In Short ■ by Charles V. Moore and Don Villarejo

Pesticide Cancellation and Kentucky Windage

The Kentucky long rifle, invented in the eighteenth century, greatly increased the range at which hunters could shoot with accuracy. At these distances, cross winds became an important variable in aiming. The only available wind speed indicator was a wetted finger. This highly subjective measure of wind speed was known as "Kentucky windage." While Kentucky windage has greatly diminished in use, the use of subjective measures has not. Here, we evaluate the use of highly subjective measures in studies predicting the economic impact of the cancellation of the registration of the pesticide ethyl parathion by the U.S. Environmental Protection Agency (EPA). The three major economic impact studies reviewed all used the same basic approach to collect data—they solicited subjective estimates of future yield losses due to cancellation. Sufficient time has passed for accurate *ex post* data on yields to become available. By comparing this *ex post* data with estimates of losses used in the earlier economic models, we can measure their accuracy for making pesticide policy.

Ethyl parathion in California—an *ex post* review

Ethyl parathion was first registered in the United States in 1948. In May of 1986, the EPA first took formal notice of parathion's high toxicity to farm workers and wildlife. For the seven-year period prior to cancellation in 1991, the injury rate to farm workers and applicators was 1.8 per 1,000 applications. These injuries were sufficiently critical to require a doctor's care and be entered into the official reporting system. These injury rates do not include the chronic illnesses which go untreated and unreported either due to ignorance or fear of contact with an "official" person or agency.

In anticipation of the EPA's cancellation of the registration of parathion and to provide information to the decision-making process, four major studies were published. Lichtenberg, Parker, and Zilberman published two studies, one in 1987 on lettuce and another in 1988 on tree crops. A College Station, Texas, group (Knutson et al.) and the U.S. Department of Agriculture's Economic Research Service (USDA-ERS) also released economic impact studies which covered fresh vegetables.

The Lichtenberg et al. lettuce study identified five groups of growers in the Central Coast area of California. During the summer and early fall months, the Central Coast area produces 89 percent of the nation's head lettuce on approximately 77,000 acres. Major lettuce pests controlled by parathion include lettuce root aphid, leaf aphids, symphylan, and leaf miner. The greatest impact of cancellation of parathion was predicted to be on an area of 35,000 acres subject to infestations of the lettuce root aphid. Using the opinion of a single entomologist, Lichtenberg, Parker, and Zilberman estimated a 25 percent yield loss without parathion use on these lands. Further, these researchers predicted that this loss would increase this group's cost of production by 33 percent. Their predicted yield loss is greater than the 20 percent figure that the California Department of Food and Agriculture expected if mevinphos was banned, but less than the 47 percent loss in lettuce production if all pesticide applications were reduced by half, as was used in the Knutson report for the American Farm Bureau Research Foundation. The USDA-ERS study used a yield loss of 5 percent for all lettuce treated with parathion across the board in the United States.

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Welfare losses (gross margin) for producers of summer lettuce due to the cancellation of ethyl parathion were estimated by Lichtenberg et al. at $16.7 million per year. Loss in consumer welfare due to higher lettuce prices during the summer were valued at $14.3 million. Only areas not infected by lettuce root aphid were made better off by cancellation.

What really did happen?

The California Pesticide Use Reporting System is unique. It requires detailed individual reporting of each pesticide application by ranch, field number, and commodity for all restricted pesticides to county agricultural commissioners and ultimately to the California EPA. We used summary data tapes from this source in our study.

During the discovery phase of litigation between the Teamsters Union and a group of six large produce growers in the Central Coast area of California, detailed produce yield data became available. Yield data by ranch, field number, and harvest dates for the

period 1985 through 1992 gave us a total of 2,045 lettuce observations from the six growers. Thus, a data base was developed in which actual yields could be compared both before and after the cancellation of ethyl parathion. The total production of these six producers in most weeks of the summer and early fall season was approximately 9 percent of the total U.S. lettuce market supply.

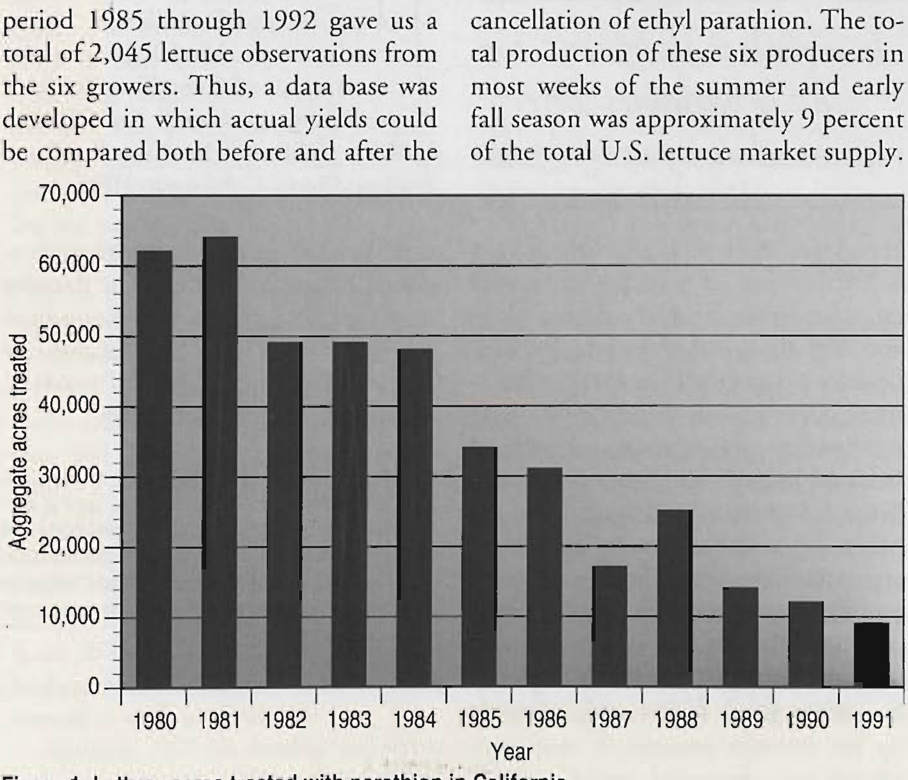

Figure 1. Lettuce acres treated with parathion in California

Although the reported studies which we evaluate were released well before actual cancellation, they failed to note that total parathion use on California lettuce had been decreasing since 1981 (see figure 1). In fact, parathion use on California lettuce at the time of cancellation had decreased to less than one-fourth of the early 1980s usage.

Given the data base, it was possible to conduct an analysis of variance comparing yields by field in the period before cancellation with yields on the same fields after cancellation. We compared yields within farms over time to see if these observations came from the same population. Statistically, there was no difference with and without parathion at the 95 percent confidence level. (See Moore and Villarejo for additional information.)

Economic Models

Three types of models were used by the earlier researchers whose work we review. Reduced to their simplest form the Knutson et al. study used a partial budget showing changes in farm gross margin if all or some pesticides were banned. This generates the greatest producer losses because neither growers nor consumers are allowed to adjust their production or consumption patterns in light of cancellation. The second model, USDA-ERS, allowed consumers to adjust lettuce consumption in response to a market price change, but producers could only respond to a shift in their costs; no substitution of other more profitable crops was allowed. The third model, Lichtenberg et al., allowed both producers and consumers to adjust to price changes but they were precluded from producing or consuming other commodities which were close substitutes. All models ignored the degree of market concentration in the fresh produce industry, the diversity of commodities produced on farms there, the degree of vertical coordination, and the geographic and temporal diversification of these large producers.

None of the models included the nonmarket costs imposed on farm workers and the environment by the use of parathion, thus, as pointed out by Bromley (*Choices* 1994), exaggerating society's net economic loss and biasing decision making toward maintaining the status quo.

What went wrong?

Two major problems have come to light. First, in all of the pesticide cancellation studies we reviewed, single individuals or small groups of individuals for a given commodity provided estimates of yield losses. Although these individual estimators were generally public employees and considered knowledgeable in their fields, a subjective bias toward the worst-case scenario in terms of overestimating yield loss appears to have crept into the final figures used.

Second, all of the economic models used failed to include the full set of costs and benefits which accrue to society. The models were too simplistic to capture the true behavior of the very dynamic and highly resilient fresh produce industry. For example, none of the models captured the effects of the high degree of vertical integration in the industry, which provides quicker response to changes in relative commodity prices. Nor did they take into account the diversification over time, space, and commodity, which is unique to the fresh produce industry and which allows more rapid shifts in crop mix and production in alternative agroclimatic zones in response to changes in prices and technical relations. They also ignored the gains from reduced illness and injury to farm workers, applicators, and wildlife with cancellation of a highly toxic pesticide. In a rush to judgment, too many variables were assumed away or ignored. Researchers relied too heavily on Kentucky windage and not enough on a data base generated by a more rigorous methodology.

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Our review of past predictions of crop loss from pesticide cancellations and our study of what actually happened to crop yields has three implications. First, readers should hold severe reservations about results developed from subjectively generated data bases. Second, legislators and agricultural experiment station directors should increase the allocation of funds to research on the efficacy and efficiency of target pesticides. And third, researchers should start measuring the nonmarket losses to society from illness and injury to farm workers and the environment.

■ For more information

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