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**RE-CREATING THE DELIVERY OF INFORMATION: PACKAGING EXISTING IPM KNOWLEDGE IN MORE TRANSPARENT WAYS.** *P.B. Goodell, UCIPM, Kearney Ag Center, and M.L Flint, UCIPM and Dept. of Entomology, UC Davis.*

**Abstract.** Over the past 50 years, pest management approaches have developed in quantum leaps from being chemically dependent to integrated and environmentally responsible, and our delivery methods have significantly advanced as well. The newest delivery format from the UC Statewide IPM Program is the Year-round IPM Program. It is a web-based, multi-pest, seasonally-integrated program that allows the user to explore a large database of information and delve as deeply as needed for details on how to carry out specific activities. Pest management guidelines in alfalfa forage is presented in this paper as an example of these changing technologies.

#### **Introduction**

Relevant and current information is the stock-in-trade of dynamic and robust integrated pest management (IPM) programs. For each pest or problem, one must correctly identify the cause, estimate the population density, establish the threat to the crop, and make management decisions. Each of these steps requires knowledge, the application of information to rational decision-making, and management approaches that result in as few secondary consequences to the environment as possible. In advanced IPM programs, the practitioner must further integrate activities for multiple pests and cultural practices so that they function in a compatible manner. Providing information and guidance in accessible, relevant, and accurate media that growers or pest control advisors (PCAs) can and will use has been, and continues to be, a challenge to the University of California Division of Agricultural and Natural Resources. Pest management guidelines developed for alfalfa forage will serve as an example of the changes that have occurred over the past 50 years.

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## **Delivering Pest Control Information: the Printed Pest Control Circulars and Circulars**

Since at least the early 1950s, The University of California Cooperative Extension (CE) and Agricultural Experiment Station (AES) have been producing leaflets and bulletins that provide guidance in the timing and use of control options. These publications usually included not only recommended chemical controls, but information on cultural and biological controls and suggested monitoring techniques, as well.

During the 1960s and 1970s, a series of printed circulars and bulletins were the primary sources of pest management information from AES and CE. These publications were developed and written by crop and pest discipline experts who gathered together and reached a consensus on best control approaches, but usually focused on pesticide options. By the mid-1980s, with increasing retirements of campus faculty and increased emphasis on publishing in peer-reviewed research journals, production of these circulars and other timely, relevant pest management publications dwindled.

When the UC Statewide IPM Program (UC IPM) was established in 1980, a major goal was to revive the University of California's (UC's) practical pest management publications for growers and PCAs and promote available IPM methods. The first series of publications put out by the program were the IPM manuals. These manuals were developed by dedicated technical writers who researched literature, interviewed individuals, convened discussion meetings and gathered the best production and pest management information available for major California crops. Sixteen crop IPM manuals are now available from UC IPM. These manuals also include information about crop development, regional production areas, and abiotic problems. The manuals were richly illustrated with professionally obtained color photographs. Management guidelines were provided, including information on biological and cultural controls, but specific pesticide suggestions were not made to avoid locking in pesticides that were subject to change over short time durations. The manuals were dedicated to collecting information that did not substantially change over a 5- 10 year period.

## **Delivering Timely Information: Development of Pest Management Guidelines**

The IPM manual for alfalfa was the first of the UC IPM manuals and was published in 1981. It was revised slightly in 1985 and then reprinted without revision in 1990. While much of the information is still accurate (e.g. biology, pest and natural enemy identification and crop cycles), farm advisors and others identified a need for publications that contained pesticide guidelines similar to the pest control circulars and bulletins. Beginning in 1987, the UC IPM Program developed the Pest Management Guidelines (PMGs) as companion publications to the manuals in order to provide relevant, timely, and easily revised information about pesticides and other pest management decisions. There are currently 44 PMGs available which are revised on a three year cycle.

The Alfalfa PMG (Summers *et al*, 2006) consists of sections on general information (IPM, biological control, use of a sweep net and selectivity of insecticides), information on insects and mites, diseases, weed management in seedling alfalfa, weed management in established alfalfa, and nematodes. A typical entry on an insect pest includes description of pest, damage, and management, including cultural, biological and organically approved methods.

The UC IPM PMGs are written by UC faculty, CE Specialists and Farm Advisors following a standard format and assisted by an IPM Project PMG Coordinator. The Coordinator initiates and coordinates 3-year revisions with authors. Updates may also be initiated when changes in registrations or use of pesticides occur, or if requested by authors.

While the PMGs offered brief descriptions of non-chemical options, at first they were primarily aimed at providing guidance on relative efficacy and selectivity of pesticide choices. The PMGs are arranged by pest organism. Limited information about the pest, its biology and damage, sampling and action threshold information was provided, but the reader was often referred to an IPM manual if available. However, for those crops without a companion IPM manual, PMGs provided the most complete collection of information.

When they were first produced in the late 1980s, the PMGs were printed and circulated from a central distribution facility. They were available from both the University of California Agricultural and Natural Resources division (ANR) central publications

warehouse and county Cooperative Extension offices for a modest cost. The entire collection can be purchased on subscription basis and updates are mailed as they occurred.

### **Delivery of Information Through the Internet**

With the advent of the internet, information could be delivered to individual desktop computers. The UC IPM Program's web site went on-line in 1995 with the PMGs as a central feature. PMGs could be delivered without cost as printable files, or could be read on-line. The on-line versions of the PMGs featured thousands of color photographs of pests, natural enemies, and pest damage unavailable in the paper versions.

However, the internet allowed even greater opportunity than simply providing delivery and printing services and photographs. New approaches to packaging and presenting information became apparent and electronic PMGs (e-PMGs) were born. The e-PMGs had the advantage of providing linkages and relationships between different types of information. New opportunities for blending IPM manuals and PMGs became available. For example, real time weather models could be linked into appropriate pest information and degree-day models were available which allowed predictive activities. The collection of IPM images developed from manuals could be digitized and made available for identification keys. Interactive web pages provided the opportunity for users to customize the information they sought. The most recent example of e-PMG advantages over PMG is the incorporation of "WaterTox" information. This program is linked to a data base modified from USDA Natural Resource Conservation Service (NRCS) WIN-PST (Pesticide Safety Tool for Windows) and provides rankings for potential pesticide water quality hazards for high risk soil types.

The PMGs evolved into interactive electronic documents. While PDF files were still available for printing, the information could be more easily found and accessed as e-PMGs. However, the e-PMGs were still organized along pest lines and looked similar to the hard copy, except the home page serves as a hyperlinked table of contents.

### **Year-Round Programs: the Next Stage of Delivery**

As attention to environmental issues has increased during the first decade of the 2000s, the demand for IPM information that addresses environmental quality

has also increased. Issues such as water and air quality, worker safety, and food security require relevant IPM responses. In addition to adding features such as WaterTox, pesticide selectivity charts, mode of action classes, and impacts of pesticides on natural enemies, the UC IPM Program recognized the need for reorganization of e-PMGs based on seasonal activity rather than pest species. The resulting Year-Round IPM Programs were designed to alert farmers and PCAs to major activities they might need to be doing at each crop growing/development period, in order to implement a comprehensive IPM program (Strand and Flint, 2005).

By organizing information around annual crop events, year-round programs provide more grower-friendly access to information than a simple list of pests. Growers can plan their activities around the entire growing season, and knowing which pests or pest management activities should be considered at any one phase makes it easier for them to conduct a successful and comprehensive IPM program. This innovative structure creates new opportunities for accessing knowledge and seeking solutions to individual questions. It also facilitates the planning and use of preventive methods that are essential to good IPM programs. In the alfalfa year-round program, the "year" is divided into sections focused on seasonal activities in winter, spring, summer, fall, and the unique situation of establishing a stand. For each season, the program provides information on special issues related to water quality and activities that should be carried out, such as which pests should be monitored. Activities related to insects, weeds, vertebrates, nematodes, pathogens, and often cultural practices, are integrated on the same checklist.

For detailed information on how to monitor or manage pests, the year-round program links with the appropriate PMG. Within individual pest guidelines, users can continue to seek as much information as they desire. Portable document formatting (PDFs) of pest monitoring forms and pest or damage identification guides also are incorporated into the new programs. The ability to easily investigate information as thoroughly as the user wants is a major difference between paper PMGs and e-PMGs.

Another very useful feature of the Year-Round IPM programs is the Annual Checklist. This checklist is a summary of all activities required to carry out a comprehensive IPM program in that crop. The grower or PCA can easily record the completed tasks

throughout the production season. This checklist provides a good communication tool for PCAs and growers and can also serve as a personal record keeping tool, or can provide a record for agencies requiring proof of IPM activities.

Year-Round IPM programs are recognized as the University of California's best management practices (BMPs) for pest management in the crops on which they have been developed. Year-Round IPM programs are currently available on the UC IPM web site for alfalfa, almonds, cotton, grape, nectarine, peach, plum and prune. Several others are under development. Beginning in the 2007 season, the USDA Natural Resource Conservation Service is providing financial incentives for growers who implement and document the use of Year-Round IPM programs for one of these crops (<http://www.ca.nrcs.usda.gov/programs/eqip/>).

### **The Future of IPM Information Delivery and Learning**

The Year-Round IPM Programs represent a big step toward implementing more comprehensive IPM programs. The seasonal approach allows growers to easily grasp which pests need to be watched during each crop development period, potential implications to the environment if pesticides are used, alternate approaches and product choices, and clear-cut guidelines for monitoring pests and applying treatment thresholds. These integrated programs provide the opportunity for new, self-directed learning environments. The user is not limited to a linear experience in seeking information, but rather, because the information in the Year-Round IPM Programs and e-PMGs are relationally linked, can explore issues and topics of immediate interest and relevance. New learning experiences emerge along unique pathways.

A next step in this process might be to provide application opportunities for using these programs in a

continuing education environment. On-line training and evaluation could be developed around the Year-Round IPM Programs to allow a user to test their knowledge and apply it in a safe and virtual environment. Such applications could be tailored to the individual learning style to allow for exploration of this knowledge at their own pace.

While the technology to deliver IPM information has rapidly changed in a single generation, the mission of UC ANR to teach people to apply current research-based information has not. The goal of developing relevant, integrated and sustainable crop and pest management approaches that end users can easily access and apply will be as important over the next 50 years as it has been over the past 50 years.

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