by an NPC-EPA Pesticide Environmental Stewardship Grant (National Potato Research and Education Foundation). The protocol involves a point system; but unlike Hollingsworth's system, the NPC system breaks up the IPM continuum into three levels. In addition, the NPC system has a correction for pest pressure.

Fernandez-Cornejo and Jans (1998) provided a method to develop a point system similar to that of Hollingsworth et al., except that the weights are calculated econometrically from the data, based on the contribution of each practice to IPM objectives. They illustrate the method by assuming that the main IPM objective is to reduce the use of chemical herbicides while maximizing farm profits. The model used to obtain the weights considers the simultaneous adoption of pest management practices and pesticide use decisions, corrects for self-selectivity (farmers are not assigned randomly to the two groups), and is consistent with farmers' optimization. The model can also control for pest pressure by incorporating proxies for infestation levels.

Coble proposed an approach that classifies pest management practices into four groups: prevention, avoidance, monitoring, and suppression of pest populations (PAMS). Coble proposed using a diversity index as an indicator of IPM resilience based on a concept that arose in the IPM Measurement Systems Workshop (held in Chicago on June 12-13, 1998, co-sponsored by the American Farmland Trust, EPA, and the World Wildlife Fund). An empirical measure for each PAMS component and the procedure to weight or combine them into an overall index are still to be developed.

There have been encouraging advances in methodology in recent years, but a complete, practical, and accepted method to measure overall IPM adoption is not yet available.[8] For this reason, this report does not provide results on the overall measure of IPM. This report includes survey results on the extent individual pest management practices or techniques have been used for major field crops and selected fruits and vegetables.

[8]Despite the measurement difficulties discussed here, as well as data comparability problems, some broad results have been obtained from IPM research regarding the factors of adoption and the impact of adoption on pesticide use, yields, and farm profits (Burrows; Fernandez-Cornejo, 1996, 1998; Greene and Cuperus; Hall; Harper et al.; McNamara et al.; Norton and Mullen; Mullen et al.; Wetzstein et al.; VCES). A summary and synthesis of this research will be presented in a later publication.