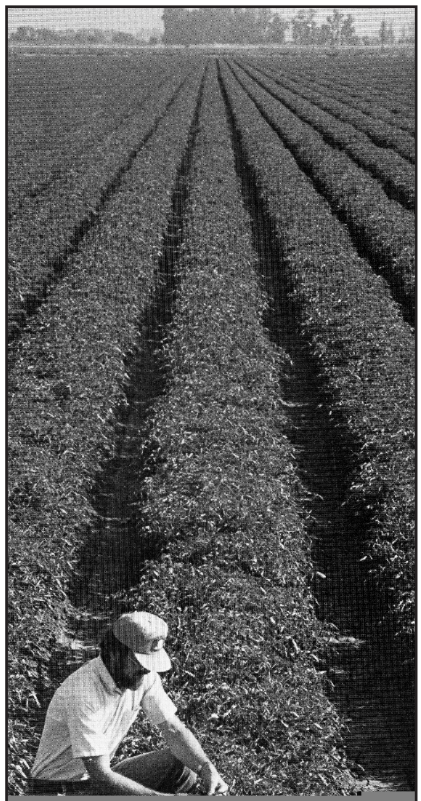
Pesticide Use, IPM and Pest Management Advice

by Mark Metcalfe

A survey of processing tomato growers reveals the more time growers spent monitoring their fields and the higher the quality of that monitoring, the less chemical pesticides that were used by the grower. Ê

A recent report by the National Research Council documents the fact that chemical pesticide use contributes to the value of U.S. agriculture, but it is also widely known that this pesticide use is responsible for generating undesirable environmental side effects. A long-standing objective of pesticide regulatory policy has been to reduce the occurrence of these undesirable effects, while simultaneously maintaining the effectiveness and value of pest management programs. Integrated Pest Management (IPM) strategies provide agricultural producers with the tools necessary to help achieve this regulatory objective, and therefore from a policy perspective it is important to have an understanding of the factors which influence chemical pesticide use and the adoption of IPM. To this end, a study of tomato growers in California was undertaken to examine the recommendations of pest control advisors, the use of IPM, and the factors influencing chemical use in the industry.

The availability of information is a particularly important factor that influences pesticide use in agriculture. Two important sources of information for growers are pest control advisors and Integrated Pest Management guidelines. The advice of pest control advisors and the implementation of IPM guidelines influence the use of chemical pesticides and the extent of this influence is dependent on the amount of effort devoted to the monitoring of field conditions, which is the process of information collection. Note that the use of IPM does not mean that no chemical pesticides are used. Instead, IPM guidelines provide standards for monitoring fields and call for the application of chemical pesticides when the monitoring of field conditions indicates that pesticides are necessary. The monitoring of pest populations and crop damage provides growers and advisors with the information necessary for more direct and efficient use of pesticides, both where and when they are needed.



Pest and disease monitoring provides growers and advisors with the information needed for more direct and efficient use of pesticides.
Photo courtesy of UC IPM Program

The use of IPM is not an all or nothing proposition; many different types of pest management programs utilize IPM practices to different degrees. Field monitoring and implementation of suggested guidelines are part of IPM, but the extent of monitoring and implementation of guidelines can differ substantially from farm to farm and also within the same farm depending on the nature of pest problems. That is, in cases where monitoring can be undertaken more easily, IPM is more readily adopted. Given this variability in IPM, it is difficult to determine to what degree IPM is used and the rate with which new practices are adopted. Nevertheless, it seems clear that IPM techniques have been successfully adopted by a significant number of California growers in cotton, almonds, stone fruits, walnuts and processing tomato production.

In the case of California processing tomatoes, a 1992 study surveyed 73 growers in six northern California counties to collect data on pest management from 130 fields of processing tomatoes with an

Table 1: Percentage Adoption of IPM Monitoring Techniques

	Adopter[1]	Non Adopter[1]
Insect Monitoring		
Monitoring of seedling pests	80	20
Monitoring of mid season pests	81	18
Monitoring of mid season predators	47	52
IPM fruit worm leaf sampling	20	80
Modified IPM fruit worm leaf sampling	16	83
IPM fruit sampling	9	90
Modified IPM fruit sampling	54	43
Consideration of fruit worm parasitization	23	76
IPM worm threshold	14	34
Disease Monitoring		
Scheduled mold control	56	38
Deep soil moisture probing	69	27
Shallow soil moisture probing	27	69
Routinely moisture probing	69	29
Irrigation water budgeting	14	83
Nematode Monitoring		
Routine nematode probing	23	76
Nematode lab tests	12	85
Nematode infestation records	18	80
Weed Monitoring		
Weed infestation records	16	80

[1] *Percentage of total sample. The difference between adopter plus non adopter and 100 percent represents non-respondents.*

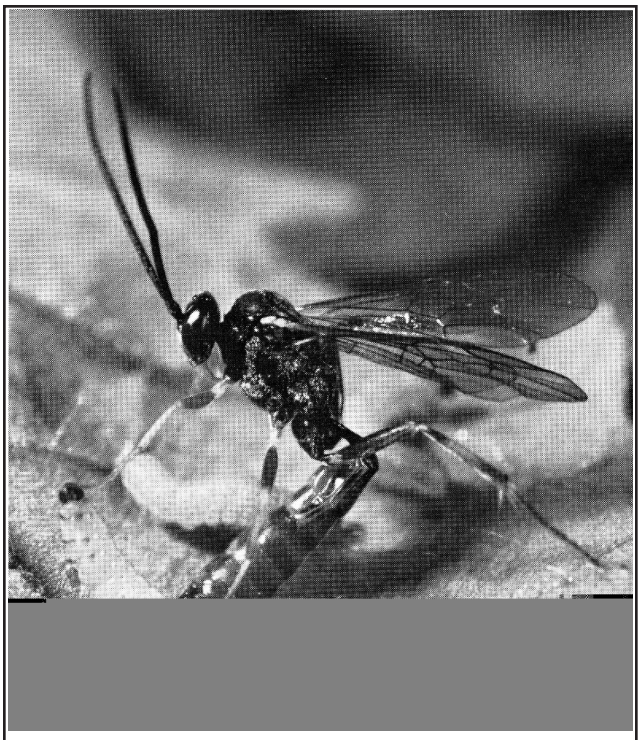
Source: Wiebers, U., "Economic and Environmental Effects of Pest Management Information and Pesticides: The Case of Processing Tomatoes in California", Ph.D. Dissertation, Techniche Universitat Berlin, 1992.

acreage of 59,658 acres, which is 19.2 percent of California's total tomato acreage and 16.8 percent of total U.S. acreage. To identify the extent of IPM use, growers were asked whether or not they employed 18 different IPM guidelines for insect, disease, nematode, and weed management. Table 1 presents the percentage of adoption of IPM monitoring techniques by the growers surveyed.

The results of the survey reveal that adoption rates varied considerably across guidelines, but also show that many types of IPM strategies were in use. There was a high percentage of adoption of seedling and mid-season insect pest monitoring as well as deep soil and routine moisture probing for disease monitoring. While these quantitative measures are surely different today as compared with 1992, our research on this topic indicates that the qualitative factors influencing these numbers are similar and therefore identification of these factors and their implications is very important.

For example, the interaction between pest control advisors and growers is an important factor that influences the level of chemical pesticide use. The influence of pesticide use advice is becoming increasingly important as pesticide products and regulations become more complex and consequently, farmers become more dependent on the specialized knowledge and information provided by pest control advisors. All growers in the survey monitored their fields to some extent in order to obtain some pest information. The monitoring activities of growers are characterized by the time allocated to monitoring and the quality of that monitoring. The more growers are involved in quality monitoring, the more likely they are to be the first to identify pest problems and to identify them in the early stages when they can be controlled with fewer chemical inputs. Thus, individual growers have incentive to invest in monitoring activities in order to both reduce damage and also to reduce overall chemical pesticide costs.

A pest control advisor may not be aware of a grower's monitoring efforts but may be aware of the grower's knowledge of pest management. An advisor may expect that informed growers are more aware of their field situation and therefore may prescribe lower amounts of pesticides, expecting that more informed growers are better able to identify pest problems as well as better able to apply the chemicals effectively. Also, since some advisors employed by chemical companies earn commision on pesticide sales, it is often hypothesized that they may have incentive to sometimes over-prescribe the use of pesticides. If so, then they would be most likely to over-prescibe to those farmers considered to be less informed.



A parasitic wasp, Hyposoter exiguae, lays an egg in a young beet armyworm. Such natural enemies play an important role in the control of many tomato pests.
Photo Courtesy of UC IPM Program

Analysis of the results of this survey demonstrate the importance of the pest control advisor and grower relationship. Results reveal that growers of processing tomatoes depend heavily on the information obtained directly from monitoring their fields. That is, the more time growers spent monitoring and the higher the quality of that monitoring, the less chemical pesticides that were used by the grower. Chemical pesticide use was shown to be higher for use recommendations made by pest control advisors. The costs associated with these higher recommendations are calculated to be $26.40 per acre for advisors compared with $20.90 per acre for growers. Thus, advisors recommended, on average, pesticide use levels that were $5.50 per acre, or 26 percent higher than growers. This suggests that designing IPM monitoring programs that can be easily implemented, as well as training growers as to the use of these programs, would help to reduce the use of chemical pesticides.

The study also found that the pesticide use recommendations of advisors are dependent on the advisor's perception of grower's pest management knowledge. That is, more chemical pesticides were suggested for use on fields where growers were perceived to be less informed about pest management decisions. This fact once again suggests that increasing grower education through improved IPM training would help reduce the use of chemical pesticides both by pest control advisors and by growers adopting IPM techniques.

What can be done to increase the use of IPM practices in California agriculture? Improvements in the ease of monitoring and increased grower information would help increase IPM adoption and reduce chemical pesticide use through two channels: 1) improved grower involvement in pest management; and 2) improved perception of grower knowledge by pest control advisors. It is important to think of IPM as more than a technology that is available for farmers to either choose to adopt or to not adopt. Rather, it is a long term way of thinking about how to manage pests and how growers and pest control advisors can work together in a more effective and environmentally safe manner. Therefore to encourage the adoption of these long-run objectives, growers and pest control advisors need to be encouraged to build and continuously update their knowledge base, through education and training.

Our current research continues to examine these issues in order to update our understanding of the economic incentives of farmers and pest control advisors as well as the outside factors which influence pesticide use decisions. Only by understanding the incentives and factors that drive pesticide use can IPM programs be tailored to fit into the long–run pest management strategy of farmers and pest control advisors.

Mark Metcalfe is a research economist in the Department of Agricultural and Resource Economics at UC Berkeley. He can be reached by e-mail at metcalfe@are.berkeley.edu or by phone at (510) 642-0262

Table 1. Frequency with which Payment to Growers is Tied Directly to Downstream Prices

	Fresh Fruit	Fresh Veg	Processed Veg.	Winegrapes
Yes	67%	46%	24% Ê	8%
No	33%	54%	76% Ê	92%

cultural products did not deal in fresh produce, and others only held a license for tax purposes (this allows a farm which packs and ships its own produce to divide its operations into two, one side of which "sells" to the other). Through a telephone screening of a random draw of respondents, I identified a sample of firms engaged in contracting for fruits and vegetables with "outside" growers. Based on the population of interest, surveys were mailed to managers of 635 firms. Given that there is a great degree of diversity in the commodity chain, we simplified the survey by asking participants to focus on that commodity that was the most important in terms of their current activities in terms of fruit and vegetables.

Completed questionnaires were returned by 361 firms for a response rate of about 60 percent. To facilitate the analysis here I have divided the survey returns into the following groups: fresh fruit (30 percent), fresh vegetables (30 percent), processed commodities (14 percent) and wine grapes (26 percent).

For fresh growers the role of downstream prices is of clear importance, although there is a difference between fruit and vegetables. This difference is due, at least in part, to the fact that a considerable proportion of fresh vegetables is grown as part of a vertically integrated production and marketing chain.

One of the most important results established by the survey relates to the role of downstream prices in deciding the payment to the grower. If the grower's compensation does not depend on downstream prices, the grower bears no price risk.

Table 2 gives some sense of the importance of price risk for different categories of commodities. For fresh growers the role of downstream prices is of clear importance, although there is a difference between fruit and vegetables. In this connection, note that a significant proportion of fresh vegetables are grown as part of a vertical integrated production and marketing chain, which helps to account for the difference in the figures above. Equally important is that for wine grapes and processed commodities almost all growers receive payments that are not based on downstream prices.

To account for the fact that downstream price risk is of relatively small importance for processed commodities and wine grapes, note that for many of these commodities, the produce of many different growers is commingled. This often makes it difficult to assign responsibility for different outcomes to different growers. For example, contrast the case of processing tomatoes for paste to the mature green tomatoes discussed above. Although a processor may face quality problems which affect the value of the final product, in such cases it is likely to be difficult to assign blame to a particular grower. Accordingly, processors and vintners are much more likely to rely on careful quality measurement and condition grower compensation on the outcomes of these measurements rather than on downstream price realizations.

Conclusion

Contracts in agriculture play an important role in reducing the risk faced by producers. However, there is a trade-off between risk-reduction and the provision of incentives. A perfectly insured grower will have less incentive to make costly investments in inputs or effort than would a grower with no such insurance. On the other hand, if the risks associated with a particular commodity are too great, growers will choose to devote their time and resources to the production of safer alternatives.

Examination of contracts governing the production of fruits and vegetables in California are generally consistent with the predictions of theory. Further, variation in the kinds of risk in contracts across different commodities matches what we'd expect if these contracts are designed in such a way as to use risk to provide grower incentives.

Ethan Ligon is a professor in the agricultural and resource economics department at UC Berkeley. His interests include growth and development, agricultural contracts, applied econometrics, information and uncertainty. He can be reached by telephone at (510)643-5411 or by e-mail at: ligon@are.berkeley.edu. Ê