An Inventory of Pest Management Practices in the Lompoc Valley,
Second Edition, August, 1995 (PM 95-02)

Executive Summary

Department of Pesticide Regulation, Environmental Monitoring, and Pest Management Branch,
Pest Management Analysis and Planning Program,
1020 N Street, Room 161, Sacramento, California 95814-5624

PURPOSE

Residents of Lompoc have expressed concerns about the use of pesticides in the agricultural areas near the town. This report describes pesticide use and pest control practices in the Lompoc Valley. The first edition of the report contained data on pesticide use in 1991 and 1992. This second edition adds data from 1993 and corrects errors and omissions in the first report.

BACKGROUND

Since late 1993, the Santa Barbara County Agricultural Commissioner's Office (SBCAC) has received complaints from Lompoc residents about pesticide use near the town. Because of the concerns raised, a panel of representatives from the SBCAC, the Department of Pesticide Regulation (DPR), the Santa Barbara County Health Department, and the U.S. Environmental Protection Agency (U.S. EPA) met with the residents of Lompoc in July 1994. Townspeople discussed health problems that they attributed to pesticide exposure and raised concerns about exposure of children to pesticides while at school. They also raised questions about pesticides in the air, water, and soil; about cropping patterns in the Lompoc Valley; the effectiveness of current regulatory restrictions in protecting citizens from pesticide exposure; the nature of pesticide toxicity; the quantities of pesticides used; and available alternatives to pesticides. The panel responded to the residents' questions, and DPR made a commitment to research some aspects of the situation, including pest control patterns.

STUDY METHODS

The report focuses on a transition zone covering parts of the town of Lompoc and the surrounding agricultural lands. In the report, this zone is called the agricultural-urban interface (AUI). It includes five one-square-mile parcels along the western and northern boundaries of the town, the area of town most often downwind of agricultural lands. Both agricultural and urban areas occur within the zone, and most of the complaints have concerned this area.

DPR's scientists used several databases to characterize the situation in Lompoc. The 1990 U.S. Census provided data for an analysis of the population in the AUI. DPR's pesticide use report (PUR) database provided information about pesticide use in the AUI during 1991 to 1993. The database contains a record of almost every pesticide application made in an agricultural setting in California, because users must report all such applications by law. DPR enters the use report information into a computerized database. The data for 1991 to 1993 are the most fully validated available.

To gather additional information on pest control practices in the Lompoc area, DPR biologists traveled to Lompoc and interviewed pest control advisors (PCAs) and organic and conventional growers.

RESULTS

The crops and pesticides in the AUI were generally similar to those in the rest of the Lompoc Valley. Thirty-nine crops received pesticide applications in the AUI. The PUR summaries do not provide information on a particular piece of land and they are affected by the different amounts of land that were planted to the different crops. Because of this, they do not directly show whether one crop or another received more pesticide on a per-acre basis. Nonetheless, five crops or crop groups received most of the pesticide use. These included lettuce (leaf and head), cole crops (cabbage, cauliflower and broccoli), flowers, celery, and dried beans, typically in that order. Because of the mild climate in the Lompoc Valley, these crops are grown year-round.

The report provides details of use for every pesticide used in each of the five major crops in the AUI, and for total insecticide, fungicide, and herbicide use for each month in each of the five major crops, for the years 1991, 1992, and 1993. Based on the number of pounds applied, the most heavily applied pesticides were fungicides, followed by insecticides, and then herbicides. Based on the number of treatments or acres treated, insecticides were applied more than fungicides or herbicides. Fungicide use varied broadly during the year, depending on the crop and year, but was relatively low during the winter months. Insecticide use was generally heaviest between April and September with almost no use during November through February. Herbicide use was scattered fairly evenly throughout the year because herbicides are mostly used just before planting and planting can occur almost year-round.

Taking together all the pesticides used in the Lompoc AUI, the total number of acres treated increased from 8,568 acres in 1991 to 10,362 acres in 1992, then remained practically unchanged in 1993. However, no data were available on the actual number of acres planted to crops in the AUI each year, and some of the changes in pesticide use could have been due to changes in the amount of land being farmed. The total amount of pesticides that were applied in the AUI increased from 8,144 pounds in 1991 to 21,636 pounds in 1992, then fell back to 9,889 pounds in 1993. The large increase in 1992 was due to the application of 12,224 pounds of fumigants to 69 acres of cole and flower crops. Fields that are planted to vegetables typically need fumigation only once every several years, and they generally require 150 to 400 pounds of fumigants per acre.

The highest levels of pesticide use in the Lompoc Valley were outside the AUI to the west, where cropping activity is more intense. The square-mile parcels that received the highest use, in terms of total number of acres treated and number of pesticide applications, were just west of the AUI and in the northwest corner of the Valley.

Our survey of pest control practices showed that the conventional growers in the Lompoc area generally use sound crop production techniques, including several practices that are fundamental to integrated pest management (IPM). IPM is an approach to managing pests that combines biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. However, there are very high market quality standards for most of the major crops in the Lompoc AUI. These standards require growers to keep the harvested crop almost completely free of damage, insects, or disease. For example, the University of California's IPM manual on cole crops recommends that cabbage should be treated for cabbage aphids when one to two plants out of a hundred have even one aphid. With the high market standards, growers find that they must use pesticides to avoid intolerable losses. The report outlines the pest problems in each of the major crops and discusses the different pesticides that are used to control them.

According to PCAs in the area, between 75 to 95 percent of all treatments are made by ground, because they are less expensive than aerial treatments and they permit better placement of the pesticides. Ground applications are made at night, usually between one a.m. and dawn, when the winds are calm and few people are outdoors. Aerial treatments are made by helicopter and are used only when ground equipment is not practical, such as when the ground is very wet or the crop fills the rows. In the winter, perhaps 75 percent of all applications are made by air, but this percentage is much lower in the warmer months. All aerial applications take place between daybreak and 9 a.m., when the windspeed is very low.

The Santa Barbara County Agricultural Commissioner has placed several restrictions on pesticide applications within the county. For example, no application can be made within 200 feet of a school at any time, nor within 500 to 750 feet if children are present. Growers in the area have taken additional voluntary steps out of consideration for residents. Some growers plant no crops within 150 feet of any residence. Others plant only crops that receive no pesticide treatments within 170 feet of homes, and one grower does not spray at all within 500 feet of homes. Beginning in mid-1993, the growers in the area have made no aerial treatments within one-quarter mile of the town. They make aerial treatments within one-half mile of the town only when there is no wind or when the wind will carry any drift away from the town.

An Inventory of Pest Management Practices in the Lompoc Valley
Second Edition

by

Patrick Akers, Larry Wilhoit, Janet Broome, Robert Hobza, Robert Teso, and David Supkoff

Department of Pesticide Regulation, Environmental Monitoring and Pest Management Branch,

Pest Management Analysis and Planning Program,

1020 N Street, Room 161, Sacramento, California 95814-5624

August 1995

PM 95-02

Pest Management Analysis and Planning Program

Acknowledgments

We would like to express our appreciation and gratitude to the people who spoke with us and shared freely of their information and knowledge.

Public Service Employees:
Glenn Janssen, Agricultural Biologist, Santa Barbara County Agricultural Commissioner's Office, Lompoc
Joe Karl, Deputy Agricultural Commissioner, Santa Barbara County
Frank Laemmlen, Farm Advisor, Santa Barabara County U.C. Co-operative Extension, Santa Maria
Ricardo Martinez, Supervising Pesticide Use Specialist, Pesticide Use Enforcement Branch, Department of Pesticide Regulation, Sacramento
Carolyn Pickel, IPM Advisor, Sutter County U.C. Co-operative Extension, Yuba City
Jim Walsh, Senior Pesticide Use Specialist, Pesticide Use Enforcement Branch, Department of Pesticide Regulation, Anaheim

Pest Control Advisors:
Greg Baldwin, Pest Control Advisor, Soilbuilders, Guadalupe
Stan Deguchi, Pest Control Advisor, Witt Ranch, Lompoc
Steve Heath, Pest Control Advisor, Ag America, Lompoc
John Patino, Pest Control Advisor, Western Farm Service, Lompoc
John Phillips, Pest Control Advisor and Research Director, Nature Farming, Lompoc
Joe Wickum, Pest Control Advisor, Western Farm Service, Lompoc

Growers:
Bob Campbell, Grower, Lompoc
Frank Costa, Ocean View Flowers, Grower/Shipper, Lompoc
Frank M. Costa, Jr., Grower, Lompoc
Robert D. Guerra, Grower, Witt Ranch, Lompoc
Art Hibbits, Grower, Lompoc
James D. Hurst, Operations Manager, Nature Farming, Lompoc
Richard Shiffrae, Grower, Lompoc
John A. Silva, Grower, Lompoc

We are also grateful to Rosemary Neal and Min Poe of the Environmental Monitoring and Pest Management Branch, Department of Pesticide Regulation, Riverside, for producing Figures 1, 2, and 15.

Disclaimer

The mention of commercial products, their source, or use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products.

Table of Contents

List of figures

List of tables

Preface to the Second Edition

This edition of the Inventory differs from the first edition largely in that it includes the Pesticide Use Report data for 1993. The first edition of this Inventory appeared in March of 1995 and included summaries and analyses of pesticide use around the town of Lompoc. These summaries were derived from Pesticide Use Reports which contain records of every agricultural use of a pesticide in California since 1990. At the time the Inventory was released, only the data for 1991 and 1992 had been entered and checked. At present, the data for 1993 are also available, and sections on pesticide use have been revised to reflect the new data. Errors and omissions have also been corrected.

Introduction

Since late 1993, the Santa Barbara County Agricultural Commissioner's Office (SBCAC) has received complaints from Lompoc residents about pesticide use near the town. These complaints resulted in a town meeting in the City of Lompoc in July, 1994, where all interested parties were able to voice their opinions. A panel of representatives from regulatory and health agencies was present and responded to residents' questions. The panel included representatives from the SBCAC, the Santa Barbara County Health Department, the Department of Pesticide Regulation (DPR), and the U.S. Environmental Protection Agency (U.S. EPA). Townspeople discussed health problems that they attributed to pesticide exposure, and their concerns about exposure of children to pesticides while at school. They also raised questions about pesticides in the air, water and soil, about cropping patterns in the Lompoc Valley, the effectiveness of current regulatory restrictions in protecting citizens from pesticide exposure, the nature of pesticide toxicity, the quantities of pesticides used, and available alternatives to pesticides.

This report summarizes information on pest management practices in the Lompoc Valley. It emphasizes the crops grown, their associated pests, and the pest control practices in current use. The investigation began with a set of chemicals that are on DPR's list of candidate Toxic Air Contaminants (candidate TACs)(Kelley and Reed, 1994), under the assumption that these more volatile compounds would likely be the source of any problems. Later, the investigation was expanded to include all pesticides, but the earlier emphasis influenced the data that was collected.

The report includes an evaluation of pesticide use for calendar years 1991-93. A previous edition included data only for the years 1991-1992. This evaluation focuses on a region bordering the town of Lompoc where the urban and agricultural environments meet. In this report, this area is called the agricultural-urban interface (AUI), and the methods used to define it are described. The report also includes an inventory of pest management practices used in the production of the major crops grown in the AUI. This inventory was developed primarily through a series of interviews with growers or their pest control advisors (PCAs). These interviews helped identify major crops, cultural and pest control practices, and the reasons behind their use. When possible, the interview team also identified pest control practices in the Lompoc area that did not depend on pesticide use, including cultural and biological control methods.

Integrated Pest Management in the Lompoc Area

Over the past 30 years, integrated pest management (IPM) has been growing in importance in agriculture. IPM is a systematic management scheme involving the intensive use of information and combining cultural, biological and chemical control strategies for pests. An effective IPM system is first based on crop production practices that produce vigorous plants and help exclude pests. These practices include the use of pest resistant varieties, planting seed or transplants free of disease or other pests, use of proper soil and bed preparation to provide good drainage, alignment of beds or rows to optimally catch sunlight, fertilizing to give strong but not excessive growth, and proper management of irrigation. The goal is a vigorous plant which is able to resist some diseases and insects, as well as tolerate some damage without loss of yield. Lompoc growers already follow many of these production practices in their efforts to achieve large, healthy crops.

After a grower has made all the decisions about crop and production practices, the decision to apply a particular pesticide at a particular moment is based on several criteria. Monitoring is an important part of such decisions in a good IPM program. It involves sampling fields to determine the numbers of pests present and then relating this to pest population levels that are known to cause damage. Environmental conditions may also be monitored to predict when an insect outbreak might occur or a disease might become an epidemic. Chemical intervention is based on this information.

In Lompoc, most growers already use monitoring in their production activities. Their primary source of information about pest control is their PCAs. The largest PCA service in Lompoc estimates that they are involved in about 70% of the pest control activity in the Lompoc Valley. In addition to offering pest monitoring services, this company is also a pesticide dealer. Many of the other PCAs in Lompoc are considered independent PCAs who do not sell pesticides that they recommend. A PCA usually visits each field at least once a week, and more often nearer to harvest or if a problem seems to be developing. On each visit, the PCA walks through the field, scans it for potential problems and searches for specific pests. Most experienced PCAs obtain some information on pest populations, then use their experience to decide whether a problem is developing.

After a crop is harvested, sanitation or removal of infected crop residues is important in reducing pest populations. Rotation of crops is another important aspect of pest management. This is difficult in Lompoc as the land is becoming more expensive and cole crops, lettuce, and celery are high value crops that grow well in the cool moist climate of the area. Unfortunately, these crops share some of the same pests.

The Agricultural-Urban Interface (AUI)

The AUI in the Lompoc Valley was defined using available databases. Oracle®, a relational database management system, and Arc/Info®, a geographical information system, were used along with several geographic data resources to develop maps of the Lompoc region and the AUI. Among these geographic data resources were basic reference data such as waterways, and administrative or political boundaries of familiar features in the Lompoc Valley. These data were obtained from Digital Line Graph data supplied by the U.S. Geological Survey (USGS) and administrative maps provided by the SBCAC. Pertinent data were digitized from these sources.

Section identification numbers were used to identify the AUI (Cazier, 1976). A section is one square mile of land, and many sections in the country have been given their own identification numbers by the USGS Rectangular Coordinate Survey System. These identifiers are a primary method that DPR uses to locate areas for its Pesticide Use Report (PUR). Much of the area in question is not covered by the Rectangular Coordinate Survey System, but the USGS system has been extended to such areas for the purposes of filing Pesticide Use Reports. These section data appear to be the result of an earlier private land survey that provided the basis for land subdivision in the city of Lompoc. Major city streets in Lompoc and the Lompoc Valley often follow section boundaries.

Primary criteria for including sections in the AUI were:

- the land use patterns within the section included both agricultural and residential (urban) areas,

- the section included certain administrative boundaries such as city limits, where applicable,
- the location of residential areas from which complaints have originated, and
- the relative positions of agricultural and residential areas with respect to typical wind patterns.

Though not an explicit criterion in defining the AUI, some consideration was given to the location of schools in the area.

The California Department of Conservation's (DOC) Farmlands Database was also important in establishing the AUI. This database is an inventory of the state's prime farmlands, produced by the Farmland Mapping and Monitoring Program. This database contains information on certain categories of land use within the state, including prime and unique farmlands, lands of statewide or local importance, and grazing lands. The DOC is also charged with monitoring the conversion of prime farmlands to urban land uses. These data are updated on a biennial basis. In defining the AUI for the Lompoc area, the 1992 Farmlands Database for Santa Barbara County was used to identify the portions of the Western Lompoc Valley that are currently being farmed or have the potential to be farmed. Grazing lands were excluded in order to better visualize the valley floor and to emphasize the location of agricultural areas where pesticide use is concentrated. A visual check of the area was made to verify existing boundary conditions, such as the abrupt transition from urban to agricultural use on the western city limits.

Using the methods and resources described above, the AUI for the Lompoc Valley was defined to include approximately five square miles of land (Fig. 1). The area is located on the western city limits and along Central Avenue. Specifically, the AUI includes most or all of sections 27, 28, 29, and 32 of Township 07N, Range 34W and section 5 of Township 06N, Range 34W. Landmarks that delimit the area include the intersection of McLaughlin and Rucker Roads at its northeastern extreme, to a point on Floradale Road along a line more or less parallel to the flow path of the Santa Ynez River in the area north of the Lompoc Airport. Floradale Road constitutes the major portion of the western boundary of the AUI, but the boundary continues along the line of Floradale Avenue to a point about 1.05 miles south of Ocean Avenue. The AUI boundary then runs east approximately 1 mile, where it turns north on a line parallel with 'V' Street, to its intersection with North Avenue. It continues east along North Avenue to Seventh Street where it turns to the north. The final leg terminates at the McLaughlin-Rucker intersection. (Fig. 1).

Population Patterns in the AUI

To determine the age characteristics of the people who live in the AUI, U.S. Census data were obtained from the State of California's Stephen P. Teale Data Center, as datasets for geographical mapping. Land in the AUI was broadly classified as residential or non-residential based on a visual survey. Most areas to the north of Central Avenue have industrial, agricultural or special purpose uses, such as the Lompoc Airport and water treatment facilities. Areas to west of the Lompoc City Limits are largely agricultural. Residential areas within the AUI are restricted to areas south of Central Avenue (the southern halves of sections S07N34W27, 28, and 29). On the western city limits in sections S07N34W29, 32 and S06N34W05, residential areas extend from 'V' Street through 'Z' Street (about 1/4 mile). An exception occurs in section S06N34W05 where a 1/4-mile wide residential strip between Olive and Willow Avenues extends 1/2 mile from 'V' Street to Bailey Avenue on the west.

Table 1 shows the age structure for these portions of the AUI. The residential class includes all parts of the AUI that fall within Lompoc City Limits south of Central Avenue. All other areas are assigned as non-residential. Census information can be extracted based on section boundaries, with the exception of the census tract that covers the extreme southwest corner of the city limits and extends into parts of sections S06N34W05 and S06N34W04.

According to the 1990 U.S. census, the City of Lompoc has a population of 37,649. There are 11,326 residents that are 18 years old or less, constituting 30% of the population. The AUI has a total population of 9,517 (25.3% of Lompoc city residents). Sixty-six percent of the residents in the AUI are 18 years old or less. In residential areas of the AUI, persons 18 years or less make up 70.2% of the population. Four public schools are located within the AUI and include: La Cañada, La Honda, Miguelito and Clarence Ruth.

Table 1. Population structure of the AUI.

SECTION	PRINCIPAL USE	POPULATION	18 & UNDER	OVER 18
S07N34W27	Residential	2731	1896	835
S07N34W27	Non-residential	612	428	184
S07N34W28	Residential	2960	2116	844
S07N34W28	Non-residential	25	21	4
S07N34W29	Residential	920	648	272
S07N34W29	Non-residential	0	0	0
S07N34W32	Residential	1533	1065	468
S07N34W32	Non-residential	63	45	18
S07N34W05	Residential	666	467	199
S07N34W05	Non-residential	7	4	3
	Total Non-Residential	**707**	**498**	**209**
	Total Residential	**8810**	**6192**	**2618**
	Total	**9517**	**6690**	**2827**

Survey Methodology

Much of the information that was gathered for the inventory of pest management practices came from interviews with people knowledgeable about the area of Lompoc. The SBCAC and the farm advisor for vegetable crops in Santa Barbara County provided the names of knowledgeable pest control advisors (PCAs), organic and conventional growers, and others familiar with the pest management practices for crops grown around the City of Lompoc.

Appointments were made by telephone with the identified PCAs and an organic grower. Scientists from DPR's Pest Management Analysis and Planning Program traveled to Lompoc in mid-January, 1995, to interview the PCAs and the organic grower. The information collected during this survey, and information extracted from the PUR, provided the basis for this report.

A separate meeting was held with growers who farm within the Lompoc AUI. In this meeting, growers presented their perspective on the background of the issue, and discussed changes in cropping patterns, growing practices, pest management practices, and other topics relevant to the Lompoc agricultural pesticide use issue.

Pesticide Use in the Agricultural-Urban Interface

In addition to the survey of the pest management practices used in the Lompoc Valley, the Pesticide Use Reports for 1991-1993 were evaluated to determine the pesticides used on all crops grown in the five-square-mile area of the AUI. As of 1990, whenever a pesticide is used in agriculture, it must be reported on a PUR. DPR has been developing a computerized system to manage and retrieve the information contained in the PURs. In the previous edition of this report, the data for 1991-1992 were the most fully validated data available. This new edition includes data for 1993 as well.

Unless stated otherwise, this summary covers pesticide use in the AUI only and does not necessarily reflect pesticide use elsewhere in the Lompoc Valley. Thirty-nine crops and other sites were reported as receiving pesticide applications in the AUI. Five crops or crop groups were identified as having received the major portion of pesticide use. These included cole crops (cabbage, cauliflower, and broccoli), lettuce (leaf and head), dried beans (and "unspecified" beans), celery, and cut flowers. Because of the mild climate in the Lompoc Valley, these crops are grown year round.

Three different measures of pesticide use can be obtained from the PUR: the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredients applied. In this report, whenever pounds of pesticide are discussed, it means pounds of active ingredient, and not pounds of formulated product. Each measure of pesticide use has its own advantages and disadvantages. The number of applications is important as a measure of how many times each pesticide was applied. One characteristic of this measure is that when different pesticides are mixed and applied during one application, the PUR will record a separate application for each pesticide. Therefore, the number of applications can overestimate the number of times application equipment was actually in the field. The acres treated is the sum of acres treated with each pesticide on each crop. The same acre would be counted multiple times if there were multiple applications of a pesticide to that acre. Nonetheless, it is a measure of the total area to which pesticides were applied and may be the best single measure of pesticide use, because it indicates how large an area has been treated. The pounds of active ingredients applied measures the amount of pesticidal chemical applied, but comparisons of pesticides that are applied at different rates per acre can be misleading. For example, permethrin is used frequently, but it is applied at 0.1 to 0.2 pounds per acre. On the other hand, fumigants are used infrequently, but are applied at a very high rate. For instance, cole and lettuce crops typically receive 150 to 300 pounds of methyl bromide per acre. All the measurements of pesticide use are summarized across the entire AUI, so they are affected by the different amounts of land that were planted to the different crops. The PUR does not provide information on a particular field or acre of land through time, and the summaries do not directly reflect pesticide use on a per-acre basis. As one result, the total use in a crop could be higher than other crops in part because more acreage was devoted to that crop. When apparent errors were detected in the 1992 PUR data (that is, when a treatment was reported as using an application rate 100 or more times greater than normal), the data were deleted for the purposes of analysis.

When the patterns of pesticide use in the different crops were compared for 1992 and 1993 (Figs. 2-7), all the pesticides were ranked by each of the three measures of use. In addition, a set of pesticides identified as candidate Toxic Air Contaminants (candidate TACs) (Kelley and Reed, 1994) were used as an initial focus of the investigation. Assembly Bills 1807/3219 require DPR to identify air pollutants that "may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health" (Section 14021, Food and Agricultural Code), and to declare and regulate them as toxic air contaminants. At present, approximately 150 pesticides are being considered as candidate TAC pesticides. These pesticides have a wide range of physical characteristics and biological effects. They have been placed on the candidate TAC list primarily because they may have effects on human health, not because they are known to pollute the air. At present, none of the candidate TACs have been shown to pollute the air, and their presence on the candidate list does not indicate that they are air contaminants.

Most of the pesticides that were used in the Lompoc AUI in 1991-1993 were on the candidate TAC list (Tables 2-4). Many of the candidate TAC pesticides were among those that received the most use, whether measured in pounds applied or acres treated. These included acephate, chlorothalonil, methomyl, oxydemeton-methyl, and permethrin. One of the most commonly used pesticides, maneb, has been declared a hazardous air pollutant by the U.S. EPA.

Of all the pesticides used in the Lompoc AUI each year during 1991 to 1993, several pesticides were always among the fifteen that received the most use, no matter whether use was measured in pounds applied or acres treated (Tables 2-4). These pesticides were acephate, chlorpyrifos, fosetyl-al, iprodione, maneb, methomyl, oxydemeton-methyl, and propyzamide. If use is measured only by acres treated, then dimethoate, esfenvalerate, and permethrin join the previous list, and if use is measured by pounds applied then chlorthal-dimethyl and dicloran join the list. The lists are different when based on acres treated and pounds applied because pesticides differ in the amounts applied per acre.

Some pesticides were used heavily only in certain years. The clearest example was provided by the fumigants, such as methyl bromide. Fumigants were used only in 1992, when 12,224 pounds were applied to 69 acres of cole and flower crops (Tables 3, 5-7, Figs. 6, 7). Because they are typically applied at much higher rates per acre than other pesticides, limited treatments with fumigants lead to the use of more pounds of fumigants than of other pesticides, even though other pesticides are used more often and are applied to wider areas. For example, growers applied methyl bromide to 22 acres of crops in the AUI in 1992, using 6,759 pounds of the fumigant (Table 6). In contrast, growers applied 1,084 pounds of the non-fumigant pesticide chlorthal-dimethyl, but they used it on 210 acres of crops. Of the non-fumigant pesticides, chlorthal-dimethyl accounted for the greatest number of pounds in 1992.

Lettuce received the highest use of many pesticides, such as acephate, dimethoate, fosetyl-al, iprodione, maneb, methomyl, permethrin, and propyzamide. For example, 400 to 460 acres of lettuce were treated each year with acephate, 105 to 180 acres of celery were treated, and zero to 92 acres of the other crops were treated (Figs. 4, 5, Tables 5-7). In the cases of fosetyl-al, maneb, and propyzamide, almost all the treatments were to lettuce. For example, fosetyl-al was applied to 590 to 1,200 acres of lettuce each year. The only other treatment with fosetyl-al was to 14 acres of flowers in 1993.

Some pesticides were applied primarily to crops other than lettuce, especially to cole crops and, to a lesser extent, to flowers. Esfenvalerate and oxydemeton-methyl were applied almost exclusively to cole crops. Chlorpyrifos was applied to 220 to 272 acres of cole crops each year, to 120 to 140 acres of flowers, and to none of the other crops (Figs. 4, 5, Tables 5-7).

In terms of total pesticide use, lettuce generally received the most use, followed by the cole crops, then flowers and celery, and lastly beans. For example, between 1991 and 1993, pesticides were applied to 4,700 to 5,900 acres of lettuce per year, 1,760 to 2,800 acres of cole crops, 860 to 1,560 acres of celery, 800 to 1,270 acres of flowers, and 90 to 350 acres of beans (Tables 5-7). A similar pattern occurs in the pounds of pesticide applied to the different crops, except in 1992 when fumigants were applied. In 1992, 10,651 pounds of fumigants were applied to cole crops, almost half of the total 21,636 pounds of pesticide used in the AUI that year. Applications of pesticides to cole crops accordingly accounted for most of the pounds of pesticide applied that year. Fungicides, insecticides, and herbicides were applied every year from 1991 to 1993. Taken together, 4,100 to 6,300 pounds of these pesticides were used on lettuce each year during 1991-1993, 1,200 to 2,100 pounds on cole crops, 1,050 to 1,550 pounds on celery, 660 to 1,630 pounds on flowers, and 140 to 530 pounds on beans. This pattern is similar to that based on acres treated.

Pesticide use through the months of the year depended strongly upon the combination of the type of pesticide, the crop, and the year (Figs. 8-13, Tables 8-10). There are few if any generalizations that apply to every case. These variations are driven by differences in weather and pest pressure from year to year, differences in pest complexes from crop to crop, and by the year-round growing season in the Lompoc Valley.

An example of the effect of pesticide type is provided by the herbicides. While fungicide and insecticide use was low from the middle of fall through the middle of winter and much higher in the warmer months (Figs. 8, 9, 12, 13), herbicide use was more regular throughout the year (Figs. 10-11). Although herbicide use was somewhat higher in the warmer months, relatively large treatments occurred even in December, January, and February (Figs. 10-11, Tables 8-10). The only month that consistently had lower herbicide treatments was November. The pattern of herbicide use occurs because herbicides are usually applied very close to planting in Lompoc, and many of the crops in the Lompoc area are planted year round.

Fungicides provide the clearest example of differences among crops in the monthly pattern of pesticide use. In general, fungicide use was low from October through January and the largest number of acres were treated in March through August or September (Figs. 8, 9). However, celery and cole crops received most of their fungicides before the end of May, while lettuce received most of its fungicide later in the year, between March and August (Figs. 8, 9, Tables 8-10).

There were often large differences between years in the use of fungicides, insecticides, and herbicides in any particular month in many different crops (Figs. 8-13, Tables 9-10). For example, insecticide use generally was much lower in November, December, and January, began to increase in February until it reached a peak in August or September and then fell off rapidly in the fall, but the pattern varied from year to year and crop to crop. For example, in 1992 use in cole crops increased irregularly after February until it peaked in September (Fig. 12, Table 9). In 1993, insecticide use in cole crops was generally lower in 1993 than in 1992 and did not increase much until August, but it still peaked in September (Fig 13, Table 10). These variations are probably due to variations in the weather, cropping patterns, and pest complexes from year to year.

The total number of acres treated with all pesticides increased from 8,568 acres in 1991 to 10,362 acres in 1992, then remained practically unchanged at 10,217 acres in 1993 (Tables 5-7). A similar pattern occurs for total insecticide and herbicide use, but total fungicide use increased each year (3,236 acres in 1991, 3,596 in 1992, and 3,898 in 1993). Based on the number of pounds applied, total pesticide use increased from 8,144 pounds in 1991 to 21,636 pounds in 1992, then fell back to 9,889 pounds in 1993 (Tables 5-7). The large increase in 1992 was due to the application of 12,224 pounds of fumigants to 69 acres of cole and flower crops.

The crops grown and the pesticides used in the AUI were generally similar to those in the Lompoc Valley. The five-section area of the AUI did not receive the highest rates of pesticide use (Fig. 14). The upper panel of Figure 14 shows the results of an analysis that included only those acres in a section that were planted to a crop; therefore, it shows the average number of pounds of pesticides applied per year per acre. The lower panel of Figure 14 shows totals over entire sections. The highest rates of use per acre occurred in sections just west of the AUI. The sections that received the total highest use, in terms of total number of acres treated and number of pesticide applications, were just west of the AUI (S07N34W30) and in the northwest corner of the Lompoc Valley (S07N35W22) (Tables 11 and 12).

Crop and Pest Control Practices in the Lompoc Area

Cole Crops (Cauliflower, Cabbage, Broccoli)

Pesticide Use in Cole Crops in the AUI, 1991-93

After lettuce, cole crops had the highest number of acres treated with pesticides each year during 1991-1993. In 1991 and 1993, cole crops also received the highest number of pounds applied, after lettuce. However, in 1992, 10,651 pounds of the fumigants metam-sodium and methyl bromide were applied to 59 acres of cole crops (Table 6). This accounted for almost half of all the pounds of pesticides used on all crops in 1992. Consequently, cole crops received the highest number of pounds applied to any crop in 1992 (Tables 5-7).

Except for lettuce, cole crops received more insecticides and herbicides than most of the other crops, based on pounds applied during 1991 to 1993 (Tables 5-7). For example, cole crops received 698 to 1,091 pounds of insecticides per year in 1991-1993, behind lettuce, which received 938 to 1,339 pounds. On the other hand, cole crops used less fungicide than lettuce, celery, and usually flowers. For example, cole crops received 136 to 310 pounds of fungicide per year in 1991-1993, while flowers received 155 to 670 pounds. Based on pounds applied, insecticides were the most heavily used pesticide in cole crops in every year during 1991-1993, followed by herbicides and then fungicides. Insecticides were the most widely used pesticides, followed by fungicides and then herbicides, based on the number of acres treated.

The weather strongly influences fungus problems in cole crops, and fungicide use varied widely from year to year, with 136 pounds used in 1991, 310 pounds in 1992, and 175 pounds in 1993 (Tables 5-7). The fungicides with the most pounds applied and acres treated were generally chlorothalonil, copper hydroxide, iprodione, and metalaxyl. In 1991, the applications occurred fairly evenly throughout the year (Table 8). In 1992, most of the applications were made from January through March during the rainy season for control of downy mildew (Fig. 8, Table 9). In 1993, use was low most of the year, except for small peaks in March and May (Fig. 9, Table 10).

Insecticide use also varied throughout the 1991-1993 period (Tables 5-7). In 1991, cole crops received 698 pounds of insecticides, 1091 in 1992, and 752 in 1993. The insecticides with the most pounds applied and acres treated were generally acephate, chlorpyrifos, esfenvalerate, and oxydemeton-methyl. Insecticide use in cole crops generally began to increase during March and April, reached their highest levels in July through September, and then decreased to low levels by November (Figs.12, 13, Tables 8-10).

Herbicide use in cole crops consisted mostly of one herbicide, chlorthal-dimethyl (Tables 5-7), which, over the three years, was used rather evenly among the months of the year (Figs. 10, 11, Tables 9-10). Herbicides are used to prepare the seedbed before planting a crop, and cole crops may be planted at almost any time of year.

Diseases in Cole Crops

Downy mildew (*Peronospora parasitica* (Pers.) Fr.) is the primary disease of cole crops in the Lompoc region. Characteristic symptoms include yellow lesions on the upper side of the leaves and grayish white mycelial growth on the undersides of leaves during cool moist weather. It survives on overlapping cole crops or as thick-walled resting spores called oospores.

Downy mildew is favored by cool moist weather, which can start in September and continue throughout the winter months in Lompoc. Even during the summer months in Lompoc, fogs and dew can occur and contribute to disease problems. In Lompoc, the greatest loss from this disease occurs during the seedling stage, when whole plants can be killed. Severe leaf, stem, or flower infections can stunt older plants, resulting in reduced yield and quality. Systemic invasion of the heads can occur, leading to complete loss of the plant. Soft rot organisms may enter the wounds caused by downy mildew. The soft rot may then cause damage in transit and storage. If disease symptoms are limited to the leaves on fresh market crops, yield losses may not be high. However, when cauliflower is grown for seed, infection of flower parts can result in the failure to produce flowers or viable seeds. In cole crop seed production, plants are in the field for a total of nine months and thus exposed to pests for longer periods, complicating pest control practices.

Fungicides are usually needed for control of downy mildew. The disease can occur early in crop development and repeated applications may be needed, depending on the weather. In seed crops, treatment against downy mildew is required at early flowering. It is essential that several materials be used during the season, as resistance to some materials has been reported.

Alternaria leaf spot (*Alternaria* spp.) is a problem on cabbage during cool, rainy months, but it only occasionally infects broccoli and cauliflower. Leaf spots begin as small dark areas and spread to form larger, concentric rings. Spores are spread by wind and survive on plant debris or on seed. Losses occur by seedling death and spotting of lower leaves and heads of cabbage. Although spotting is superficial, it can reduce the ability to market the crop. Fungus mycelium can be seed-borne under the seed coat and is therefore a problem in seed production. In the Lompoc area, Alternaria leaf spot is usually controlled by the various fungicides that growers apply to control downy mildew.

Sclerotinia rot (*Sclerotinia sclerotiorum* (Lib.) de Bary, *S. minor* Jagger) fungi have a wide host range. The first symptoms of infection are water-soaked lesions on plant parts near the ground. Leaves then wilt and the entire plant collapses in 10 to 14 days, after which the cottony mycelium covers the plant and black hard bodies called sclerotia are formed. The fungus can survive in the soil for five to ten years on plant debris and as sclerotia. Cabbage heads can develop disease after harvest, during transit or storage. White blight occurs when the fungus enters the stem and causes death of the plant before seeds are produced.

Powdery mildew (*Erysiphe polygoni* De Candolle ex St. Amans) is not felt to be of economic importance in most areas of the United States. In the Lompoc area, one PCA mentioned that powdery mildew can be a problem in cabbage and cauliflower seed production.

Fungicides in Cole Crops

For downy mildew control, growers need to rotate the fungicides they use to avoid the development of resistance. Therefore, the products described here should not be considered simply as alternatives to one another. Also, fungicides are not applied on a fixed schedule for downy mildew control in Lompoc, but are applied when environmental conditions favor disease development. This can reduce the number of applications.

Chlorothalonil (Bravo®) is a nitril compound used in cole crops as a preventive fungicide. In Lompoc, growers apply this pesticide principally to control downy mildew, but they also obtain control of Alternaria leaf spot at the same time. Chlorothalonil can be used up until the day before harvest. It is typically applied early in the season to protect against seedling losses and also when weather conditions are favorable for downy mildew development. In Lompoc, it is the fungicide of choice for control of downy mildew. It is considered to be as effective as metalaxyl, a more expensive material that also has resistance problems. In Lompoc, it is used one or two times per year in rotation with other materials; the frequency of applications depends on the weather conditions. In Lompoc, tank mixes are also fairly common, such as mixing chlorothalonil with maneb and a copper compound.

In Lompoc, growers consider chlorothalonil to be as good as metalaxyl. Fosetyl-al and maneb are considered to be less effective than chlorothalonil, and copper compounds are the least effective. Chlorothalonil is more expensive than maneb or copper compounds and therefore is used somewhat less frequently than those compounds.

For Alternaria leaf spot control, chemical alternatives to chlorothalonil include iprodione, maneb and benomyl. In Lompoc, growers consider iprodione to be more effective than chlorothalonil, and chlorothalonil to be more effective than benomyl. Copper is thought to be the least effective of all chemical alternatives.

Metalaxyl (Ridomil®) is a systemic fungicide that controls only pathogens in the oomycete class of fungi, which includes the fungus that causes downy mildew. In Lompoc it is used on cole crops for control of downy mildew in rotation with other materials. Resistance problems have been observed in other areas, however this was not mentioned in Lompoc interviews. It is considered expensive, but it was ranked as the most effective by some of the growers. It is used one or two times a year in fresh market cole crops, and two to three times a year in seed crops. This material would not be expected to have activity against Alternaria leaf spot.

For downy mildew in Lompoc, growers consider metalaxyl to be as good as chlorothalonil. Resistance to metalaxyl has been reported and therefore it can not be used alone. Fosetyl-al and maneb are considered to be less effective than metalaxyl, and copper compounds are the least effective.

Maneb (Manex®; Dithane®) is a carbamate fungicide used on cole crops in the Lompoc area primarily for the control of downy mildew and secondarily for Alternaria leaf spot control. On average it is used one to two times a year depending on the weather conditions. It is frequently tank mixed with chlorothalonil and copper compounds.

For downy mildew control, maneb is not considered to be as good as chlorothalonil or metalaxyl. For Alternaria leaf spot control, it is considered as effective as chlorothalonil and superior to copper compounds.

Copper hydroxide (Champ® and others) is an inorganic foliar fungicide used for downy mildew control. In Lompoc it is considered less effective than the other materials but it is the least expensive and it is important in rotations with other fungicides for resistance management. Copper hydroxide also controls Alternaria leaf spot. Typically it is used once or twice per year, depending on weather conditions. Copper products are the only acceptable fungicides available to organic growers for downy mildew control.

Iprodione (Chipco 26019®; Rovral®) is a broad spectrum organic contact fungicide with preventive and some curative activity. It is used against powdery mildew in seed production, particularly in cabbage and cauliflower. It is applied just after bloom to prevent infections. The growers may spray several more times during the season depending on weather conditions. Iprodione also is applied in seed and fresh market cole crops for control of Alternaria leaf spot, again as a preventive application. In other crops, resistance to both iprodione and benomyl have been reported. However, in Lompoc cole crops, no resistance was reported.

For control of Sclerotinia diseases in seed production of cole crops in the Lompoc area, iprodione is sprayed post-bloom one to four times during the season.

Cultural and Natural Control of Diseases

In Lompoc, non-chemical control methods for downy mildew include the use of resistant varieties. In broccoli, several resistant varieties have been developed, such as Cindy, Citation, Excalibur, and Nancy. In cauliflower and cabbage, no commercially acceptable resistant varieties have been developed to date. In seed production, Lompoc growers are careful about previous cropping history. In particular, growers use clean, well-drained soils where cole crops have not been grown for two years, in order to minimize downy mildew. One of the organic growers in the Lompoc area applies a mixture of beneficial microorganisms through the sprinkler irrigation system. The mixtures contain actinomycetes, fungi, and bacteria that are normally present on plant surfaces and in a healthy soil. This farmer claims that they do not have any foliar or soilborne disease problems in the cabbage and broccoli crops, due to the use of these beneficial microorganisms.

In Lompoc, growers use hot-water seed treatments as a non-chemical control for Alternaria leaf spot. If Alternaria is found invading a field, then overhead irrigation is avoided.

Non-chemical controls for Sclerotinia rot in Lompoc include planting into well-drained soils and rotation with resistant crops if at all possible. If *S. minor* is the main pathogen, then deep plowing is practiced to aid in decay of the sclerotia. Deep plowing does not help as much if *S. sclerotiorum* is the main pathogen as wind-blown sexual spores can come from other fields. The organic grower in Lompoc suggested that the use of winter cover crops and compost, as well as the use of beneficial microorganisms, might explain the lack of Sclerotinia diseases on the land.

Insects in Cole Crops

In the Lompoc area, the major insect pest in cole crops is the cabbage aphid, *Brevicoryne brassicae* (Linn.). Growers were also consistently concerned about the green peach aphid (*Myzus persicae* (Sulzer)), the diamondback moth (*Plutella xylostella* (Linn.)), the beet armyworm (*Spodoptera exigua* (Hübner)), and the cabbage looper (*Trichoplusia ni* (Hübner)). The lygus bug (*Lygus* spp.) is a sporadic pest, but it can cause serious damage when large populations migrate from the wildlands in the spring, as native host plants dry out.

Under normal circumstances in the Lompoc area, a cole crop generally requires from one to four insecticide treatments from planting through harvest, with an average of two to three treatments. The number of treatments depends on the time of year and will also vary from year to year.

Since cole crops are in the ground year round in the Lompoc area, insecticides may be used at any time of year, although they are used more heavily during the warmer parts of the year (summer and fall), as insect populations build up.

Cabbage aphids present a threat to all stages of the crop. The aphids commonly occur in dense colonies and they often hide deep within the plant, where they feed on the youngest leaves and flowering parts. Large populations can stunt or kill small plants, and they often cause the leaf to curl about them, making them even more difficult to reach with insecticides. Cabbage aphids also create a serious problem if they are present in the crop at harvest, because the crop may not meet quality standards and the grower will be unable to sell it. As few as five aphids per plant can be grounds for rejection. Usually, Lompoc growers apply two to three treatments per crop against the cabbage aphid, at the button stage and a few weeks before harvest. More applications are made in crops being grown for seed.

Green peach aphids are generally a pest of seedlings, which can be stunted by heavy populations feeding on them. Green peach aphids do not generally pose a threat to later stages of the crop, because they tend to feed on the older leaves and do not hide deep within the head. They do not usually contaminate the harvested crop.

The greatest threat from the cabbage looper comes after the crops begin to form heads. Loopers eat ragged holes in leaves, which can reduce quality although the damage rarely reduces yield. More importantly, they also chew into or through the heads, contaminating them with their droppings or remaining in the harvested product. Even a small amount of such contamination may be grounds for rejecting the crop. The Lompoc growers have not noticed many problems with cabbage loopers in the last several years, but loopers can become a problem at any time of the year with the continuous cropping systems now used in the area. Growers estimated they might have to treat specifically for loopers once per year.

Beet armyworms and corn earworms pose threats that are similar to the cabbage looper. In addition, beet armyworms can destroy seedlings, eat large portions of leaves or stunt growth by damaging buds. The beet armyworm is considered a consistent and tenacious pest, often difficult to control.

The diamondback moth causes damage similar to the cabbage looper and also sometimes stunts growth by feeding on buds. It is emerging as a more important problem. In the past, it was usually not the main target of control, and was controlled by treatments applied for other problems. In the last two to three years some growers have begun to treat specifically for it. These growers have found themselves applying four to five applications to a crop, rather than two or three, because of the added pressure from the diamondback moth.

Insecticides in Cole Crops

The major insecticides in cole crops are oxydemeton-methyl used primarily for control of the cabbage and green peach aphids, methomyl for the worms, permethrin for the cabbage looper, and acephate for the green peach aphid. Other materials are sometimes used to control these and other insects because of limitations on pre-harvest intervals, because of cost, because of limitations on the number of times a particular compound may be applied to a crop, because a material is easier or safer to handle, or in an attempt to prevent a pest from becoming resistant.

Other materials that are used include naled, *Bacillus thuringiensis* (B.t.), methamidophos, chlorpyrifos, dimethoate, and esfenvalerate.

Oxydemeton-methyl (Metasystox-R®) is the insecticide that Lompoc growers prefer by far to control the cabbage aphid. Other materials that have some effect against the cabbage aphid include methamidophos, chlorpyrifos, naled, acephate, and dimethoate, but the growers consider them all inferior to oxydemeton-methyl. Aside from its effectiveness, oxydemeton-methyl has the advantage of a short pre-harvest interval (seven days). Its limitations are that it can only be applied three times per crop to cauliflower, and it can be toxic to the crop if overused.

Oxydemeton-methyl is also the preferred material for control of the green peach aphid, although this insect is often controlled by the treatments against the cabbage aphid. Acephate and methamidophos are also relatively effective against the green peach aphid, and dimethoate has some effect. Oxydemeton-methyl also gives some control of the diamondback moth, but that insect is usually controlled with other insecticides.

Methomyl (Lannate®) is the material of choice against several moth pests, especially the beet armyworm and the diamondback moth, but it also gives good control of the corn earworm and the cabbage looper. The Lompoc growers consider methomyl to be the most effective material by far for control of the beet armyworm. One grower even thought that there is no effective alternative. Others consider methamidophos to give some control. Other possible alternatives include esfenvalerate and permethrin (especially when mixed with B.t.).

Methomyl is also considered the best material for control of the diamondback moth. Methamidophos is considered a good alternative, and acephate, esfenvalerate, permethrin (alone or mixed with B.t.), and chlorpyrifos may also have some effect.

Growers consider methomyl to be very effective for control of the lygus bug, but chlorpyrifos, methamidophos, acephate, and sometimes dimethoate also perform well. Esfenvalerate and cypermethrin provide some control, and permethrin may have some effect.

Permethrin (Pounce®, Ambush®) is most often used against the cabbage looper. It is particularly effective when mixed with B.t. Growers often consider using permethrin because it is relatively safe to handle and because it has a short pre-harvest interval, so it can be used shortly before harvest. Methomyl is also an excellent alternative for control of the looper, and esfenvalerate and B.t. alone can give some protection.

Permethrin can also give some control of the beet armyworm and diamondback moth, but other materials perform better, particularly methomyl. It can also be used to control the lygus bug, but again, other materials are considered more effective (see methomyl).

Acephate (Orthene®) is considered to provide good control of the green peach aphid, but less than satisfactory control of the main aphid pest, the cabbage aphid. It is usually used early in the crop to control green peach aphids, because of its long pre-harvest interval (21 days), and because the insects are more accessible at that time. Acephate also provides some control of the diamondback moth, but the Lompoc growers find methomyl and methamidophos to be more effective.

Naled (Dibrom®) is rarely used in the Lompoc area, apparently because the growers do not like to handle it and because they consider it particularly devastating to natural enemies. However, they sometimes use it against the cabbage aphid, particularly close to harvest. Naled has a one-day pre-harvest interval, while the interval is seven days for the more effective oxydemeton-methyl.

Methamidophos (Monitor®) has fallen out of favor in the Lompoc area because of its high mammalian toxicity and because it is sometimes toxic to the crops. It also has a strong odor. It is considered to have some effectiveness against diamondback moth and the lygus bug, although other insecticides are preferred.

Chlorpyrifos (Lorsban®) is a possible alternative treatment for the cabbage aphid, but is not considered to be as effective as oxydemeton-methyl. It is most effective early in the crop before the aphids can hide deep within the plant, and it also has a 21-day pre-harvest interval, which limits its use to the early stages of the crop. Some growers prefer to use it when possible, because it has a lower mammalian toxicity than oxydemeton-methyl and because oxydemeton-methyl can only be applied three times to some crops. Chlorpyrifos is considered an effective option for control of lygus bugs. It is a possible option for control of the diamondback moth, although it is not considered as effective as methomyl.

Dimethoate (Cygon®) finds some use against the green peach and cabbage aphids, but growers consider oxydemeton-methyl to be much more effective. It is also occasionally used to control lygus bugs, but methomyl, acephate, and methamidophos are considered more effective.

Esfenvalerate (Asana®) is sometimes used in an attempt to control beet armyworms, loopers, and diamondback moths, but it has not proved as effective as methomyl.

Cultural and Natural Control of Insects

One activity that can greatly help to keep down pest populations is the destruction and burial of cole crop residues within a day after harvest. Many Lompoc growers already use this practice, but it is not universal in all cole, lettuce, and celery crops. It can be particularly important for the control of leafminers, especially in an area where host material is available year round. In the relatively cool, moist conditions around Lompoc, crop residues can remain succulent for a week after harvest, which is more than enough time for many larvae to complete their development.

Another useful practice is the control of weeds, which reduces the availability of alternate hosts to pests. Lompoc farmers already pay strict attention to weed control and try to keep their fields and field borders clean. The next step beyond destroying weeds is to manage the vegetation on the borders of the fields. The organic grower in our survey reported some success by planting borders. However, border plantings and intercrops can have both positive and negative influences on natural enemy and pest populations, and finding the most useful border plants takes some experimentation. The local organic grower reported success with a mixture of alfalfa and clover, which can harbor large numbers of aphid parasites. That grower now keeps about 5% of the land in borders. Researchers in other localities have not found borders or intercrops to provide the level of control needed to meet quality requirements for the conventional market.

Local organic farmers have also reported some success in cleaning insects from their cole crops after harvest by using hydro-coolers. These cool the crops immediately after harvest and before storage. It seemed to be particularly effective at removing cucumber beetles (*Diabrotica* spp.), a common problem in organic production. Local conventional growers find cucumber beetles to be only an occasional problem.

Weeds and Herbicides in Cole Crops

Chlorthal-dimethyl (Dachtal®) is a selective compound and is often mixed with **bensulide (Prefar®)**. Bensulide and chlorthal-dimethyl are not considered to be very effective when applied alone against key broadleaf weeds and some grassy weeds. When mixed together they are very effective and are the products of choice for weed control. However, bensulide was not applied in the AUI during 1992.

Glyphosate (Roundup®) is a broad spectrum herbicide that is applied only to open beds before planting. It was only used once in 1992. Soil fumigants are also used to kill weed seeds prior to planting, but because of cost they are infrequently applied.

Once the crop is growing, conventional growers use cultural cultivation practices such as hand hoeing and weeding to control weeds.

Cultural and Natural Control of Weeds

The organic vegetable grower we interviewed manages a 75-acre farm in the Lompoc region. The grower does not use chemicals for weed control and relies on specialized weeding equipment two to four times per crop and hand hoeing once or twice per crop. In addition, the organic grower plants summer cover crops of Sudan grass, which is thought to produce a chemical in the soil that is toxic to weed seed germination. He also plants winter cover crops (green manures) to compete with weeds and improve soil fertility. These cover crops are planted in areas where weeds become a problem.

Celery

Pesticide Use in Celery in the AUI, 1991-93

Celery often accounted for less total pesticide use than most of the other crops in the AUI. Except for beans, celery had the lowest total number of acres treated and the lowest total pounds of pesticide applied in 1991 and 1992. In 1993, it had more acres treated than flowers and beans, and received more pounds of pesticide than cole crops, flowers, and beans (Tables 5-7). The higher overall pesticide use in celery in 1993 was due to increased use of herbicides, insecticides, and particularly fungicides.

Among the crops raised in the Lompoc AUI, celery generally was somewhere near the middle in its use of fungicides, insecticides, and herbicides. Celery always received fewer pounds of fungicide than lettuce, and, in 1991 and 1992, fewer acres of celery were treated with fungicide than lettuce and flowers (Tables 5-7). Celery always received fewer pounds of insecticide than lettuce and cole crops, and usually fewer pounds than flowers. Based on either pounds applied or acres treated, celery was always lowest in herbicide use, except for beans.

Fungicides accounted for the most pounds of pesticides in celery each year in 1991-1993, followed by insecticides and then herbicides. More acres of celery were treated with fungicides than insecticides in 1992 and 1993, but in 1991 more acres were treated with insecticides than fungicides. Based on the number of pounds applied, fungicide use was two to three times that of insecticides in each year during 1991-1993, but based on the number of acres treated, insecticides and fungicides were similar in their levels of use (Tables 5-7).

Total pesticide use increased through the 1991-1993 period in celery (Tables 5-7), with 862 acres treated in 1991, 970 acres in 1992, and 1,562 acres in 1993. There were similar increases in the pounds of pesticide applied. Fungicides accounted for over half of the increase, with 362 acres treated in 1991, 497 acres in 1992 and 778 acres in 1993. There was a great amount of variability from year to year in the fungicides that received the most use. For example, chlorothalonil use varied from 24 to 635 pounds per year, and anilzine use varied from 50 to 304 pounds per year. Dicloran use was among the highest each year, with 184 to 315 pounds per year. Fungicides were most frequently applied to celery in April through June, although there was some variation from year to year (Figs. 8, 9, Tables9-10).

The number of acres treated with insecticide was similar in 1991 and 1992, but increased from 385 acres in 1992 to 664 acres in 1993 (Tables 5-7). The pounds of insecticide decreased from 225 to 186 pounds between 1991 and 1992, but increased to 365 pounds in 1993. The insecticides that generally received the most use each year were acephate and permethrin. Insecticide applications were scattered between March through December, with generally little or no use in December through February (Figs. 12, 13, Tables 8-10). Applications peaked slightly in May and June of 1991 and 1992, and in September and October of 1993.

Only 27 herbicide treatments were made to celery in 1991-1993, covering about 320 acres (Tables 5-7). They were scattered over a period covering January through August, with a small peak in March or April, and possibly another small peak in August (Figs. 10, 11, Tables 8-10). Since herbicides are usually applied before planting or shortly after, their use reflects the cropping pattern in the Lompoc area, where celery may be planted as late as August. Prometryn was the most used herbicide (Tables 5-7).

Diseases in Celery

Late blight (*Septoria apiicola* Speg.) is the primary foliar disease of celery in the Lompoc area. Late blight causes losses by defoliating the plant and reducing its growth rate, by increasing harvesting costs because of labor needed to remove and trim diseased leaves and stalks, and finally by increasing the likelihood of storage rots. Contaminated celery seed or transplants are the primary sources of inoculum. Rain and sprinkler irrigation encourage disease development, as splashing water disperses spores and aids in spore germination. Spore germination and penetration of the plant requires relative humidity above 90% for about two days, or free moisture for at least 24 hours. Temperature is seldom limiting for the disease. With long periods of wet weather, which occur frequently in the Lompoc area, the disease increases explosively. In general fungicides are necessary for disease control once the disease is in the field. However, there are control methods that can be useful for excluding the disease in the first place.

Pink rot (*S. sclerotiorum*) occurs in a variety of crops in the Lompoc area, and it can be a problem depending on the previous cropping history. It is not as devastating as late blight in the celery fields of Lompoc, but it can be fairly common. The pathogen can survive in the soil on plant debris and as small black survival structures, called sclerotia, for five to ten years. Within a field, primary inoculum can come from the soil, from previous crops, or from neighboring fields. The fungus produces two types of spores. The asexual spores typically infect near the soil line. The sexual spores are actively discharged and are borne on the wind for greater distances. Upon infection, brown lesions develop on the petiole. The lesions expand rapidly into soft, watery, decayed areas. Tissue surrounding these lesions turns pink. The disease is most prevalent after cold, moist weather. The optimum temperature for fungus growth is 75° F, but the sexual spores only form when the temperature is below 70° F. These conditions are common in Lompoc from fall through spring.

Crater rot (*Rhizoctonia solani* Kühn) occurs sporadically in the Lompoc area, but fungicide applications can be necessary for its control. Symptoms occur on the outer stalks in contact with soil. Lesions are small, tan to brick red, and elongate, becoming darker brown and sunken as the tissue dries. Severity of the disease varies by season and increases with continuous celery cultivation. *R. solani* can also be involved in the death of seedlings in seedbeds. The fungus has a wide host range and survives in the soil on organic debris.

Fungicides in Celery

Chlorothalonil (Bravo®) is a nitril compound used as a preventive fungicide. In Lompoc, it is used to control several diseases on celery, the most important being late blight. Applications can start soon after transplants are set in the field and may be repeated at five to seven day intervals, if disease is present in the field. The pre-harvest interval is seven days to harvest. In Lompoc, it is considered one of the best products for the control of late blight, more effective than benomyl. For late blight control, chlorothalonil is used at least one to three times a year in rotation with other materials, depending on the weather conditions. It is applied mostly in the fall and winter from mid-September onward.

Chlorothalonil is also used for control of crater rot and pink rot in celery. It is better at controlling late blight than it is at controlling crater rot or pink rot. However, chlorothalonil is the only material available for control of crater rot in celery.

Alternative chemical control methods for late blight control include anilazine, which was considered the best material on celery. However, that material is no longer manufactured. Benomyl is also used for late blight control but is considered inferior to chlorothalonil. For pink rot control, dicloran is considered better than chlorothalonil. It is applied to the soil whereas chlorothalonil is applied to the plant.

Benomyl (Benlate®) is a benzimidizol compound used as a systemic fungicide. It both prevents and eradicates infections. In Lompoc, it is used to control late blight of celery. Applications begin when disease is first observed and are repeated at seven to ten day intervals. The pre-harvest interval is seven days. In other crops, resistance has become widespread to this fungicide, although no resistance was reported by Lompoc growers.

Benomyl is an alternative to chlorothalonil for control of late blight in celery, but chlorothalonil is considered a more effective material.

Dicloran (Botran®) is used for the control of pink rot in the Lompoc area. It is applied in one of two ways. If disease is anticipated to occur early in the season, it is applied at a lower dose (2 lb/acre) and repeated at seven-day intervals in the summer or 14-day intervals in the fall and winter. If the disease is not anticipated to occur early in the crop, then it is applied only once at a higher rate (5.3 lb/acre), four to eight weeks before harvest, using a sprayer with a drop nozzle boom to direct the spray at the base of plants and soil. Dicloran has a seven day pre-harvest interval in celery.

Dicloran is considered to provide more effective control of pink rot than chlorothalonil. It is applied to the soil whereas chlorothalonil is applied to the plant.

Copper hydroxide (Champ®, etc.) is an inorganic foliar fungicide used to control late blight on celery in Lompoc. It is less effective than other materials such as chlorothalonil. Typically, applications begin when disease occurs and then may be repeated at 10-14 day intervals, depending on the weather and the amount of disease present.

Copper hydroxide is the least effective material against late blight in celery, but it can be useful in a rotation to prevent the development of resistance to more effective materials. Chlorothalonil is a more effective material for late blight control.

Anilazine (Dyrene®) was considered the best fungicide for control of late blight on celery in Lompoc, but the manufacturer ceased producing it because it caused skin rashes on field workers.

Cultural and Natural Control of Diseases

In Lompoc, non-chemical control of late blight includes use of disease-free seed as well as hot water seed treatments. These treatments reduce infestation levels but may also reduce seed germination. Growers also sometimes store celery seed for two years before use. This has been reported to significantly reduce seed infection.

Infected celery debris is plowed under as soon as possible after harvest. Once plants are established in the field, overhead irrigation is avoided as much as possible, as is the movement of machinery through the field when plants are wet. Machinery can move spores from diseased to healthy plants when foliage is wet. Aerial applications of fungicides aid in reducing this spread. Resistant varieties have been developed and are used whenever possible.

For non-chemical control of pink rot in Lompoc, growers avoid planting into fields with large amounts of celery residue, or residue from other hosts of the pathogen, such as lettuce, cole crops, or beans. Proper plant and row spacing and well drained soils provide adequate air movement, which reduces pink rot.

In Lompoc, non-chemical control methods for crater rot include shallow planting of celery on ridged rows, which keeps the soil away from the stalks. Many growers also try to destroy crop residues immediately after harvest, which deprives the crater rot fungus of the organic material it needs to survive and infect. Growers also try to avoid excessive plant density and vigor as this encourages disease development.

Insects in Celery

In the Lompoc area, the main insect problems in celery appear to be leafminers (*Liriomyza* spp.) and black bean aphids (*Aphis fabae* Scopoli), although green peach aphids and beet armyworms are common pests, and cabbage loopers and corn earworms can also cause problems. Lygus bugs are sporadic but serious threats. In Lompoc, celery is planted from mid-April through August and harvesting can continue until February, so the crop is available to insects almost year round. Late crops are particularly important to the growers because consumer demand is strong during the holiday season. Typically, the number of insecticide treatments a celery crop will need depends on the year and the season. In general, growers rarely have to apply more than four treatments. They may, however, have to treat much more frequently for disease problems when the weather is damp.

Leafminers have become a serious problem in celery in the Lompoc area. Leafminer adults are small flies that lay their eggs within a leaf. The larvae tunnel between the upper and lower layers of the leaf, creating pale, winding mines. Leafminers have a very rapid lifecycle and their populations can quickly build up to high levels, causing extensive damage. They are often difficult to control as well, because most insecticides cannot reach the larvae in their mines, and because they can rapidly develop resistance. In celery, the pea leafminer, *Liriomyza huidobrensis* (Blanchard), has become a particular problem since it arrived in the valley two or three years ago. Other leafminers normally mine only the leaves, and much of their damage can be trimmed from the harvested product, so little or no loss of quality occurs. The pea leafminer, on the other hand, often mines down into the celery stalk, where the damage cannot be trimmed away. As in the other vegetable crops, cosmetic quality standards are very high and even a little such damage may cause a crop to be rejected. Leafminers are in the crop throughout the year but they become a more serious problem beginning in July and continuing on through October. In the spring, a celery crop may require one treatment for leafminers, with perhaps a total of two to three treatments for insects. In the fall, treatment intervals may fall to as little as every 10 to 14 days, and the crop may have to be treated as many as five times for insects.

Aphids are another serious problem in the Lompoc area. Heavy aphid populations can stunt young plants with their feeding, and they may transmit virus diseases. As the crop matures, they often move down into the heart of the plants, where they are more difficult to control. Aphids contaminate the product with honeydew, cast skins, and their bodies, which can lower the value of the crop. In addition, the black bean aphid can distort and twist the plant by its feeding, more so than other aphid species. The black bean aphid is a common problem from July through fall, and can be a problem at any stage of the crop. The green peach aphid is usually present in celery but it is usually a problem only during the early stages of the crop. One early treatment can usually prevent its populations from building up. In some instances, no treatments are needed.

The beet armyworm, cabbage looper, and corn earworm all cause similar types of problems. The young worms first feed on the leaves in the upper part of the plant, but they rarely do enough damage to reduce yields. Later they work down into the heart, where they often feed on the stalk and are difficult to detect and control. If only outer stalks are damaged, they can usually be removed and the plant salvaged. If inner stalks are damaged, usually the plant does not meet market standards. The beet armyworm is a consistent threat, at any stage of the crop. The looper is a common problem in celery and can attack the plant at any stage, but it is not the major pest.

The lygus bug is only a problem in some years when large populations migrate out of the wildlands in the spring, as native vegetation dries up. Once in the crop, they feed by inserting their sharp mouthparts into the plant. The plant cells in the vicinity of the wound do not divide normally, and the result is long, sunken, rough lesions. Inner stalks might also become twisted due to the feeding. Loss of yield and quality can result.

Insecticides in Celery

The main insecticides used in celery are acephate for control of the green peach aphid and loopers, oxamyl for leafminers and black bean aphid, abamectin for leafminers, and methomyl for the worms. Other materials are sometimes used against these and other insects because of cost, because of limitations on pre-harvest or re-entry intervals, because of limitations on the number of times a particular compound may be applied to a crop, because a material is easier or safer to handle, or in an attempt to prevent a pest from becoming resistant. Other materials that are used include permethrin, *Bacillus thuringiensis* (B.t.), and naled.

Acephate (Orthene®) finds its main use against the cabbage looper and the green peach aphid. Lompoc growers did not consider it effective for the control of the black bean aphid.

Acephate is very effective against the looper and some growers consider it the material of choice. Permethrin, especially when mixed with B.t., is also considered very effective and is sometimes preferred over acephate. It has a pre-harvest interval of only one day, while the interval for acephate is 21 days. Growers in the Lompoc area believed that B.t. by itself is not always trustworthy. Methomyl is another effective alternative for the looper.

Acephate is considered the most desirable option for control of the green peach aphid, and it also gives relatively long-term protection. Naled is probably an effective alternative, but the growers consider it to be particularly devastating to natural enemies and they prefer not to use it.

When lygus bugs become a problem, acephate and methomyl are the materials of choice, while cypermethrin and dimethoate are reasonably effective, and permethrin may have some effect.

Methomyl (Lannate®) is mostly used against caterpillars, especially the beet armyworm, but also the corn earworm and the cabbage looper At least one Lompoc grower considered methomyl to be the only effective option for control of the beet armyworm, and all believed it is the superior choice. Other alternatives include permethrin, naled, and B.t. B.t. alone is only effective when the worms are very small, and they are difficult to detect at that stage. B.t. mixed with permethrin holds more promise of achieving control. The alternatives for the corn earworm are similar to those for the beet armyworm, although permethrin might be more effective on this insect than it is on the beet armyworm.

Permethrin (Ambush®, Pounce®) is a possible alternative for control of the cabbage looper and corn earworm, especially when mixed with B.t., but it is not considered to be effective against the beet armyworm, where methomyl is considered the only highly effective treatment. It is a possible alternative for control of the green peach aphid, but acephate is more effective. Permethrin is also a possible alternative for use against the leafminers, but it has serious drawbacks. It gives good control of the adult leafminer flies, but it does not kill the larvae mining in the leaves. It also has little or no long-term effectiveness, so the crop is susceptible to leafminer attack almost immediately after the treatment. The growers prefer oxamyl and abamectin because they control the larvae or give some long-term protection. They report that they must use many closely spaced treatments to control the leafminers with permethrin.

Naled (Dibrom®) is little used by the growers in the Lompoc area, apparently because they consider it particularly damaging to natural enemies and because other materials will generally work as well or better. Late in the crop, growers may choose naled because it has a short pre-harvest interval. Naled is a possible alternative for the control of beet armyworm, corn earworm, and looper, but methomyl works better and permethrin plus B.t. would do as well. Naled is a possible alternative for use against the black bean aphid, but oxamyl is more effective and also gives leafminer control. It is a possible alternative for control of green peach aphid but acephate is more effective.

Bacillus thuringiensis **(Dipel®, Thuricide®, Javelin®)** is a possible alternative for the control of caterpillars, such as the beet armyworm, cabbage looper, and corn earworm. The growers recognize that the preparations are improving in effectiveness, but sometimes they still do not give good control. Mixed with permethrin, B.t. can often provide very good control of the cabbage looper and corn earworm, although methomyl is probably still more effective. Even mixed with permethrin, however, it does not usually give very good control of the main worm pest, the beet armyworm. Only methomyl seems to be very effective against this pest.

Oxamyl (Vydate®) is a preferred material for the control of leafminers and the black bean aphid, although some growers considered it to damage natural enemy populations more than other materials. When oxamyl can be used, it and abamectin are the materials of choice for control of leafminers. Oxamyl can move short distances into the plant, so it can give some direct control of the leafminer larvae in the leaves. It also has moderate long-term effectiveness, but it can only be applied to the crop three times. It also has a six-month "permissive plant back restriction" on the label, which is a recommendation that the same crop not be planted back in an area treated with oxamyl within a six month interval. This often restricts its use to earlier in the crop. Other alternatives include permethrin and acephate, but they are much less effective.

Oxamyl is also the material of choice to control the black bean aphid, which is not well controlled by acephate. Lompoc growers sometimes also use naled against the black bean aphid, either early in the season to accommodate plant-back recommendations, or near to harvest because of its short pre-harvest interval.

Abamectin (Avid®) is considered to be an effective option for the control of leafminers in celery, although it is very expensive relative to other materials. It does not move into the plant like oxamyl, but it provides relatively good long-term protection. It may be applied no more than twice to a celery crop.

Cultural and natural controls are similar to those in cole crops.

Weeds and Herbicides in Celery

Prometryn (Caparol®) is a pre- or post-emergent herbicide. It is the material of choice for the control of mallow, pigweed, lambsquarters, other broadleaf weeds and some grasses. It has a unique quality in that it can be applied to growing celery up to eight inches high, without damaging the celery plants.

Glyphosate (Roundup®) is a broad spectrum herbicide that is applied only to open beds before planting.

Cultural and natural controls for weeds are similar to those used in cole crops. Standard cultivation practices and hand hoeing are also used when needed.

Lettuce

Pesticide Use in Lettuce in the AUI, 1991-93

Of the five major crops, lettuce received the highest fungicide, insecticide, and total pesticide use each year during 1991 to 1993, for every measure of use (Tables 5-7). Lettuce usually received fewer pounds of herbicides than cole crops and flowers, but it was highest in the number of acres treated each year. In most instances, pesticide use in lettuce was often much higher than any other crop in the AUI. For example, the cole crops usually followed lettuce in pesticide use. Each year during 1991 to 1993, 4,688 to 5,893 acres of lettuce were treated with pesticide, while 1,761 to 2,768 acres of cole crops were treated.

The type of pesticide that received the most use in lettuce depended on the measure of use. Based on the number of pounds applied, more fungicides were applied to lettuce than insecticides, and more insecticides than herbicides, each year during 1991 to 1993 (Tables 5-7). Based on the number of acres treated, insecticides were applied more widely than fungicides, followed by herbicides in each year.

Total pesticide use increased in lettuce over the three years (Tables 5-7). The number of pounds applied decreased slightly from 4,139 pounds in 1991 to 4,089 pounds in 1992, but increased to 6,330 pounds in 1993. The number of acres treated increased from 4,688 acres in 1991 to 4992 acres in 1992, and to 5,893 acres in 1993. Of the different types of pesticide, the largest increases were in fungicide use, followed by insecticides.

Fungicides were applied most frequently and in the largest amounts in April through October (Figs. 8, 9, Tables 8-10), but weather strongly affects the severity of fungus problems in lettuce and there were large variations in the yearly pattern of applications. For instance, in 1991, there were 14 fungicide applications in April, and 34 in August (Table 5). In 1992, there were 33 applications in April, and 18 in August (Table 6). The fungicides that received the most use were generally fosetyl-al, iprodione, and maneb (Tables 5-7).

Insecticide use in any month did not generally change as much from year to year as did fungicide use. Insecticide use generally began to increase after February or March, leveled to an irregular plateau in April through July, peaked sometime in August or September, and then fell off rapidly in September or October (Figs. 12, 13, Tables 8-10). The insecticides that received the most use were generally acephate, dimethoate, methomyl, and permethrin (Tables 5-7).

Herbicide use was scattered throughout the year, and use in any month was extremely variable from year to year (Figs. 10, 11, Tables 8-10). For example, in 1992, about 33 acres were treated in April and 90 acres were treated in July (Fig. 10). In 1993, about 110 acres were treated in April and 30 in July (Fig. 11). Since herbicides are usually applied before planting or shortly after, their use reflects the cropping pattern in the Lompoc area, where lettuce is grown year round. The herbicide that accounted for the most pounds applied was propyzamide (Tables 5-7).

Diseases of Lettuce

Downy mildew (*Bremia lactucae* Regel) is the most important disease of lettuce in the Lompoc area. This fungus grows only upon the living tissues of lettuce. The first symptoms of the disease are light green to yellow angular spots on the upper surfaces of leaves. Later, a white fluffy mycelial growth develops on the lower side of these spots. On rare occasions the fungus may enter the stem and cause a dark discoloration. Spores are dispersed by the wind and can travel long distances. The fungus survives as a mycelium and sometimes as sexual spores in debris from infected plants. It is not clear whether the fungus is seed-borne. Spores infect within three to four hours. Following germination and penetration, the fungus produces fruiting stalks that grow through stomata (air holes) on the lower leaf surface. The fungus is affected by moisture, temperature and light. It reproduces most rapidly when night temperatures are 43-50° F, day temperatures are 55-70° F, and when the weather is cloudy with the relative humidity near 100%. Almost no sporulation occurs in bright sunlight and when night temperatures rise above 60° F. Recent work in California has shown that the fungus requires about 4 hours of actual free water on leaf surfaces at night for infection to occur. A spray forecasting system is being developed to predict periods of dew formation several hours in advance, which would allow fungicides to be applied before infection occurs and would improve their effectiveness. Favorable environmental conditions occur frequently in Lompoc, where temperatures can be in a conducive range almost every night of the year, and free water can come from rain, dew, or overhead irrigation systems.

In lettuce, breeding for resistance to downy mildew is an important control strategy. However, there are 7 races of the fungus and recent races have overcome resistant lettuce varieties.

Lettuce drop (*Sclerotinia minor, S. sclerotiorum*) occurs in a variety of crops in the Lompoc area. It can be a problem in lettuce, depending on the previous cropping history, but it is not as devastating as downy mildew. The pathogen can survive as small black structures, called sclerotia, in the soil and on plant debris for five to ten years. If *S. minor* is the pathogen, then primary inoculum comes from the soil and crop debris. If *S. sclerotiorum* is the pathogen then inoculum can also come from neighboring fields. *S. minor* produces only one spore type and infects the lettuce plants near the soil line. *S. sclerotriorum* produces two types of spores: asexual spores that typically infect near the soil line, and sexual spores that are actively discharged and borne on the wind for greater distances. Upon infection, brown lesions develop on the leaf stem. The lesions expand rapidly into soft, watery, decayed areas, and tissue surrounding these lesions turns pink. The disease is most prevalent after cold, moist weather. The optimum temperature for fungus growth is 75° F., but the sexual spores only form when the temperature is below 70° F. These conditions are common in Lompoc from fall through spring.

Fungicides in Lettuce

Maneb (Manex®; Dithane®) is a carbamate fungicide used on lettuce in the Lompoc area for the control of downy mildew. It is considered the chemical of choice. Growers only achieve mediocre control with this material, but it performs better than other fungicides and is cost effective. Typically it will be rotated either with fosetyl-al or with copper compounds. The number of applications depends very much on weather conditions, but usually averages one to tow times a year in the Lompoc area. Once the disease occurs, growers will spray every 14 days until harvest. Maneb has a 14-day pre-harvest interval, which limits its use close to harvest.

Maneb is considered to be the best material for downy mildew control in lettuce, more effective than copper compounds and metalaxyl. Fosetyl-al is considered as good or better than maneb in controlling downy mildew, but due to expense and complications that occur when it is mixed with copper, some growers do not use it as much as maneb.

Fosetyl - Al (Aliette®) is a systemic organic phosphate compound used in Lompoc for control of downy mildew of lettuce. It is one of the best materials in terms of effectiveness, but it has some other aspects that limit its use. It is considered to damage the crop in some instances. It is relatively expensive and it can not be combined with copper compounds, because the combination is even more damaging to the crop than either compound alone. It is more effective when used to kill an active infection and not as a preventive treatment.

Different growers had very different opinions about fosetyl-al as an alternative for the control of downy mildew. Some considered it their best choice and as effective as maneb. Others considered it less effective than maneb or copper compounds.

Metalaxyl (Ridomil®) is a systemic fungicide that controls only pathogens in the oomycete class of fungi, which includes the fungus that causes downy mildew. In Lompoc it is used on lettuce for control of downy mildew, in rotation with other materials. Resistance problems have been observed in other areas, but this was not mentioned as a problem in Lompoc. The Lompoc growers considered it expensive and less effective than maneb or fosetyl-al for downy mildew control, and some believed it is less effective than copper. This may indicate that there is resistance to this material.

Copper hydroxide (Champ®, etc.) is an inorganic foliar fungicide used for downy mildew control. In Lompoc it is considered less effective than the other materials, but it is used routinely because it is the least expensive alternative and it helps in resistance management. Typically it is used once or twice a year, depending on weather conditions. Copper products are the only acceptable fungicides that organic growers may use for downy mildew control. Copper compounds can not be used with fosetyl-al.

Iprodione (Rovral®) is a broad spectrum organic contact fungicide with preventive and some curative activity. In Lompoc, it is used for the control of lettuce drop caused by *Sclerotinia* species. For *S. minor* control, preventive applications are directed at the base of the plant and the soil, before plants become very large. For *S. sclerotiorum* control, applications begin at the rosette stage if conditions are favorable for disease.

Vinclozolin is an alternative that can be used for control of lettuce drop. In other crops, resistance to iprodione and vinclozolin have been reported. However, no resistance was reported in Lompoc.

Vinclozolin (Curalan®, Orlanin®) is a broad spectrum dicarboximide fungicide with preventive and some curative activity. It is used in Lompoc to control lettuce drop. It is in the same family as iprodione. Its chemical structure is very similar to iprodione and it provides similar control. As the two chemicals are nearly identical, using them in rotation does not prevent resistance. See iprodione.

Cultural and Natural Control of Diseases

In Lompoc, non-chemical control of downy mildew of lettuce is based on the use of resistant varieties. However, the fungus has developed up to seven different races, and Lompoc growers did not believe that the available varieties had much resistance to the fungus. Some races of the fungus have also developed fungicide resistance. Leaf lettuce tends to have more resistance or tolerance to downy mildew than head lettuce. Growers also try to plant into well drained soils. This helps minimize free water on the plants, which the fungus needs for infection.

In Lompoc, non-chemical control methods for lettuce drop involve plowing under lettuce residue immediately after harvest. Lettuce is also planted on raised beds with good spacing. Several varieties of lettuce have resistance to the two species of pathogen.

Insects in Lettuce

The major insect pests in lettuce are leafminers, the cabbage looper, and the green peach aphid. The beet armyworm and corn earworm can also be pests, and lygus bugs and cucumber beetles are occasional problems. Unlike some other localities, there is no regulated host-free period in the Lompoc area, and lettuce is available to pests nearly year round. Planting of lettuce crops begins in December and then proceeds until the next fall at seven to ten day intervals. Head lettuce takes an average of 90 days from planting to harvest, and the head begins to form at about day 30. Quality standards for lettuce are extremely high and even a very few defects, whether from insects or disease, may cause the crop to be rejected for marketing. A head lettuce crop will typically require three to four treatments for insects. Leaf lettuce requires more treatments because there are no effective controls for the green peach aphid in that crop. A typical crop may require four to seven treatments for insects. Many more treatments can be required on either leaf or head lettuce when leafminer problems are severe.

The green peach aphid can be a problem both early and late in the crop. Heavy populations can stunt young seedlings with their feeding, and they may transmit virus diseases. As the crop matures, the aphids rarely damage the plants directly. However, they often move down into the heart of the lettuce plant, unlike the cole crops where they more often remain on the older outer leaves. Aphids down in the heads present a serious contamination problem. At harvest, even a few aphids per plant can cause a crop to be rejected because of quality standards. Growers prefer to control the aphid early in the crop. Adequate control is very difficult to achieve once populations are high, and when the aphids move down into the plants they are more protected from insecticides. Some growers believe they are seeing more frequent problems with aphids.

Leafminers cause problems in lettuce that are similar to those in celery, although the leaves are the most important part of the crop in lettuce, as opposed to the stalks in celery. As in celery, leafminers are often difficult to control in lettuce, and the choice of materials is more restricted. Like the green peach aphid, problems with leafminers seem to be increasing for the Lompoc growers, and they have become tenacious in the last couple of years. Leafminers can cause problems at any stage of crop development. They are usually not a problem early in the year, but problems become progressively more severe from July through October, when a crop will often require two or three treatments for leafminers. In extremely severe infestations, treatments may begin at day 14 in the crop, and continue at five to seven day intervals until harvest at about day

90. None of the available treatments are very effective because they only kill the adults and cannot usually penetrate to the larvae in their mines. Leafminer populations can then rebound very rapidly.

The cabbage looper, beet armyworm, and corn earworm all cause similar types of damage. Early in the crop, they may eat enough of the foliage that they decrease the growth and development of the plant. They may also damage the growing points and either destroy or deform the plant. Later in the crop, the worms often burrow into the heads, contaminating them with their droppings and their bodies, and possibly introducing rot organisms. Once the worms burrow into the head, they are very difficult to detect and control. Cabbage loopers are considered serious threats to lettuce, if not the major pest. Most problems with cabbage loopers occur during May through October, at any stage of the crop. The beet armyworm is a common pest and can cause serious damage in lettuce, but it does not seem to cause as much concern as the looper, leafminers, and green peach aphid. Also, it seems to be somewhat easier to control in lettuce than in the cole crops or celery.

The lygus bug causes no problems in many years. In some years, large populations will migrate out of the hills as the native vegetation dries out in the spring, and then they can cause serious damage to any stage of the crop.

Insecticides in Lettuce

In terms of insect control, a major difference between head lettuce and leaf lettuce is that acephate has been registered for use in head lettuce but not for leaf lettuce. In head lettuce, acephate is a major insecticide. It is especially important for control of the green peach aphid, and it is also used to control the cabbage looper and sometimes the lygus bug. In leaf lettuce, acephate is not available for control of the green peach aphid, and less effective materials must be used. The other major insecticides used in lettuce are permethrin, used mostly for control of the cabbage looper and leafminers, and methomyl, used mostly for control of the worms. Other insecticides that are used in lettuce include *B. thuringiensis* (B.t.), dimethoate, oxydemeton-methyl, abamectin, cypermethrin, and diazinon.

Acephate (Orthene®) is used to control the cabbage looper and the occasional lygus bug problem, and, in head lettuce, it is the material that Lompoc growers most prefer for control of the green peach aphid. Growers prefer to control the aphid early in the crop and acephate is best used early in the crop, as it has a 21-day preharvest interval and can only be used one or two times at most. One treatment usually gives effective control, although a second may be necessary. Acephate is not registered in leaf lettuce, and some growers felt that none of the alternatives are effective. Dimethoate, permethrin, diazinon, and methomyl are used against the aphid in leaf lettuce, but some growers find they put on three to four treatments to maintain control. One grower felt that dimethoate is an effective alternative. Oxydemeton-methyl is another alternative for control of aphids in head lettuce, but it is not registered for use in leaf lettuce. The growers state that it is very effective, but they do not use it much on lettuce because it controls only aphids while acephate will also control loopers, and because it has a 28-day preharvest interval and a 72-hour re-entry interval.

Acephate is commonly considered to be the most effective material against the cabbage looper, with methomyl a close second. Growers regard permethrin and B.t., particularly when mixed, to be good alternatives, as is cypermethrin, although it is relatively expensive.

Growers consider acephate to perhaps provide the best control of the lygus bug. Permethrin, cypermethrin and dimethoate also provide good protection. Methomyl and carbaryl are also effective.

Permethrin (Ambush®, Pounce®) is most used against the cabbage looper and leafminers. Many growers prefer to use it when possible because it is relatively safe and easy to handle, it gives a rapid knock-down of pests, it has no odor, and it can be used up to one day before harvest. Its major shortcomings are that some other compound will usually be the most effective for any given pest, and it loses its effectiveness very rapidly once applied, providing almost no long-term protection. In lettuce, however, it is widely used against leafminers, where there are few better alternatives. Permethrin gives very good knockdown of the adults but little control of the general population because it does not kill the larvae in the leaves. Some growers feel abamectin is an alternative that gives some control of the larvae, although it is not considered to penetrate the plant. In any case, it also does not provide a high level of control of the general population, and it is restricted to only two or three applications per crop. Some growers consider dimethoate or acephate to give as good control as any alternative, while others question their effectiveness. At least one grower tried methomyl, but was not satisfied with the results.

Permethrin is used against a number of other pests, at least occasionally. Growers consider it a useful alternative for control of the lygus bug, although acephate and dimethoate may work better. It is effective against the cabbage looper in lettuce, especially when mixed with B.t., although acephate and methomyl may be even more effective. When mixed with B.t., it is considered to give acceptable control of the beet armyworm in lettuce, but methomyl is again considered to give the best control. It is also used to control the green peach aphid, although acephate is much more effective. In leaf lettuce, where acephate cannot be used, dimethoate is considered a more effective choice.

Methomyl (Lannate®) is considered to be the insecticide of choice for the beet armyworm, and is also very effective for control of the cabbage looper and corn earworm. Methomyl is up to twice as expensive as some other compounds, but it is still popular because of its effectiveness. While methomyl may give the best control, growers were often satisfied with the performance of acephate and permethrin, especially when mixed with B.t. Cypermethrin is also useful. For control of the cabbage looper, acephate may be more effective than methomyl. Growers have tried methomyl for control of the green peach aphid in leaf lettuce, but acephate provides much better control where it can be used. Dimethoate is also more effective for control of the aphid, and permethrin performs as well as methomyl. In a few instances, growers have also tried methomyl for control of leafminers, but the results were not satisfactory.

Bacillus thuringiensis **(Dipel®, Thuricide®, Bactospeine®, Cutlass®)** can be effective in lettuce for control of the cabbage looper and corn earworm. It is more effective in mixtures with permethrin, which also give some control of the beet armyworm. Most commonly, methomyl or acephate were considered to give more reliable control.

Dimethoate (Cygon®) can give some, possibly adequate, control of the green peach aphid, particularly early in the season. Although growers would prefer to use acephate, dimethoate may be the best control available in leaf lettuce. Dimethoate can also give some control of leafminer adults, but its control of the population is barely satisfactory. Permethrin, acephate, and abamectin provide similar levels of control. Dimethoate gives good control of lygus bugs, but acephate may be more effective. Other useful alternatives for lygus control include cypermethrin, permethrin, methomyl, and carbaryl.

Oxydemeton-methyl (Metasystox-R®) is not much used in head lettuce in the Lompoc Valley, although the growers consider that it is very effective for control of the green peach aphid, even more so than acephate. However, it has a 28-day preharvest interval and a 72-hour re-entry interval in lettuce, which complicates its use. Also, oxydemeton-methyl is only effective against aphids. Growers prefer to use acephate against the aphids, because it also gives them good control of any problems with loopers or other worms. Oxydemeton-methyl is not registered for use in leaf lettuce, but growers would use it to control aphids if it were available.

Abamectin (Avid®) is mostly used against leafminers in lettuce. Some Lompoc growers believe that it mostly controls the adults, while others consider it to have some activity against the larvae. It does not enter the plant, but it is reported to give fairly good long-term protection and to be resistant to washing off, and this may give the impression that it is giving some control of the larvae. Nonetheless, no material, including abamectin, gives the Lompoc growers very satisfactory control of leafminers in lettuce, and abamectin is a relatively expensive option. Permethrin and dimethoate control the leafminers about as well as abamectin. Acephate gives some control, but does not seem to be quite as effective.

Cypermethrin (Ammo®) is used against many of the same targets as permethrin: the cabbage looper, beet armyworm, and lygus bug for example. Lompoc growers believe it is moderately more effective than permethrin, but it is much more expensive and so is not chosen as often.

Diazinon (Basudin®, Spectracide®) is little used any more in the Lompoc area. However, it is sometimes used against the green peach aphid in leaf lettuce, where there are no highly desirable alternatives. It is also occasionally used against flea beetles, which are sporadic pests. These beetles can also be controlled with permethrin or acephate.

Cultural and natural controls are similar to those used in cole crops.

Weeds and Herbicides in Lettuce

Propyzamide (Kerb®) is the material of choice in the Lompoc area for burning nettle, shepherd's purse, wild radish, mallow, lambsquarters, broadleaf weeds and some grasses. Propyzamide is primarily used as a pre-emergence treatment but is also registered as a post-emergence herbicide. It was used in 9 of the 12 herbicide applications to leaf lettuce in the Lompoc AUI in 1992.

Benefin (Balan®) is a pre-emergence herbicide. It and **bensulide (Prefar®)** are registered for certain grasses and broadleaf weeds in lettuce, but they are not considered to be effective alone. Also, bensulide is not used often because it does not control as broad a spectrum of weeds as propyzamide.

Glyphosate (Roundup®) is a broad spectrum herbicide that is only used on open beds before planting.

Cultural and natural controls are similar to those in cole crops.

Flowers

Pesticide Use in Flowers in the AUI, 1991-93

Total pesticide use in flowers was always less than in lettuce and cole crops, and always more than in beans. In 1991 and 1992, flowers received less pesticide use than lettuce and cole crops, based either on acres treated or pounds applied (Tables 5, 6). In 1993, flowers received less use than lettuce, cole crops, and celery as well (Table 7). Fungicide, insecticide, and herbicide use in flowers also tended to be less than in lettuce, more than in beans, and similar to cole crops or celery. For example, flowers always received fewer pounds of fungicide than lettuce and cole crops in each year during 1991 to 1993, and, in 1993, they received fewer than celery as well. Flowers received relatively more fungicide use when measured in acres treated. For example, in 1991 and 1992, except for lettuce, more acres of flowers were treated with fungicide than any other crop (Tables 5, 6).

The type of pesticide most used in flowers depended on the year and the measure of use. Based on total pounds applied, herbicides received the most use in 1991 and 1993, followed by fungicides and then insecticides (Tables 5-7). In 1992, fungicides received the most use, followed by herbicides and then insecticides (Table 6). Based on acres treated in 1991 and 1992, fungicides were the most widely used pesticides, followed by insecticides, then herbicides. In 1993, insecticides were the most widely used pesticides, followed by fungicides and then herbicides.

During the 1991 to 1993 period, total pesticide use in flowers was highest in 1992 and was lowest in 1993. The number of pounds applied increased from 1,215 pounds in 1991 to 1,628 pounds in 1992, but then decreased to 663 pounds in 1993 (Tables 5-7). Similarly, the number of acres treated increased from 1,027 acres in 1991 to 1,265 acres in 1992, but then decreased to 814 acres in 1993.

Like total pesticide use, fungicide use in flowers increased from 1991 to 1992, and then decreased in 1993. For example, the pounds of fungicide increased from 363 pounds in 1991 to 670 pounds in 1992, but then decreased to 155 pounds in 1993 (Tables 5-7). This is probably due to variability in weather conditions and cropping patterns during the three years. Fungicide use by month also varied from year to year, but most use occurred between the beginning of March and the end of July (Figs. 8, 9, Tables 8-10). In 1991, there were also some later applications between August and October. Iprodione and sulfur were among the fungicides used most, although there were large changes from year to year in the use of the different fungicides.

Changes in insecticide use based on pounds applied in flowers during the 1991-1993 period were different from changes in use based on acres treated. The number of pounds of insecticide increased from 238 pounds in 1991 to 366 pounds in 1992, but then decreased to 83 pounds in 1993 (Tables 5-7). On the other hand, the number of acres treated increased every year, from 328 acres in 1991, to 393 in 1992, and 450 acres in 1993. The changes were due in part to decreasing pounds used of chlorpyrifos and to increasing acres treated with permethrin and *Bacillus thuringiensis*. Insecticide use was broadly scattered from February through November, although most treatments occurred sometime between April and June (Figs. 12, 13, Tables 8-10).

Herbicide use decreased during 1991-1993. The number of pounds of herbicide decreased from 614 pounds in 1991 to 592 pounds in 1992, and to 426 pounds in 1993 (Tables 5-7). Herbicide use was broadly scattered throughout the year, but more than two-thirds of all treatments occurred before the end of July (Figs. 10, 11, Tables 8-10). Chlorthal-dimethyl received the most use.

Diseases in Flowers

Many different cut flowers are grown in Lompoc including such flowers as statice (*Limonium sp.*), sweet pea (*Lathyrus odoratus*), stock (*Mathiola* sp.), schizanthus (*Schizanthus* sp.), nemesia (*Nemesia strumosa*), larkspur (*Delphinium* sp.), nasturtium (*Nasturium* sp.), and calendula (*Calendula* sp.). Many of these flowers can be infected by some of the same pathogens that infect food crops in the Lompoc area. Some flowers can be infected by *Botrytis cinerea*, various powdery mildew species (*E. polygoni, E . cichoracearum* DC, *Spaerotheca fuliginea* (Schlechtend.: Fr.) Pollacci, *Sclerotinia sclerotiorum, R. solani,* and *Verticillium* spp. In Lompoc, however, the two principal diseases in cut flowers are the powdery mildews and Botrytis blight.

Botrytis blight (*B. cinerea*) reduces both yield and quality of cut flowers. The pathogen can directly infect the young leaf and stem tissue, the flowers, and any cut or wounded tissue. As the pathogen has a wide host range and infects other crops in the valley, inoculum can come from outside the field. In addition, because it is also survives on decaying vegetation, inoculum can come from crop debris within the field. Infection by the pathogen is favored by cool, moist climatic conditions, which are present in Lompoc for much of the year. *Botrytis* can grow and infect from 32° F to 90° F with an optimum at about 65° F. The pathogen requires free water for infection, which in Lompoc can come from dew, rain or irrigation water. Unlike other pathogens such as powdery mildew, Botrytis blight will continue to develop on the flowers after they are harvested, as the pathogen is capable of infection and growth down to 32° F.

In flower seed production, Botrytis blight can be very damaging. It can attack the entire head after bloom such that no seeds are produced. In addition, Botrytis blight is more damaging in flowers being grown for seed production because the plants are in the field for a longer period of time, with a greater likelihood of being exposed to damaging environmental conditions.

Use of fungicides for control of Botrytis blight on cut flowers is fairly common due to the high value of the product, the high cosmetic standards for flowers, and the fact that the disease continues to develop after harvest. However, in other crops such as grapes and greenhouse roses, cultural control methods have been developed recently that have reduced the use of fungicides for control of this disease.

Powdery mildew is the other important disease of cut flowers in Lompoc. Different species of powdery mildew are associated with the different flower species. Powdery mildew fungi only invade the epidermal cells of the plant. After the host tissue is colonized, the fungus produces fruiting stalks with chains of spores. These produce the characteristic powdery appearance. Powdery mildews can be devastating diseases as their growth rate can be extremely rapid if the environmental conditions are right. Growth and infection of powdery mildew pathogens is favored by mild temperatures (70-75° F as an optimum) and by high relative humidity.

However, spores of powdery mildew are actually damaged by the occurrence of free water on plant surfaces. In addition, if the temperature rises above 95° F, spores of many mildew species are killed. Because of their different environmental requirements, Botrytis blight and powdery mildew are not commonly found together.

Fungicides in Flowers

Iprodione (Chipco®) is a broad spectrum dicarboximide fungicide that can both prevent and partially cure infections. In Lompoc, it is used in cut flowers for the control of Botrytis blight. Some growers reported some resistance to iprodione in cut flowers. It is used mostly throughout the fall-winter-spring months, depending on weather conditions. In flowers grown for seed, iprodione use increases after seed development in the later part of the season, during September and October. In Lompoc, it was considered by some growers to be the best material for blight control, however others believe that vinclozolin, chlorothalonil, maneb, and benomyl are equivalent. Benomyl is no longer federally registered for use in ornamentals, except in flowers for seed production.

Chlorothalonil (Bravo®) is applied by Lompoc growers principally to control Botrytis blight. It can be applied every seven days if conditions warrant. The frequency of applications depends on the weather conditions. For control of Botrytis blight, several other products are used and considered basically equivalent to chlorothalonil, including iprodione, vinclozolin and mancozeb. No resistance to chlorothalonil has been reported and therefore it is a good material to rotate with iprodione, vinclozolin, and benomyl, for management of resistance to those materials.

Chlorothalonil is also used to control powdery mildew in cut flowers in Lompoc. Applications are made when powdery mildew appears and, depending on the weather conditions, several applications may be made in a season. However, chlorothalonil is not considered very effective against the disease. Myclobutanil (Eagle®) is considered the best material for powdery mildew control followed (in order of their effectiveness) by triademefon (Bayleton®), sulfur (Thiolux®), fenarimol (Rubigan®) and finally chlorothalonil.

Vinclozolin (Curalan®, Orlanin®) is a broad spectrum dicarboximide fungicide with preventive and some curative activity. It is used in Lompoc to control Botrytis blight in cut flowers. It is in the same family as iprodione. See iprodione.

Sulfur (Thiolux®) is an element that is used as a general biocide. In Lompoc it is used to control powdery mildew in cut flowers. It is relatively inexpensive and as effective as various other materials. It needs to be reapplied every seven to ten days. In Lompoc, sulfur is considered to be a superior fungicide to fenarimol and chlorothalonil but not as good as myclobutanil or triademefon. It is an important fungicide to use in rotation with more specific materials that have had resistance problems in other crops. This includes triademefon, although resistance to triademefon was not mentioned in Lompoc cut flower production.

Cultural and Natural Control of Diseases

Lompoc growers use some non-chemical controls of Botrytis blight, such as changing from sprinkler to furrow irrigation if possible. This reduces the hours of free water on foliage, which reduces infection by *Botrytis cinerea*. In addition, the length and timing of these irrigations are adjusted to keep the number of hours of free moisture on plant surfaces to a minimum. Whenever possible, growers use resistant varieties. Growers have also tried reducing planting density, to make the crop microclimate less favorable to Botrytis blight.

Non-chemical control of powdery mildew in Lompoc involves use of resistant varieties. In addition, materials such as sulfur are considered acceptable in organic farming.

Insects in Flowers

Many different flower species are grown in the Lompoc area, for both the cut market and for seed production. Different flower species will have somewhat different pest problems, but certain insect species still caused a large proportion of the problems in the Lompoc area. These included the green peach aphid, the diamondback moth, the lygus bug, and a pest that the local growers identified as chinch bugs. Very occasionally, leafminers are a problem. Quality standards for cut flowers are said to be even higher than for vegetable crops, which means a nearly zero tolerance for pests. A single crop often takes 120-150 days, making the crop available to pests for extended periods.

The green peach aphid, diamondback moth, and lygus bug cause problems in flowers that are similar to those caused in cole crops, celery, or lettuce. The green peach aphid usually requires two to four treatments per crop, with the insecticides presently available. In some flower species, the diamondback moth is probably the major pest. Normally, the moth might require two to four treatments, but one grower stated that in severe infestations he might have to treat ten to twelve times, and still would not achieve control.

The true chinch bug is a not a pest of flowers but is a pest of grasses, sorghum, and corn. The insect that local growers call a chinch bug apparently is a small, grey, mobile insect that emerges from the soil to feed on the stem and buds of flowers. It feeds by inserting its sharp, piercing mouthparts into the plant tissues and sucking the plant sap, which produces large amounts of honeydew. Dark sooty mold grows on the honeydew and ruins the flowers. The insect is a sporadic pest, but when present in large numbers it can destroy a crop. The interviewing team did not see a specimen.

Insecticides in Flowers

Insect control practices are changing in the Lompoc cut flower industry because of recent changes in regulations and labelling. DPR and SBCAC pesticide enforcement personnel are interpreting some labels more narrowly than in the past, such that some uses on flowers are no longer allowed. Also, at least one major manufacturer has dropped flowers and ornamentals from many of its labels, according to growers and SBCAC personnel. These changes have made many insecticides unavailable that previously were mainstays, including chlorpyrifos, methomyl, acephate, and oxydemeton-methyl. It has limited the choice of materials largely to permethrin and B.t., and sometimes fluvalinate, pyrellin and insecticidal soaps.

Permethrin (Pounce®, Ambush®) has generally become the material of choice for all insects, even though the Lompoc growers thought they were able to achieve only fair control at best with it, even after repeated applications. It is used against the green peach aphid, the diamondback moth, other caterpillars, and lygus bugs. Fluvalinate was also considered to give fair control of the green peach aphid, and insecticidal soaps and pyrellins were possible alternatives but were considered to have problems. The best available control for diamondback moth was considered to be permethrin, especially when mixed with B.t. *B. thuringiensis* by itself was regarded as providing a little control. For most other insects, permethrin was considered the only available product that gave any control.

Bacillus thuringiensis **(Dipel®, Javelin®, Cutlass®)** gives some control of the diamondback moth and other worm pests, but it is much more effective when combined with permethrin. *B. thuringiensis* can sometimes give adequate control of some caterpillar pests when two treatments are spaced about seven days apart.

Insecticidal soaps (eg., M-Pede®) can give some control of the green peach aphid, if the plants can be thoroughly covered with the spray. The spray must directly contact the insect to be effective. Such excellent coverage is extremely difficult to achieve, however, especially when the plants grow larger and fill in the rows. Soaps are also expensive. These constraints often make soaps much less desirable than permethrin or fluvalinate.

Fluvalinate (Mavrik®) was considered to give fair control of the green peach aphid, and to be an alternative to permethrin for controlling that insect.

Pyrellin is a combination of pyrethrin and rotenone, both of which are derived from plants. As such, it is acceptable for use in organic farming. Some growers considered it to give some control of some caterpillar pests. One grower also thought it has some effectiveness against the green peach aphid, while others were adamant that it is useless.

Weeds and Herbicides in Flowers

Chlorthal-dimethyl (Dacthal®), ethalfluralin (Sonalan®), MCPA (Weedone®) and **oxyfluorfen (Goal®)** are used for the control of weed in cut flowers. Oxyfluorfen applications in 1992 totaled seven and chlorthal-dimethyl applications totaled eleven. Chlorthal-dimethyl and oxyfluorfen are selective pre-emergent herbicides, applied prior to planting. Oxyfluorfen can be used as an herbicide after planting as well. However, users risk damage to the foliage of cut flowers.

Cultural and natural controls are similar to those in cole crops.

Dry Beans

Pesticide Use in Dry Beans in the AUI, 1991-93

Of the five major crops, beans received the fewest pounds of pesticide and had the fewest acres treated in the AUI in every year (Tables 5-7). For example, beans received 136 to 529 pounds of pesticide per year in 1991-1993. The crop that had the next highest pesticide use was usually celery, and it received 884 to 1547 pounds per year. Beans also generally had the lowest use of fungicides, herbicides, and insecticides, whether measured by pounds applied or acres treated. The only exceptions were that more acres of beans than celery were treated with herbicides in 1992, and beans received more pounds of fungicide than cole crops in 1991 and 1992 (Tables 5, 6). Sulfur is almost the only fungicide used in beans. There were no fungicides used in beans in 1993 (Table 7).

There are no patterns of change through the years in pesticide use in beans, either in total pesticide use or in use of insecticides, fungicides, or herbicides (Tables 5-7). The levels of use remained very low and irregular throughout 1991-1993.

Insecticide and fungicide treatments occurred either early (March, April) or late (August, September) in the season (Figs. 8, 9, 12, 13, Tables 8-10). The primary targets of early insecticide treatments were probably aphids. Herbicide treatments occurred in March through August (Figs. 10, 11, Tables 8-10).

Diseases in Dry Beans

Powdery mildew (*Erysiphe polygoni*) is the main disease in dry beans in the Lompoc area. Diseased bean plants can have a powdery growth on leaves, stems or pods. The pathogen infects and colonizes the epidermal cells of the bean plant. It then produces microscopic stalks that grow out of the leaf, stem, or pod tissue and produce large amounts of spores held in chains. These spores can be dispersed through wind, rain, or insects. Initial inoculum probably comes from either debris in the field or adjacent fields via wind-borne spores. Some mildew strains produce sexual structures that aid in surviving the winter months. The fungus is favored by cool, but not cold, temperatures, which occur in Lompoc from the spring through fall. Spore germination is best at 68 to 75° F, but the fungus can grow from 60 to 83° F. Free moisture does not encourage infection and can actually kill spores. Yield loss is due to pod, leaf and stem injury from the disease.

Development of resistant varieties is difficult in beans as there are between 4 and 14 different races of the powdery mildew fungus. However, some resistant varieties have been developed and are widely used. Some bean varieties are susceptible as seedlings but become resistant as they grow older.

White mold disease (*Sclerotinia sclerotiorum*) occurs in a variety of crops in the Lompoc area. It can be a problem in beans depending on the previous cropping history. The pathogen survives in the soil for five to ten years as small black sclerotia and on plant debris.

S. sclerotriorum produces two types of spores. The asexual spores typically infect near the soil line. The sexual spores are actively discharged and are borne on the wind for greater distances. Upon infection, a watery rot appears on stems, leaves and flowers. A white mycelium develops under moist conditions. The initial pathogen inoculum can come from debris from within the field or it can come from neighboring fields. The disease is most prevalent after cold, moist weather. The optimum temperature for fungus growth is 75° F, but the sexual spores only form when the temperature is below 70° F. These conditions are common in Lompoc from fall through spring.

Fungicides in Dry Beans

Sulfur (Microthiol®, Kolospray®) is used in Lompoc as a fungicide for the control of powdery mildew in dry beans. It is relatively inexpensive and as effective as various other materials, such as chlorothalonil or fenarimol. It can be used for powdery mildew control in various formulations, such as wettable sulfur, lime-sulfur or sulfur dust. Wettable sulfur is the best formulation to use if the disease is already present, because the water by itself will damage the powdery mildew growth on the plant and, the combination provides even better control than sulfur alone. Dry beans are not a high value crop and most growers in the Lompoc area use only sulfur for powdery mildew control, as they believe other materials are not economically justified.

Benomyl (Benlate®) is a benzimidizol compound used as a systemic fungicide to both prevent and eradicate infections. In Lompoc, it is used to control white mold of beans and occasionally Botrytis blight in seed beans. In other crops, resistance to this fungicide has become widespread, although no resistance was reported by Lompoc growers/PCAs. Use of a fungicide to control white mold disease is difficult, as it is difficult to get good coverage of the bean pods when a full canopy develops.

Cultural and Natural Control of Diseases

As beans are a low value crop, the inputs that Lompoc growers can afford are limited. Therefore, cultural controls become very important. Whenever possible, Lompoc growers use resistant varieties, especially for control of powdery mildew. In addition, for powdery mildew management, growers try to maintain a moist soil and avoid over-fertilizing. For Botrytis blight in seed beans, soil fertility and irrigation management are used to aid in disease management. White mold is a problem in a variety of crops grown around Lompoc. If it is possible, growers try to rotate out of susceptible crops. However, this does not happen often in Lompoc. Growers also try to promptly plow under crop residues, which reduces inoculum for the next crop.

Insects and Insecticides in Dry Beans

Dry beans are relatively free of insect problems, and in general, only a few insecticides are used on the crop. The major insect problem is a group of aphids, including the cowpea, bean, and pea aphids. The major material used against these insects is dimethoate. The only other arthropod problem in beans is an occasional outbreak of spider mites. The usual control is dicofol (Kelthane®). Neither dimethoate nor dicofol are on the candidate TAC list. At the time of the interviews, the emphasis was on candidate TAC compounds and possible alternatives to dimethoate and dicofol were not pursued. In general, beans rarely receive more than two treatments per crop for all arthropod pests.

Weeds and Herbicides in Dry Beans

The materials of choice for weeds in beans are **trifluralin (Treflan®)**and **ethalfluralin (Sonalan®)**. Both are pre-emergent herbicides that require soil incorporation prior to planting. Standard cultivation practices are also used before planting.

The aggressive growth of dry beans generally prevents weed growth from becoming a problem during crop growth and harvest, so hand hoeing or other cultivation practices are not required.

General Pesticide Application Methods

Most pesticides are applied by ground equipment in the AUI. One PCA estimated that about 80% of all applications are made by ground, and another PCA said that between 90 and 95% of his applications are by ground. PCAs prefer ground applications because they are less expensive than aerial treatments and they allow better placement of the pesticides. Ground application equipment is typically comprised of a tractor and a low-pressure sprayer. The tanks and pump for the sprayer are generally mounted on the tractor or on a trailer pulled by the tractor. Booms or pipes extend horizontally from the back of the spray rig over the crop. Nozzles are spaced along the boom and direct the spray down towards the crop. Sometimes the spray boom has pipes extending down from the main boom. These pipes carry the spray nozzles deeper into the crop and provide better coverage. Some growers use spray shields to protect plants from spray damage, especially when using herbicides. This can be important depending on the crop variety and maturity. Few if any applicators report that they use spray hoods to contain spray drift. Ground applications are made at night, usually between one a.m. and dawn, when the winds are lowest and people are least subject to exposure. Since formal complaints were filed with the SBCAC by residents of Lompoc, growers report that they have decreased the number of pesticide treatments in the AUI.

Aerial treatments in the Lompoc Valley are limited to a single helicopter application service. Growers normally use helicopters when crops have covered the spaces between rows, when crops are too tall to avoid injury by ground equipment, and when the fields are too wet for ground equipment. The pilot estimated that in the winter perhaps 75% of all applications in the Lompoc Valley are made by air, and that this percentage reverses in the warmer months. All helicopter applications take place when the windspeed is very low, between daybreak and 9 a.m. Growers report that they have greatly curtailed the use of the helicopter in the AUI because of noise, visibility, and the higher potential for drift.

Limitations on Pesticide Use

Local Regulatory Limitations

The SBCAC has responsibility for local enforcement of state regulations on pesticide use. Restricted materials may be further subject to local restrictions set by the SBCAC. The following restrictions are in place in Santa Barbara County (personal communications, Jim Welsh, DPR, and Joe Karl, SBCAC):

1) No ground applications can be made within 500 feet of a school, when children are present.
2) No aerial applications can be made within 750 feet of a school, when children are present.
3) No application can be made within 200 feet of a school at any time.
4) No aerial application can be made within 200 feet of a residential area at any time.

Depending on site-specific situations, other modifications of practices can be imposed by the SBCAC.

Voluntary Limitations Employed by Lompoc Growers and Pesticide Applicators

The severity of the pesticide issue in Lompoc concerns pest control advisors, operators, and growers in the area. The local air applicator and growers were interviewed to gather information on the spraying activities in the Lompoc Valley and especially near the town. They indicated that they were taking additional voluntary steps to try to reduce complaints:

1) Due to the small size of most fields and the abundance of poles and wires, there are no aerial applications conducted at night.

2) Most ground applications occur at night, because winds are lowest then.
3) Ground applications are always used when possible. Air applications are only used when the ground is too wet or the crop is too large to allow ground treatment.
4) Some growers plant no crops within 150 of any residence. Others plant only crops which receive no pesticide treatments, such as beans, within 170 feet of residences.
5) One grower does no spraying within 500 feet of residences.
6) For the last 12 to 18 months or more, there have been no aerial treatments within one-quarter mile of residences. Specifically, these voluntary limitations include a) no aerial spraying to the east of Bailey and b) no applications beyond the greenhouses south of Ocean and East of Bailey near Miguelito School.
7) They only make aerial treatments within one-half mile of the town when there is zero wind or the wind is coming from the east, from the direction of the town. Otherwise, they postpone treatment until conditions are favorable. The time frame for aerial application is very narrow and usually lasts from daybreak until about 9 a.m.

REFERENCES

Anonymous. 1989. Digital Line Graphs from 1:100,000-Scale Maps: Data Users Guide 2. National Mapping Program Technical Instructions. USGS, Department of Interior. Reston, VA.

Cazier, L. 1976. Surveys and Surveyors of the Public Domain: 1785-1975. Bureau of Land Management, U.S. Department of the Interior. Washington, D.C. 227 pp.

Hayes, T.P. et al. 1984. California Surface Wind Climatology. Aerometric Projects and Laboratory Branch, State of California, Air Resources Board. Sacramento, CA.

Kelley, K., and Reed, N.R. 1994. Pesticides for Evaluation as Toxic Air Contaminants. California EPA, 1020 N St., Sacramento, CA

Oudiz, D., et al. 1989. Modifications and Additions to the Candidate Toxic Air Contaminant List. EH 89-4. State of Cailifornia, Department of Food and Agriculture. Sacramento, CA.

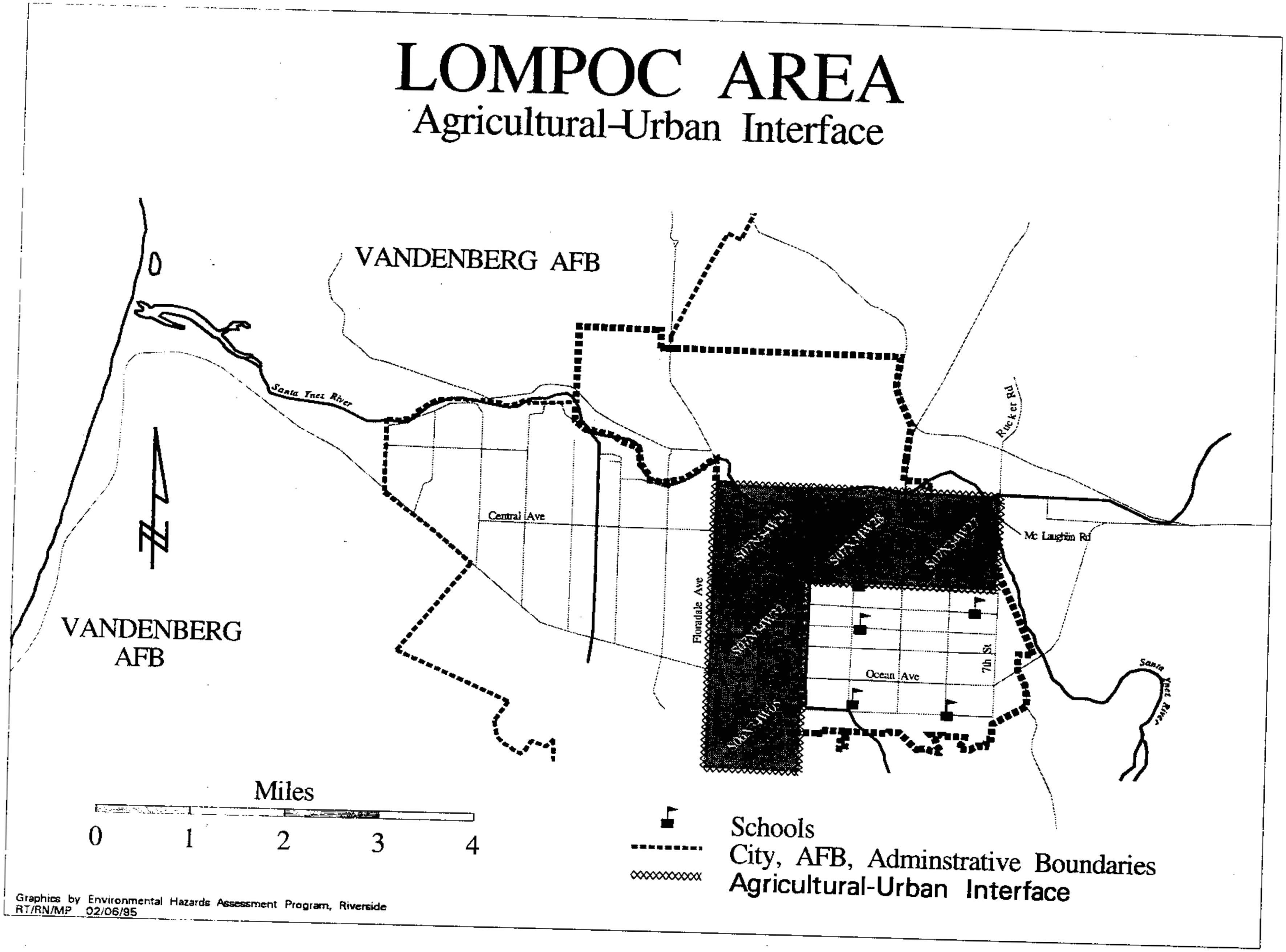

Fig. 1. The Agricultural-Urban Interface (AUI) in the Lompoc Valley. The AUI is shaded gray.

plotlombase 15.37.41 aui6.eps

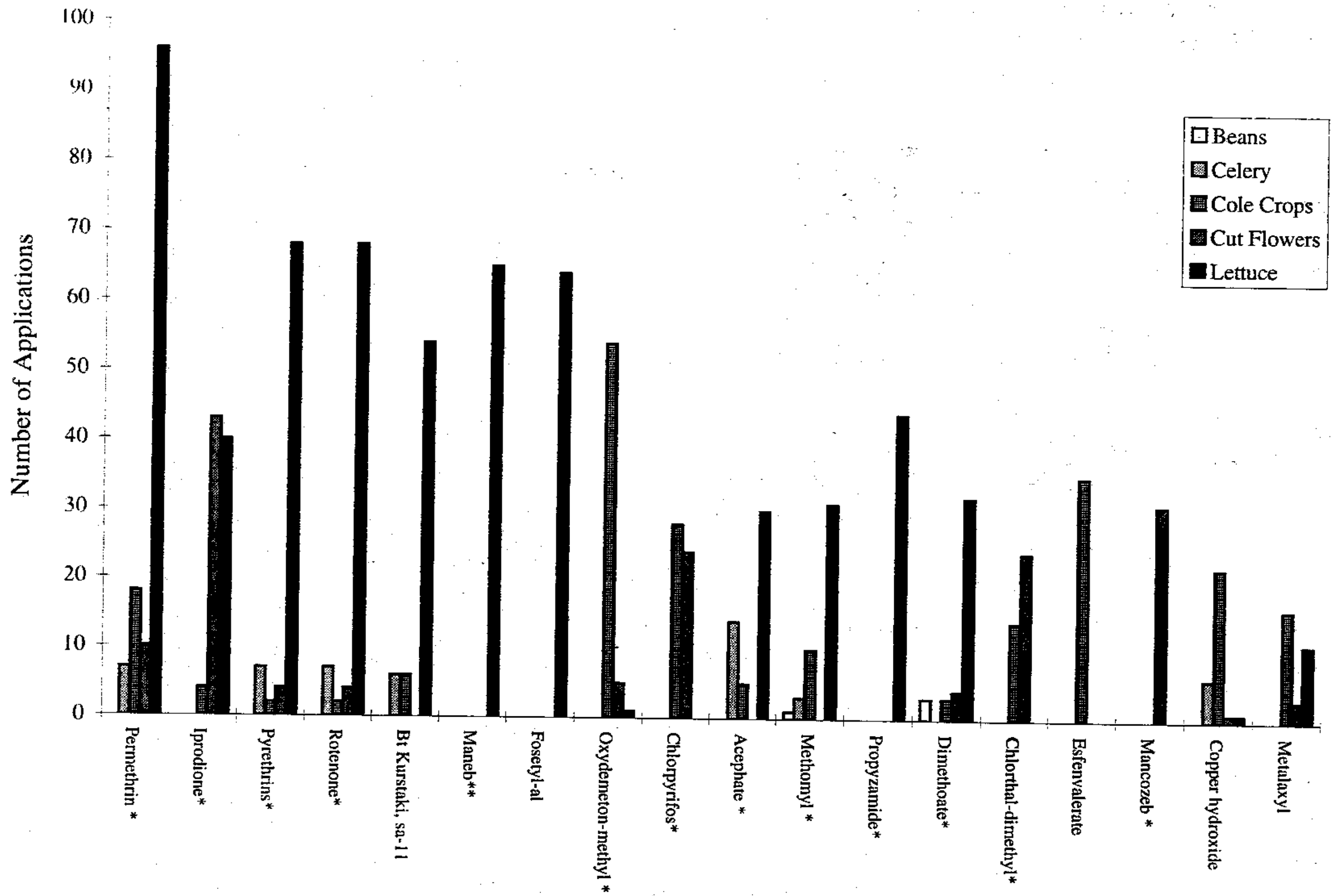

Figure 2. The number of times each of 18 major use pesticides were applied in the AUI, 1992. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs. The data are from the DPR Pesticide Use Reports.

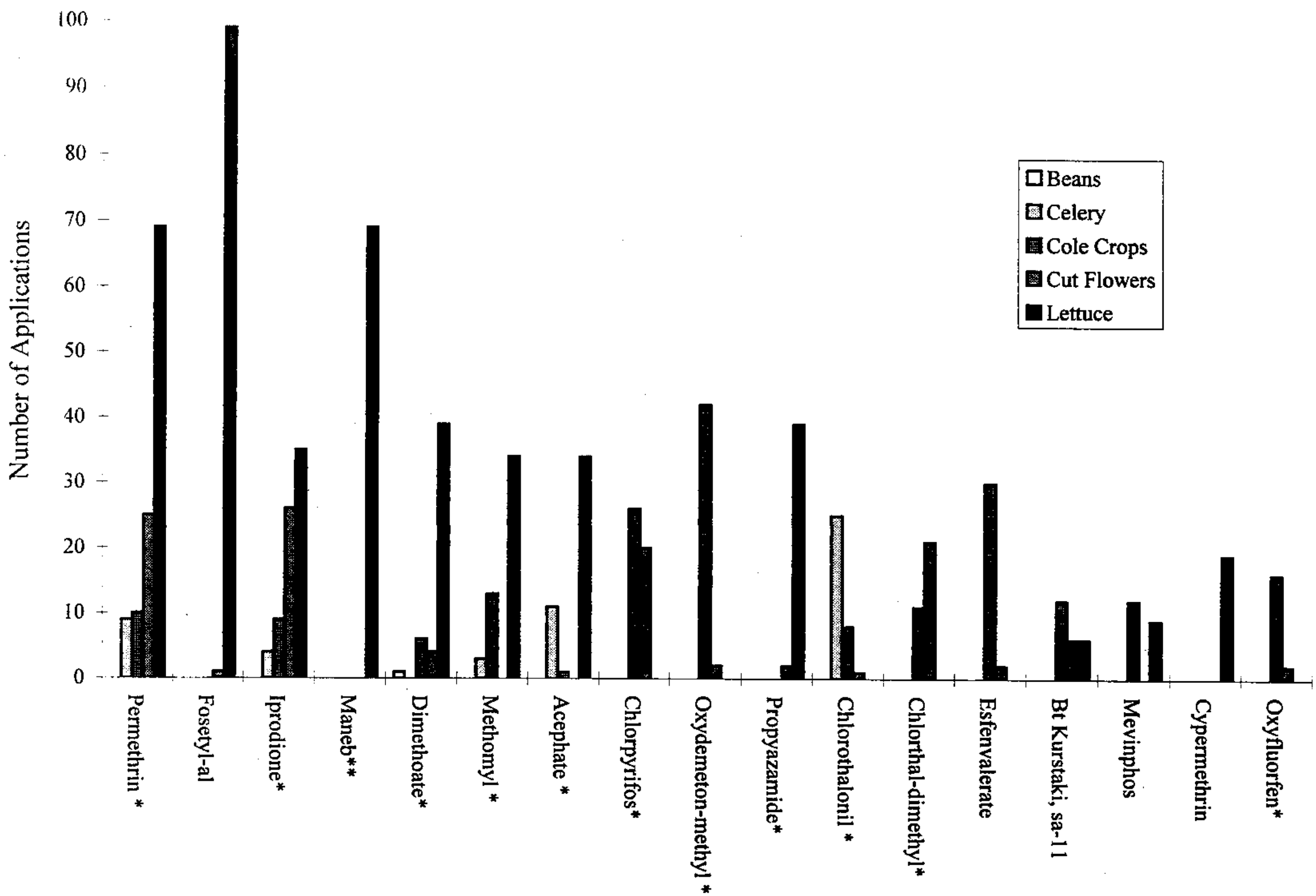

Figure 3. The number of times each of 18 major use pesticides were applied in the AUI, 1993. Pesticides marked * arc on the candidate TAC list. Pesticides marked ** are declared TACs. The data are from the DPR Pesticide Use Reports.

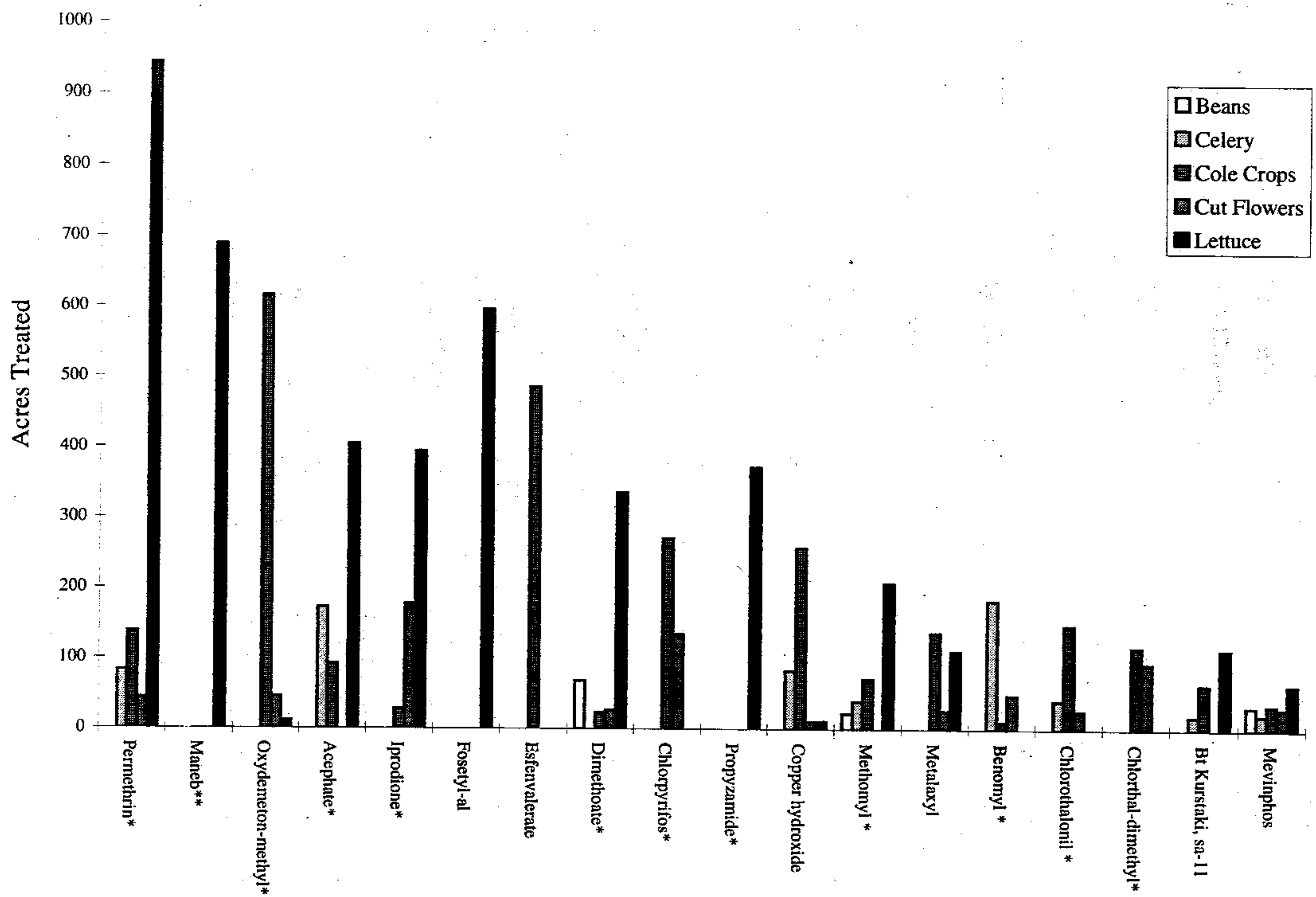

Figure 4. The number of acres treated with each of the 18 major use pesticides on the five major crop groups in the AUI, 1992. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs. Data are derived from the DPR Pesticide Use Reports.

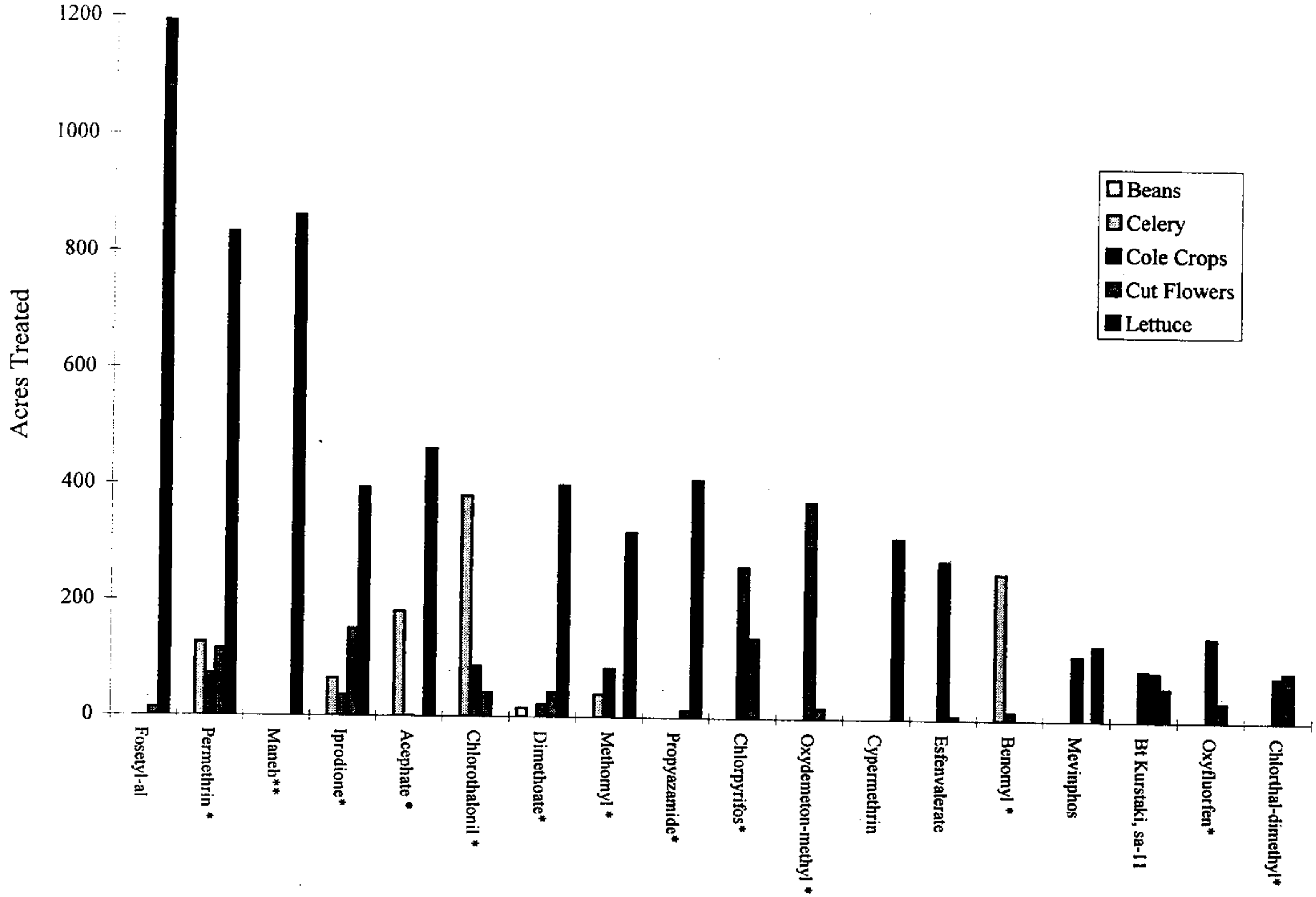

Figure 5. The number of acres treated with each of 18 major use pesticides in the AUI, 1993. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs. The data are from the DPR Pesticide Use Reports.

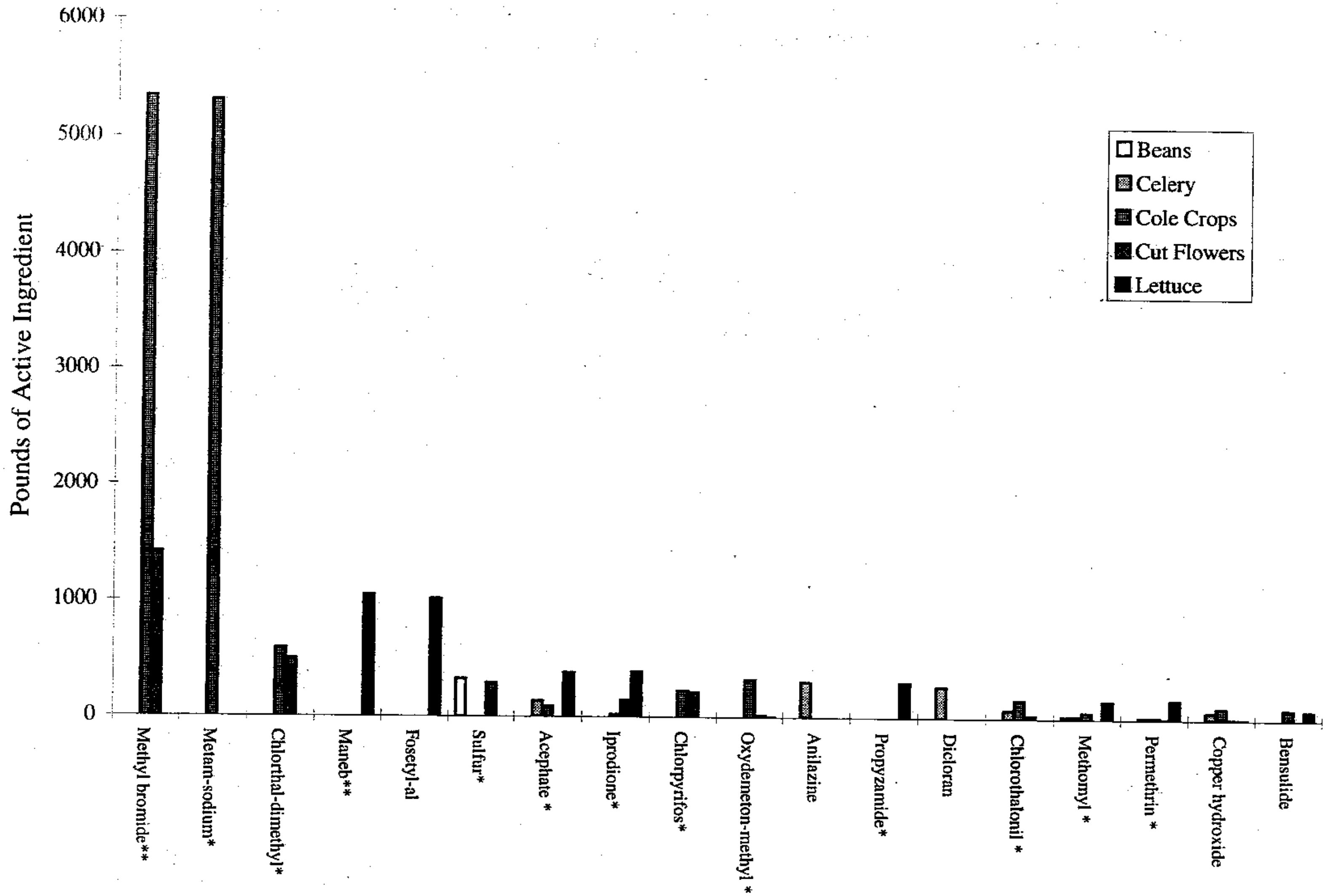

Figure 6. The number of pounds of 18 major use pesticides that were applied in the AUI, 1992. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs. The data are from the DPR Pesticide Use Reports.

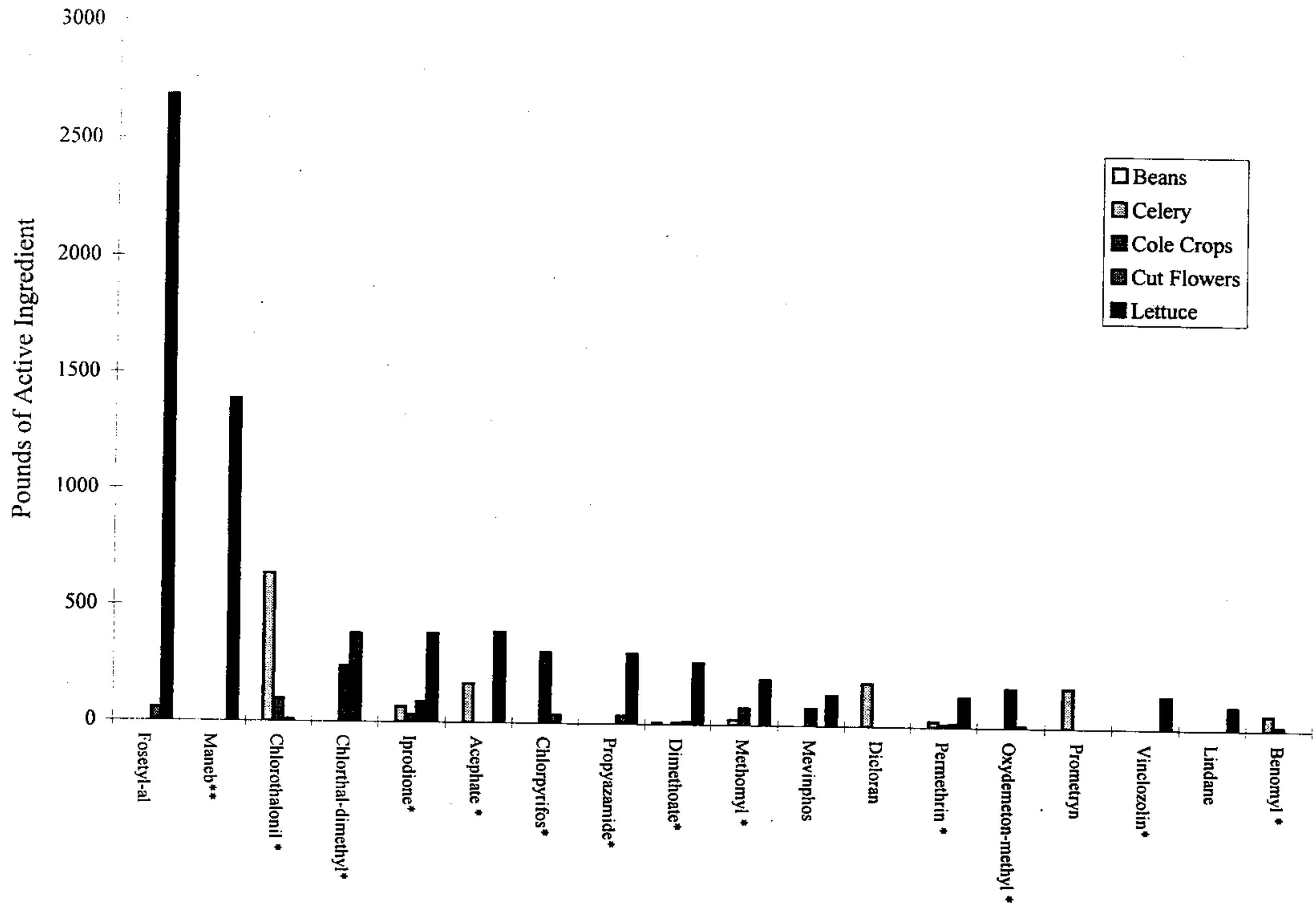

Figure 7. The number of pounds of 18 major use pesticides that were applied in the AUI, 1993. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs. The data are from the DPR Pesticide Use Reports.

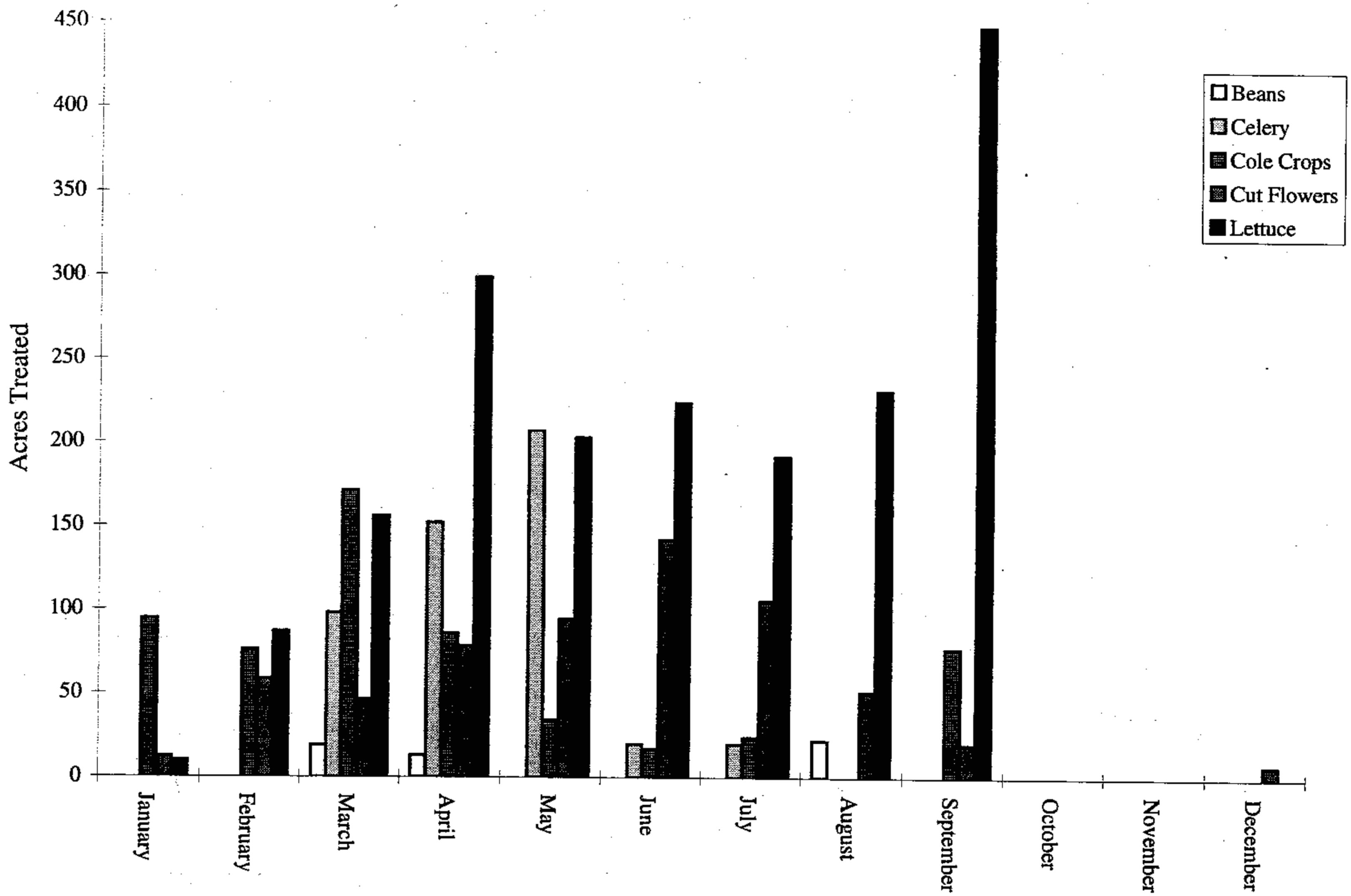

Figure 8. The number of acres treated with fungicides on the five major crop groups in the AUI by month in 1992. The data are from the DPR Pesticide Use Reports.

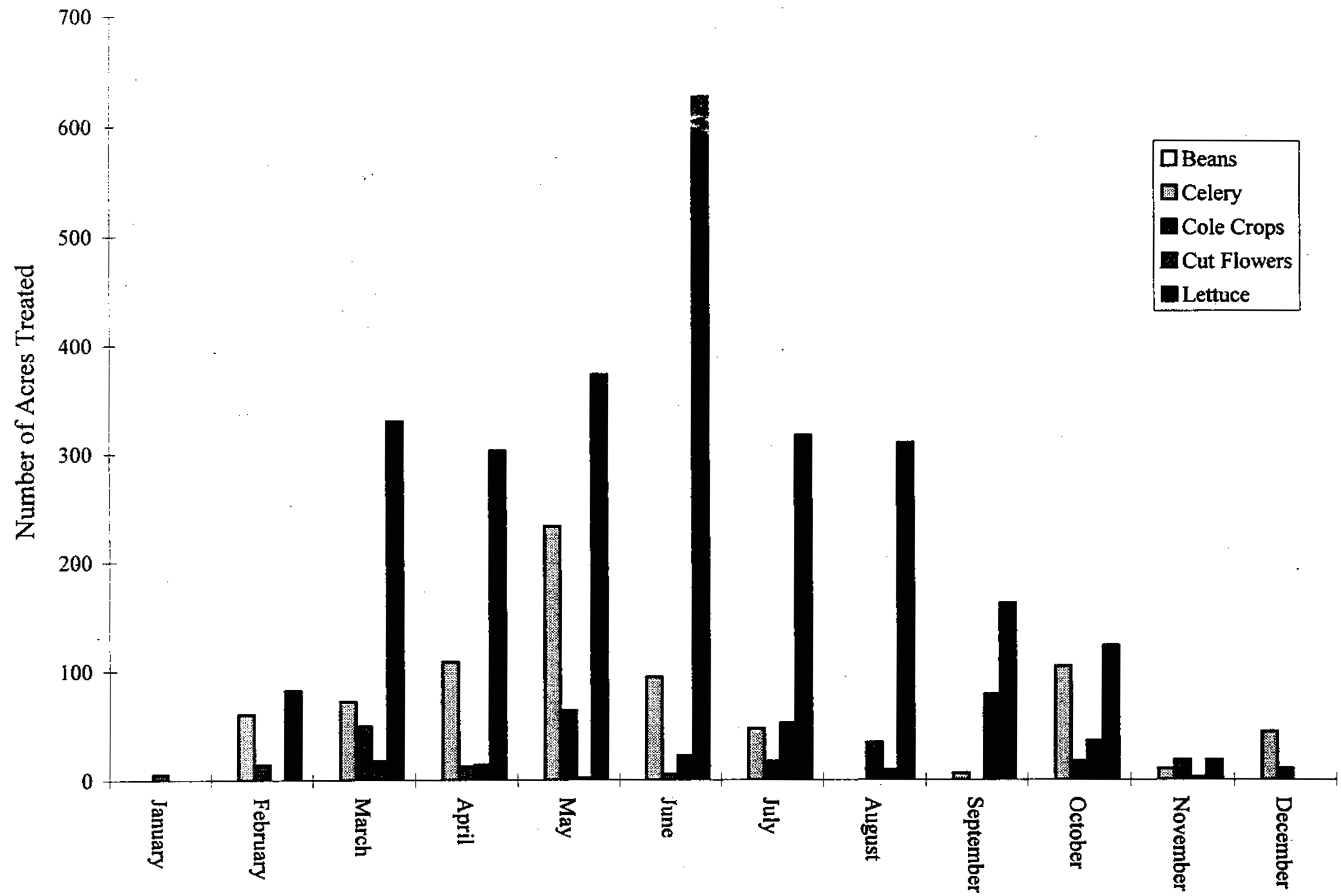

Figure 9. The number of acres treated with fungicides on the five major crop groups in the AUI by month in 1993. The data are from the DPR Pesticide Use Reports.

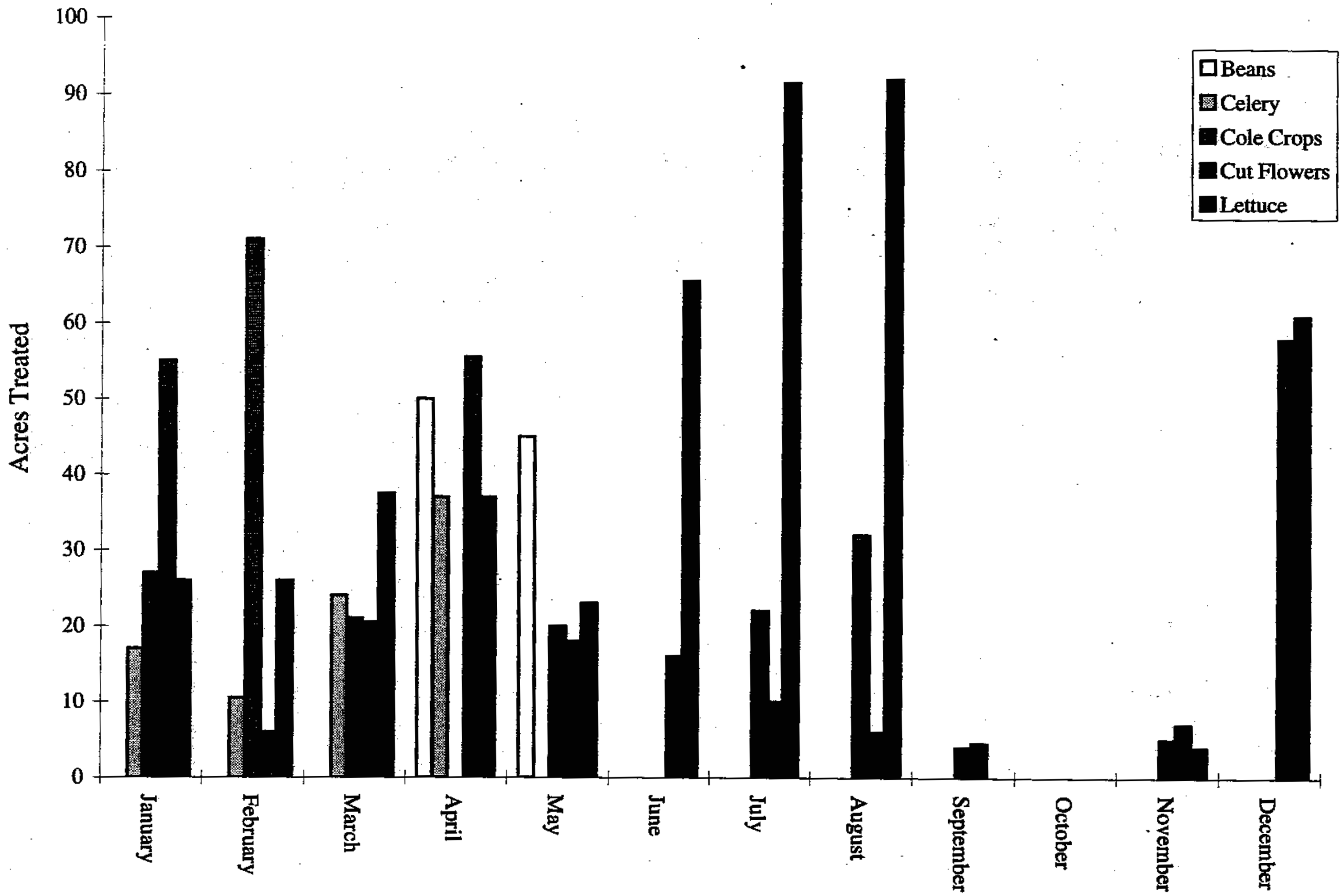

Figure 10. The number of acres treated with herbicides on the five major crop groups in the AUI by month in 1992. The data are from the DPR Pesticide Use Reports.

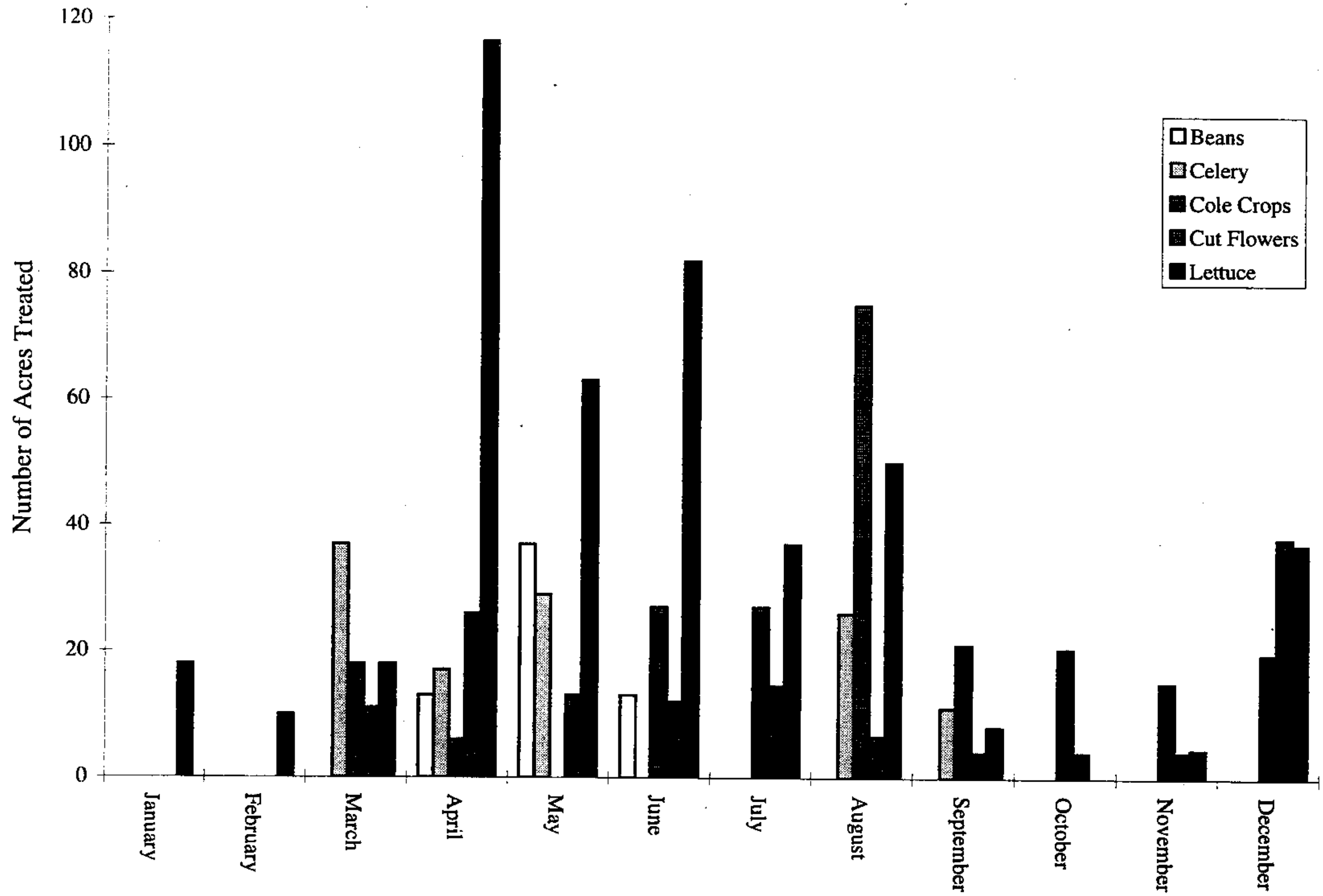

Figure 11. The number of acres treated with herbicides on the five major crop groups in the AUI by month in 1993. The data are from the DPR Pesticide Use Reports.

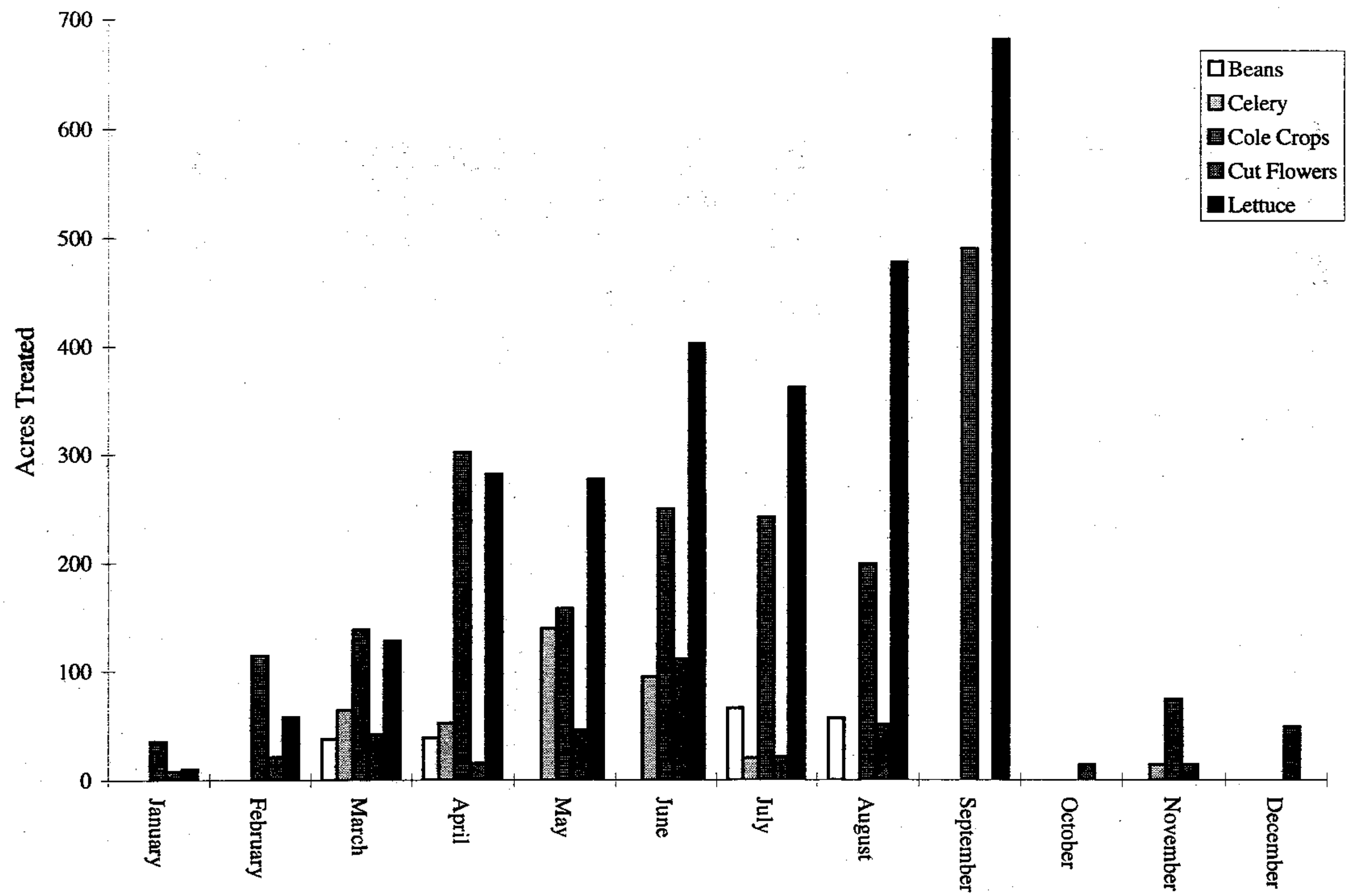

Figure 12. The number of acres treated with insecticides on the five major crop groups in the AUI by month in 1992. The data are from the DPR Pesticide Use Reports.

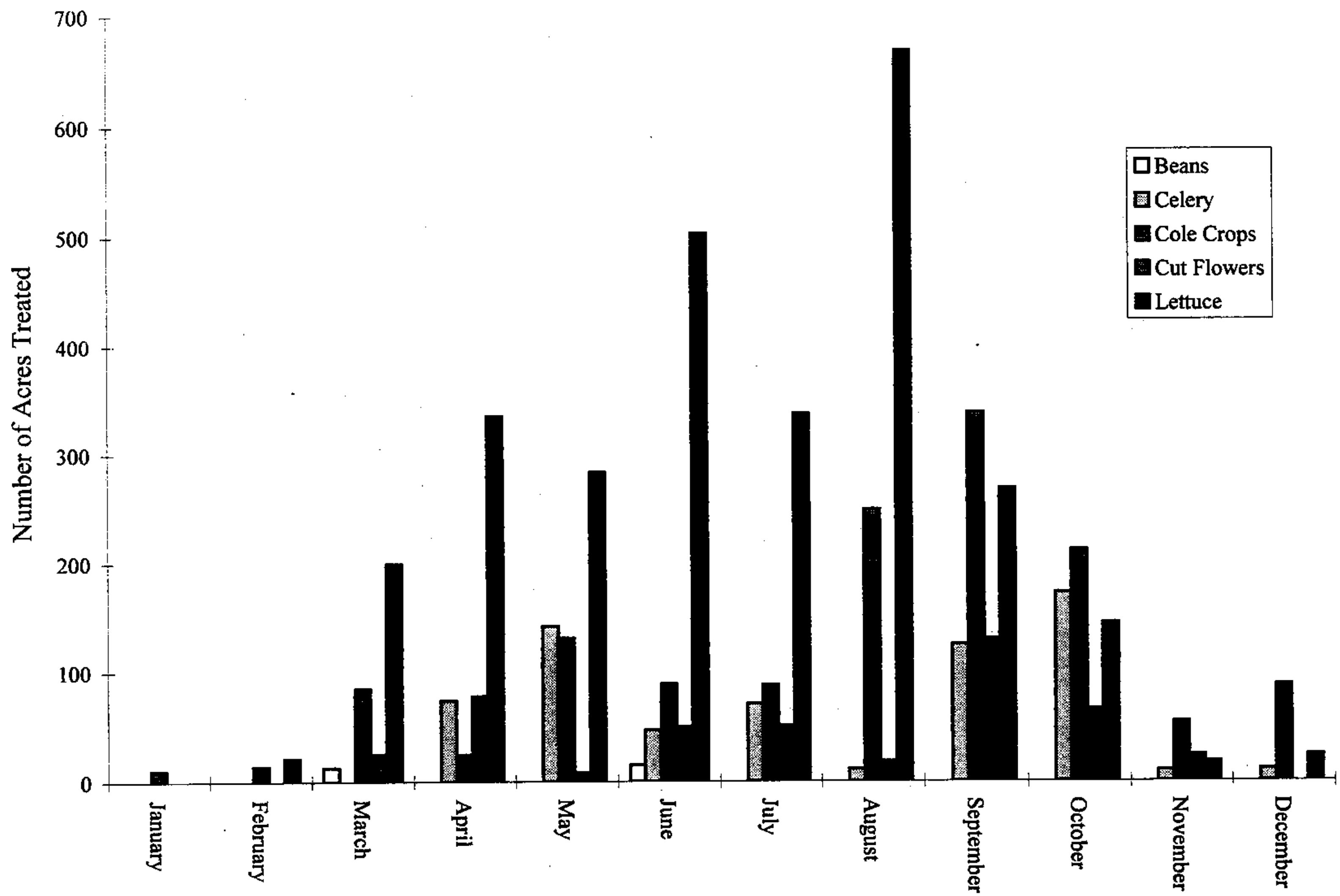

Figure 13. The number of acres treated with insecticides on the five major crop groups in the AUI by month in 1993. The data are from the DPR Pesticide Use Reports.

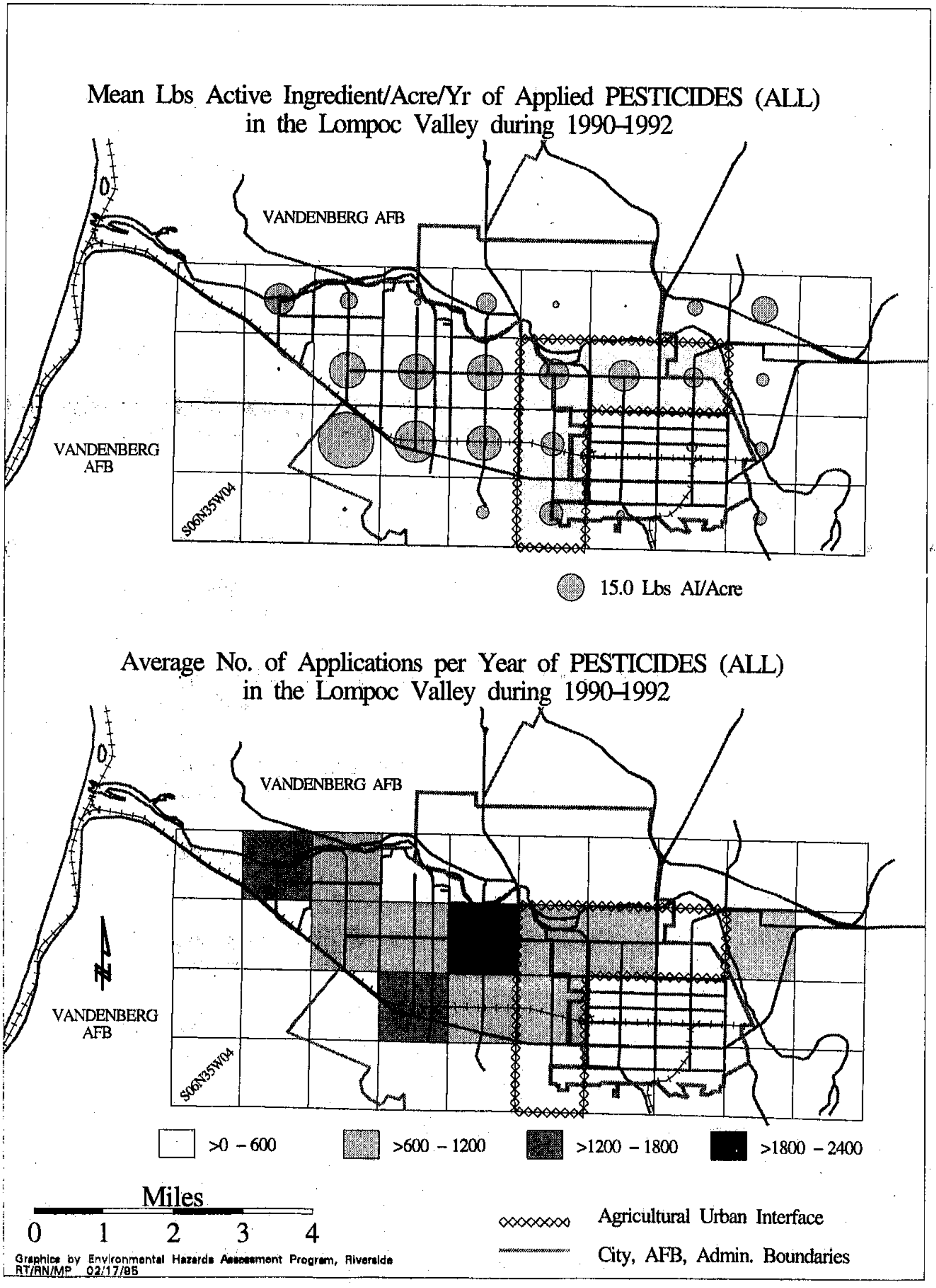

Fig. 14: The number of applications and the number of pounds of pesticide applied in the Lompoc Valley, summed over all pesticides.

Table 2. Ranking of pesticides used in the AUI in 1991 by acres treated. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Active Ingredient	Type	Acres treated	Num apps	Lbs used
Permethrin *	Insecticide	1180.5	102	207.59
Fosetyl-al	Fungicide	811.0	66	1509.55
Acephate *	Insecticide	695.5	50	654.14
Maneb**	Fungicide	497.5	35	802.40
Oxydemeton-methyl *	Insecticide	446.0	43	239.57
Iprodione*	Fungicide	444.8	47	428.57
Metalaxyl	Fungicide	385.5	36	91.76
Propyzamide*	Herbicide	366.0	29	334.25
Dimethoate*	Insecticide	365.0	25	91.73
Chlorpyrifos*	Insecticide	343.6	50	301.96
Copper hydroxide	Fungicide	327.0	22	142.37
Chlorthal-dimethyl*	Herbicide	285.0	47	968.04
Esfenvalerate	Insecticide	267.0	25	11.39
Methomyl *	Insecticide	251.5	27	177.79
Mevinphos	Insecticide	212.5	19	154.98
Benomyl *	Fungicide	138.3	26	57.13
Diazinon*	Insecticide	127.0	12	65.46
Vinclozolin*	Fungicide	124.8	27	91.50
Dicloran	Fungicide	110.5	8	371.88
Thiophanate-methyl*	Fungicide	106.0	6	37.10
Piperonyl butoxide*	Insecticide	95.5	10	57.48
Sulfur*	Fungicide	95.0	9	412.00
Prometryn	Herbicide	88.0	7	127.74
Chlorothalonil *	Fungicide	81.0	9	99.97
Pyrethrins*	Insecticide	69.1	16	0.89
Endosulfan*	Insecticide	67.0	4	50.07
Oxyfluorfen*	Herbicide	63.0	4	12.61
Rotenone*	Insecticide	61.1	14	0.92
Bt,subsp.Kurstaki	Insecticide	50.5	4	3.97
Alachlor*	Herbicide	47.0	3	150.04
Ethalfluralin*	Herbicide	42.0	3	44.95
Mancozeb**	Fungicide	35.3	11	22.65
Thiophanate	Fungicide	35.3	11	5.66
Linuron*	Herbicide	35.0	5	31.00
Anilazine	Fungicide	34.0	2	85.00
Disulfoton	Insecticide	34.0	7	59.97
Fonofos	Insecticide	30.0	3	100.03
Bensulide	Herbicide	24.0	3	53.91
Mcpa	Herbicide	23.0	2	28.27
Glyphosate*	Herbicide	16.5	3	18.45
Xylene	Insecticide	12.0	2	4.53
Methamidophos	Insecticide	10.5	2	8.31
Fenarimol*	Fungicide	10.0	6	0.40
Naled *	Insecticide	7.5	1	13.37
Petroleum distillates*	Insecticide	7.5	1	4.61
Sethoxydim	Herbicide	5.0	1	0.66
Carbaryl**	Insecticide	4.0	3	6.40
Bentazon*	Herbicide	1.0	1	0.79
Grand Total		8568.5	849	8143.80

Table 3. Ranking of pesticides used in the AUI in 1992 by acres treated. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Active Ingredient	Type	Acres treated	Num apps	Lbs used
Permethrin *	Insecticide	1207.0	131	196.21
Maneb**	Fungicide	688.5	65	1044.80
Oxydemeton-methyl *	Insecticide	671.5	60	346.31
Acephate *	Insecticide	668.0	49	601.70
Iprodione*	Fungicide	598.3	87	554.32
Fosetyl-al	Fungicide	596.0	64	1012.60
Esfenvalerate	Insecticide	486.0	35	20.52
Dimethoate*	Insecticide	453.0	42	133.10
Chlorpyrifos*	Insecticide	405.5	52	441.84
Propyzamide*	Herbicide	371.5	44	300.00
Copper hydroxide	Fungicide	360.5	30	162.97
Methomyl *	Insecticide	339.5	45	247.61
Metalaxyl	Fungicide	273.0	30	61.11
Benomyl *	Fungicide	241.0	21	74.13
Chlorothalonil *	Fungicide	213.5	19	257.71
Chlorthal-dimethyl*	Herbicide	209.5	38	1084.50
Bt Kurstaki, sa-11	**Insecticide**	**194.8**	66	12.22
Mevinphos	Insecticide	178.5	19	117.67
Pyrethrins*	Insecticide	151.3	81	1.40
Rotenone*	Insecticide	151.3	81	2.33
Lindane**	Insecticide	131.0	8	128.32
Glyphosate*	Herbicide	128.0	10	120.74
Oxyfluorfen*	Herbicide	124.5	9	23.74
Anilazine	Fungicide	121.5	12	303.75
Mancozeb *	Fungicide	114.3	31	113.35
Sulfur*	Fungicide	112.0	24	615.60
Vinclozolin*	Fungicide	106.3	23	85.88
Piperonyl butoxide*	Insecticide	104.0	14	52.67
Diazinon*	Insecticide	92.5	8	33.56
Disulfoton	Insecticide	79.0	7	155.62
Ethalfluralin*	Herbicide	76.0	2	103.69
Methamidophos	Insecticide	75.5	6	57.67
Prometryn	Herbicide	71.5	7	107.08
Dicloran	Fungicide	71.0	6	266.25
Endosulfan*	Insecticide	68.5	16	56.92
Thiophanate-methyl*	Fungicide	66.8	19	15.62
Bensulide	Herbicide	53.5	8	159.10
Cypermethrin	Insecticide	53.0	5	4.77
Trifluralin*	Herbicide	45.0	1	41.46
Metam-sodium*	Fumigants	42.0	2	5308.36
Methyl parathion *	Insecticide	32.0	2	15.80
Fonofos	Insecticide	26.0	1	46.01
Xylene	Insecticide	24.0	2	5.56
Methyl bromide *	Fumigants	21.8	3	6758.71
Thiophanate	Fungicide	21.5	8	4.84
Bt Kurstaki	Insecticide	20.0	2	9.06
Potash soap	Insecticide	18.0	2	139.32
Alachlor*	Herbicide	13.0	1	27.67
Mcpa	Herbicide	13.0	1	15.98
Fenarimol*	Fungicide	12.0	5	0.48
Carbaryl**	Insecticide	10.3	2	8.25
Naled *	Insecticide	8.0	1	14.22
Petroleum distillates*	Insecticide	8.0	1	4.90
Fluvalinate*	Insecticide	5.0	1	0.78
Chloropicrin *	Fumigants	4.8	2	157.20
Grand Total		10431.0	1311	21635.94

Table 4. Ranking of pesticides used in the AUI in 1993 by acres treated. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Active ingredient	Type	Acres Treated	Num Apps	Lbs Used
Fosetyl-al	Fungicide	1206.7	100	2740.00
Permethrin *	Insecticide	1147.2	113	177.60
Maneb**	Fungicide	861.7	69	1386.70
Iprodione	Fungicide	645.0	74	566.13
Acephate *	Insecticide	643.0	46	556.91
Chlorothalonil *	Fungicide	509.5	34	740.98
Dimethoate*	Insecticide	479.5	50	292.88
Methomyl *	Insecticide	441.5	50	291.48
Propyazamide*	Herbicide	422.0	41	336.38
Chlorpyrifos*	Insecticide	398.5	46	339.45
Oxydemeton-methyl *	Insecticide	391.5	44	174.53
Cypermethrin	Insecticide	311.5	19	24.94
Esfenvalerate	Insecticide	278.5	32	11.15
Benomyl *	Fungicide	266.0	16	77.00
Mevinphos	Insecticide	240.0	21	204.50
Bt Kurstaki, sa-11	Insecticide	227.5	24	14.48
Oxyfluorfen*	Herbicide	177.4	18	32.51
Chlorthal-dimethyl*	Herbicide	163.0	32	617.63
Metalaxyl	Fungicide	157.0	16	37.10
Diazinon*	Insecticide	130.3	12	62.22
Prometryn	Herbicide	114.0	7	170.68
Piperonyl butoxide*	Insecticide	101.0	13	57.32
Lindane*	Insecticide	100.0	7	96.94
Copper hydroxide	Fungicide	91.0	12	36.34
Naled *	Insecticide	90.8	7	63.90
Petroleum distillates*	Insecticide	71.0	4	19.81
Vinclozolin*	Fungicide	66.2	9	137.70
Avermectin	Insecticide	60.0	3	0.54
Pyrethrins*	Insecticide	59.0	10	1.30
Dicloran	Fungicide	49.0	3	183.75
Rotenone*	Insecticide	38.0	8	0.56
Fenamiphos*	Insecticide	35.0	2	51.02
Oxamyl*	Insecticide	33.0	3	30.13
Ethalfluralin*	Herbicide	26.0	2	39.09
Alachlor*	Herbicide	24.0	2	47.86
Bensulide	Herbicide	23.5	3	63.04
Disulfoton	Insecticide	20.5	4	44.70
Anilazine	Fungicide	20.0	1	50.00
Glyphosate*	Herbicide	20.0	2	30.74
Myclobutanil	Fungicide	18.0	5	1.80
Endosulfan*	Insecticide	13.0	2	12.95
Fonofos	Insecticide	13.0	1	26.01
Mcpa	Herbicide	13.0	1	15.98
Carbaryl**	Insecticide	8.0	1	16.00
Fenarimol*	Fungicide	7.0	2	0.27
Linuron*	Herbicide	6.0	1	6.00
Grand Total		10217.3	972	9888.97

Table 5, page 1

The pesticide use for each active ingredient on each major crop in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides in the PUR, grouped into fungicides, herbicides, and insecticides for each crop. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Beans	**Fungicide**	Benomyl *	1	15.0	15.00
		Sulfur*	4	69.0	276.00
		Fungicide Total	**5**	**84.0**	**291.00**
	Herbicide	Mcpa	1	13.0	15.98
		Herbicide Total	**1**	**13.0**	**15.98**
	Insecticide	**Acephate ***	4	64.0	63.75
		Fonofos	1	5.0	20.01
		Mevinphos	4	64.0	31.66
		Insecticide Total	**9**	**133.0**	**115.41**
		Beans Total	**15**	**230.0**	**422.39**

Table 5, page 2

The pesticide use for each active ingredient on each major crop in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides in the PUR, grouped into fungicides, herbicides, and insecticides for each crop. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Celery	**Fungicide**	Anilazine	2	34.0	85.00
		Benomyl *	4	71.0	17.75
		Chlorothalonil *	2	23.0	24.37
		Copper hydroxide	2	37.0	27.42
		Dicloran	6	84.5	314.99
		Maneb**	2	6.0	7.20
		Thiophanate-methyl*	6	106.0	37.10
		Fungicide Total	**24**	**361.5**	**513.82**
	Herbicide	Glyphosate*	1	3.0	3.08
		Linuron*	3	18.0	14.00
		Prometryn	7	88.0	127.74
		Herbicide Total	**11**	**109.0**	**144.81**
	Insecticide	Acephate *	8	105.5	95.63
		Diazinon*	3	54.0	27.87
		Endosulfan*	4	67.0	50.07
		Mevinphos	3	27.0	26.72
		Permethrin *	13	130.5	24.51
		Pyrethrins*	1	4.0	0.04
		Rotenone*	1	4.0	0.07
		Insecticide Total	**33**	**392.0**	**224.92**
		Celery Total	**68**	**862.5**	**883.56**

Table 5, page 3

The pesticide use for each active ingredient on each major crop in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides in the PUR, grouped into fungicides, herbicides, and insecticides for each crop. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Cole Crops	**Fungicide**	Chlorothalonil *	2	10.0	14.40
		Copper hydroxide	16	254.0	98.75
		Iprodione*	1	3.0	3.00
		Metalaxyl	9	81.0	19.63
		Fungicide Total	**28**	**348.0**	**135.78**
	Herbicide	Bensulide	3	24.0	53.91
		Chlorthal-dimethyl*	22	204.0	595.29
		Sethoxydim	1	5.0	0.66
		Herbicide Total	**26**	**233.0**	**649.86**
	Insecticide	Acephate *	6	89.0	87.11
		Bt,subsp.Kurstaki	1	15.0	2.32
		Carbaryl**	3	4.0	6.40
		Chlorpyrifos*	23	224.5	227.59
		Diazinon*	1	3.0	1.52
		Dimethoate*	1	14.0	6.83
		Disulfoton	7	34.0	59.97
		Esfenvalerate	24	261.0	11.15
		Methamidophos	2	10.5	8.31
		Methomyl *	6	45.0	33.86
		Mevinphos	4	18.5	15.84
		Naled *	1	7.5	13.37
		Oxydemeton-methyl *	37	395.0	214.08
		Permethrin *	3	41.0	4.22
		Petroleum distillates*	1	7.5	4.61
		Pyrethrins*	3	4.0	0.02
		Rotenone*	3	4.0	0.04
		Xylene	1	3.0	1.14
		Insecticide Total	**127**	**1180.5**	**698.37**
		Cole Crops Total	**181**	**1761.5**	**1484.02**

Table 5, page 4

The pesticide use for each active ingredient on each major crop in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides in the PUR, grouped into fungicides, herbicides, and insecticides for each crop. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Cut Flowers	**Fungicide**	Benomyl *	21	52.3	24.38
		Chlorothalonil *	5	48.0	61.20
		Copper hydroxide	3	26.0	10.27
		Fenarimol*	6	10.0	0.40
		Iprodione*	18	69.8	53.57
		Mancozeb**	11	35.3	22.65
		Metalaxyl	6	63.0	11.42
		Sulfur*	5	26.0	136.00
		Thiophanate	11	35.3	5.66
		Vinclozolin*	22	70.8	37.50
		Fungicide Total	**108**	**436.3**	**363.04**
	Herbicide	Alachlor*	3	47.0	150.04
		Bentazon*	1	1.0	0.79
		Chlorthal-dimethyl*	25	81.0	372.75
		Ethalfluralin*	3	42.0	44.95
		Glyphosate*	1	1.5	3.08
		Linuron*	2	17.0	17.00
		Mcpa	1	10.0	12.29
		Oxyfluorfen*	4	63.0	12.61
		Herbicide Total	**40**	**262.5**	**613.51**
	Insecticide	Acephate *	1	20.0	19.95
		Bt,subsp.Kurstaki	1	9.5	0.30
		Chlorpyrifos*	27	119.1	74.37
		Esfenvalerate	1	6.0	0.24
		Fonofos	2	25.0	80.02
		Methomyl *	1	4.0	1.80
		Mevinphos	2	40.0	28.79
		Oxydemeton-methyl *	6	51.0	25.49
		Permethrin *	11	49.5	7.38
		Pyrethrins*	3	2.1	0.02
		Rotenone*	3	2.1	0.04
		Insecticide Total	**58**	**328.2**	**238.40**
		Cut Flowers Total	**206**	**1027.0**	**1214.95**

Table 5, page 5

The pesticide use for each active ingredient on each major crop in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides in the PUR, grouped into fungicides, herbicides, and insecticides for each crop. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Lettuce	**Fungicide**	Copper hydroxide	1	10.0	5.93
		Dicloran	2	26.0	56.90
		Fosetyl-al	66	811.0	1509.55
		Iprodione*	28	372.0	372.00
		Maneb**	33	491.5	795.20
		Metalaxyl	21	241.5	60.71
		Vinclozolin*	5	54.0	54.00
		Fungicide Total	**156**	**2006.0**	**2854.29**
	Herbicide	*Glyphosate**	1	12.0	12.30
		Propyzamide*	29	366.0	334.25
		Herbicide Total	**30**	**378.0**	**346.55**
	Insecticide	Acephate *	31	417.0	387.70
		Bt,subsp.Kurstaki	2	26.0	1.34
		Diazinon*	8	70.0	36.06
		Dimethoate*	24	351.0	84.90
		Methomyl *	20	202.5	142.13
		Mevinphos	6	63.0	51.99
		Permethrin *	75	959.5	171.48
		Piperonyl butoxide*	10	95.5	57.48
		Pyrethrins*	9	59.0	0.80
		Rotenone*	7	51.0	0.78
		Xylene	1	9.0	3.39
		Insecticide Total	**193**	**2303.5**	**938.05**
		Lettuce Total	**379**	**4687.5**	**4138.88**
		Grand Total	**849**	**8568.5**	**8143.80**

Table 6, page 1

The pesticide use for each active ingredient on each major crop in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Beans	**Fungicide**	Sulfur*	3	54.0	324.80
		Fungicide Total	**3**	**54.0**	**324.80**
	Herbicide	Ethalfluralin*	1	50.0	75.18
		Trifluralin*	1	45.0	41.46
		Herbicide Total	**2**	**95.0**	**116.64**
	Insecticide	Dimethoate*	3	68.0	32.62
		Methomyl *	1	22.0	19.80
		Methyl parathion *	2	32.0	15.80
		Mevinphos	2	32.0	7.93
		Piperonyl butoxide*	1	33.0	10.21
		Xylene	1	13.0	1.42
		Insecticide Total	**10**	**200.0**	**87.77**
		Beans Total	**15**	**349.0**	**529.22**

Table 6, page 2

The pesticide use for each active ingredient on each major crop in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Celery	**Fungicide**	Anilazine	12	121.5	303.75
		Benomyl *	16	182.5	45.63
		Chlorothalonil *	3	40.0	73.03
		Copper hydroxide	6	82.0	59.29
		Dicloran	6	71.0	266.25
		Fungicide Total	**43**	**497.0**	**747.94**
	Herbicide	Glyphosate*	1	17.0	13.07
		Prometryn	7	71.5	107.08
		Herbicide Total	**8**	**88.5**	**120.15**
	Insecticide	Acephate *	14	172.0	132.26
		Bt Kurstaki, sa-11	6	18.5	1.18
		Methomyl *	3	39.0	22.27
		Mevinphos	1	20.0	9.89
		Permethrin *	7	82.5	13.48
		Piperonyl butoxide*	2	10.0	6.18
		Pyrethrins*	7	21.5	0.20
		Rotenone*	7	21.5	0.34
		Insecticide Total	**47**	**385.0**	**185.81**
		Celery Total	**98**	**970.5**	**1053.90**

Table 6, page 3

The pesticide use for each active ingredient on each major crop in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Cole Crops	**Fumigants**	Metam-sodium*	2	42.0	5308.36
		Methyl bromide *	1	17.0	5342.62
		Fumigants Total	**3**	**59.0**	**10650.98**
	Fungicide	Benomyl *	1	10.5	5.25
		Chlorothalonil *	13	147.5	158.40
		Copper hydroxide	22	257.0	95.22
		Iprodione*	4	27.5	20.63
		Metalaxyl	16	137.0	30.18
		Fungicide Total	**56**	**579.5**	**309.68**
	Herbicide	Bensulide	4	25.5	85.51
		Chlorthal-dimethyl*	14	116.5	586.50
		Glyphosate*	3	47.0	37.41
		Oxyfluorfen*	2	13.0	1.42
		Herbicide Total	**23**	**202.0**	**710.85**
	Insecticide	Acephate *	5	92.0	89.70
		Bt Kurstaki	1	10.0	5.44
		Bt Kurstaki, sa-11	6	63.0	3.71
		Carbaryl**	1	10.0	8.00
		Chlorpyrifos*	28	271.0	226.46
		Diazinon*	2	19.0	9.51
		Dimethoate*	3	23.0	6.60
		Disulfoton	3	30.0	83.70
		Endosulfan*	5	32.0	22.41
		Esfenvalerate	35	486.0	20.52
		Methamidophos	4	39.5	29.18
		Methomyl *	10	71.0	54.41
		Mevinphos	5	34.0	33.09
		Naled *	1	8.0	14.22
		Oxydemeton-methyl *	54	615.5	324.25
		Permethrin *	18	138.0	15.21
		Petroleum distillates	1	8.0	4.90
		Potash soap	2	18.0	139.32
		Pyrethrins*	2	18.0	0.15
		Rotenone*	2	18.0	0.25
		Insecticide Total	**188**	**2004.0**	**1091.03**
		Cole Crops Total	**270**	**2844.5**	**12762.53**

Table 6, page 4

The pesticide use for each active ingredient on each major crop in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Cut Flowers	**Fumigants**	Chloropicrin *	2	4.8	157.20
		Methyl bromide *	2	4.8	1416.08
		Fumigants Total	**4**	**9.5**	**1573.28**
	Fungicide	Benomyl *	4	48.0	23.25
		Chlorothalonil *	3	26.0	26.28
		Copper hydroxide	1	10.5	4.12
		Fenarimol*	5	12.0	0.48
		Iprodione*	43	176.8	144.94
		Mancozeb**	31	114.3	113.35
		Metalaxyl	3	26.0	3.29
		Sulfur*	21	58.0	290.80
		Thiophanate	8	21.5	4.84
		Thiophanate-methyl*	19	66.8	15.62
		Vinclozolin*	17	56.3	42.88
		Fungicide Total	**155**	**616.0**	**669.84**
	Herbicide	Alachlor*	1	13.0	27.67
		Chlorthal-dimethyl*	24	93.0	498.00
		Ethalfluralin*	1	26.0	28.51
		Mcpa	1	13.0	15.98
		Oxyfluorfen*	7	111.5	22.32
		Herbicide Total	**34**	**256.5**	**592.47**
	Insecticide	Carbaryl**	1	0.3	0.25
		Chlorpyrifos*	24	134.5	215.38
		Dimethoate*	4	26.5	12.74
		Disulfoton	2	28.0	29.40
		Fluvalinate*	1	5.0	0.78
		Fonofos	1	26.0	46.01
		Mevinphos	2	30.0	29.68
		Oxydemeton-methyl *	5	45.0	17.94
		Permethrin *	10	43.0	5.79
		Piperonyl butoxide*	2	14.5	7.49
		Pyrethrins*	4	20.0	0.22
		Rotenone*	4	20.0	0.37
		Insecticide Total	**60**	**392.8**	**366.04**
		Cut Flowers Total	**253**	**1274.8**	**3201.63**

Table 6, page 5

The pesticide use for each active ingredient on each major crop in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Lettuce	**Fungicide**	Copper hydroxide	1	11.0	4.34
		Fosetyl-al	64	596.0	1012.60
		Iprodione*	40	394.0	388.75
		Maneb**	65	688.5	1044.80
		Metalaxyl	11	110.0	27.65
		Vinclozolin*	6	50.0	43.00
		Fungicide Total	**187**	**1849.5**	**2521.14**
	Herbicide	Bensulide	4	28.0	73.59
		Glyphosate*	6	64.0	70.25
		Propyzamide*	44	371.5	300.00
		Herbicide Total	**54**	**463.5**	**443.84**
	Insecticide	Acephate *	30	404.0	379.74
		Bt Kurstaki	1	10.0	3.62
		Bt Kurstaki, sa-11	54	113.3	7.33
		Cypermethrin	5	53.0	4.77
		Diazinon*	6	73.5	24.05
		Dimethoate*	32	335.5	81.14
		Disulfoton	2	21.0	42.53
		Endosulfan*	11	36.5	34.50
		Lindane**	8	131.0	128.32
		Methamidophos	2	36.0	28.49
		Methomyl *	31	207.5	151.14
		Mevinphos	9	62.5	37.08
		Oxydemeton-methyl *	1	11.0	4.12
		Permethrin *	96	943.5	161.73
		Piperonyl butoxide*	9	46.5	28.79
		Pyrethrins*	68	91.8	0.83
		Rotenone*	68	91.8	1.38
		Xylene	1	11.0	4.14
		Insecticide Total	**434**	**2679.3**	**1123.69**
		Lettuce Total	**675**	**4992.3**	**4088.66**
		Grand Total	**1311**	**10431.0**	**21635.94**

Table 7, page 1

The pesticide use for each active ingredient on each major crop in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Beans	**Herbicide**	Alachlor*	2	24.0	47.86
		Ethalfluralin*	2	26.0	39.09
		Mcpa	1	13.0	15.98
		Herbicide Total	**5**	**63.0**	**102.93**
	Insecticide	Dimethoate*	1	15.0	7.20
		Fonofos	1	13.0	26.01
		Insecticide Total	**2**	**28.0**	**33.20**
		Beans Total	**7**	**91.0**	**136.13**

Table 7, page 2

The pesticide use for each active ingredient on each major crop in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Celery	**Fungicide**	Anilazine	1	20.0	50.00
		Benomyl *	15	252.0	63.00
		Chlorothalonil *	25	381.0	635.69
		Copper hydroxide	1	11.0	8.15
		Dicloran	3	49.0	183.75
		Iprodione*	4	65.0	65.00
		Fungicide Total	**49**	**778.0**	**1005.59**
	Herbicide	Linuron*	1	6.0	6.00
		Prometryn	7	114.0	170.68
		Herbicide Total	**8**	**120.0**	**176.68**
	Insecticide	Acephate *	11	181.0	166.49
		Avermectin	3	60.0	0.54
		Carbaryl**	5	83.0	43.57
		Methomyl *	3	39.0	22.71
		Naled *	4	71.0	57.45
		Oxamyl*	3	33.0	30.13
		Permethrin *	9	126.0	24.15
		Petroleum distillates*	4	71.0	19.81
		Insecticide Total	**42**	**664.0**	**364.85**
		Celery Total	**99**	**1562.0**	**1547.12**

Table 7, page 3

The pesticide use for each active ingredient on each major crop in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Cole Crops	**Fungicide**	Benomyl *	1	14.0	14.00
		Chlorothalonil *	8	86.5	96.29
		Copper hydroxide	11	80.0	28.19
		Iprodione*	9	35.5	31.50
		Metalaxyl	7	28.0	5.43
		Fungicide Total	**36**	**244.0**	**175.42**
	Herbicide	Bensulide	1	7.5	22.35
		Chlorthal-dimethyl*	11	77.0	238.88
		Oxyfluorfen*	16	144.4	23.60
		Herbicide Total	**28**	**228.9**	**284.83**
	Insecticide	Acephate *	1	0.5	0.49
		Bt Kurstaki, sa-11	12	86.5	7.66
		Carbaryl**	1	8.0	16.00
		Chlorpyrifos*	26	261.0	303.57
		Diazinon*	2	9.3	3.66
		Dimethoate*	6	21.5	7.92
		Disulfoton	3	6.0	15.30
		Esfenvalerate	30	272.5	10.88
		Fenamiphos*	2	35.0	51.02
		Methomyl *	13	83.5	71.89
		Mevinphos	12	111.0	73.15
		Naled *	3	19.8	6.44
		Oxydemeton-methyl *	42	373.5	167.15
		Permethrin *	10	72.0	9.45
		Piperonyl butoxide*	1	14.0	6.89
		Pyrethrins*	1	5.0	0.03
		Rotenone*	1	5.0	0.05
		Insecticide Total	**166**	**1384.1**	**751.54**
		Cole Crops Total	**230**	**1857.0**	**1211.79**

The pesticide use for each active ingredient on each major crop in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Cut Flowers	**Fungicide**	Chlorothalonil *	1	42.0	9.00
		Fenarimol*	2	7.0	0.27
		Fosetyl-al	1	14.0	56.00
		Iprodione*	26	150.5	87.63
		Myclobutanil	5	18.0	1.80
		Fungicide Total	**35**	**231.5**	**154.70**
	Herbicide	Chlorthal-dimethyl*	21	86.0	378.75
		Glyphosate*	1	2.0	3.08
		Oxyfluorfen*	2	33.0	8.91
		Propyazamide*	2	12.0	35.00
		Herbicide Total	**26**	**133.0**	**425.74**
	Insecticide	Bt Kurstaki, sa-11	6	84.0	2.18
		Chlorpyrifos*	20	137.5	35.88
		Diazinon*	2	16.0	4.00
		Dimethoate*	4	43.0	12.97
		Esfenvalerate	2	6.0	0.27
		Oxydemeton-methyl *	2	18.0	7.38
		Permethrin *	25	115.0	14.80
		Piperonyl butoxide*	3	9.0	5.08
		Pyrethrins*	4	12.0	0.24
		Rotenone*	3	9.0	0.16
		Insecticide Total	**71**	**449.5**	**82.96**
		Cut Flowers Total	**132**	**814.0**	**663.40**

Table 7, page 5

The pesticide use for each active ingredient on each major crop in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. The list includes all pesticides reported in the PUR and for each crop are grouped into fumigants, fungicides, herbicides, and insecticides. Pesticides marked * are on the candidate TAC list. Pesticides marked ** are declared TACs.

Crop	Pesticide Type	Pesticide	Num Apps	Acres Treated	Pounds of AI
Lettuce	**Fungicide**	Fosetyl-al	99	1192.7	2684.00
		Iprodione*	35	394.0	382.00
		Maneb**	69	861.7	1386.70
		Metalaxyl	9	129.0	31.67
		Vinclozolin*	9	66.2	137.70
		Fungicide Total	**221**	**2643.6**	**4622.07**
	Herbicide	Bensulide	2	16.0	40.69
		Glyphosate*	1	18.0	27.66
		Propyazamide*	39	410.0	301.38
		Herbicide Total	**42**	**444.0**	**369.72**
	Insecticide	Acephate *	34	461.5	389.93
		Bt Kurstaki, sa-11	6	57.0	4.64
		Cypermethrin	19	311.5	24.94
		Diazinon*	3	22.0	11.00
		Dimethoate*	39	400.0	264.79
		Disulfoton	1	14.5	29.40
		Endosulfan*	2	13.0	12.95
		Lindane	7	100.0	96.94
		Methomyl *	34	319.0	196.88
		Mevinphos	9	129.0	131.35
		Permethrin *	69	834.2	129.20
		Piperonyl butoxide*	9	78.0	45.36
		Pyrethrins*	5	42.0	1.03
		Rotenone*	4	24.0	0.35
		Insecticide Total	**241**	**2805.7**	**1338.75**
		Lettuce Total	**504**	**5893.3**	**6330.55**
		Grand Total	**972**	**10217.3**	**9888.97**

Table 8, page 1

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 5 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Beans	**Fungicide**	April	3	54.0	216.00
		September	2	30.0	75.00
		Fungicide Total	**5**	**84.0**	**291.00**
	Herbicide	June	1	13.0	15.98
		Herbicide Total	**1**	**13.0**	**15.98**
	Insecticide	April	7	113.0	100.49
		May	2	20.0	14.92
		Insecticide Total	**9**	**133.0**	**115.41**
		Beans Total	**15**	**230.0**	**422.39**

Table 8, page 2

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 5 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Celery	**Fungicide**	April	2	34.0	73.53
		May	11	195.0	249.46
		June	6	98.5	141.16
		July	1	16.0	11.86
		August	1	6.0	23.99
		September	2	9.0	10.23
		October	1	3.0	3.60
		Fungicide Total	**24**	**361.5**	**513.82**
	Herbicide	February	2	20.0	28.53
		March	1	20.0	29.93
		April	4	49.0	61.39
		August	4	20.0	24.96
		Herbicide Total	**11**	**109.0**	**144.81**
	Insecticide	April	2	34.0	25.46
		May	9	161.0	99.87
		June	9	131.0	75.77
		July	1	16.0	3.19
		August	2	12.0	7.11
		September	5	20.0	9.36
		October	2	6.0	3.44
		November	3	12.0	0.72
		Insecticide Total	**33**	**392.0**	**224.92**
		Celery Total	**68**	**862.5**	**883.56**

Table 8, page 3

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 5 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Cole Crops	**Fungicide**	January	4	26.0	11.31
		February	3	17.0	14.34
		April	3	55.0	19.24
		May	2	36.0	13.90
		June	1	18.0	6.95
		July	3	39.0	13.26
		August	3	56.0	21.77
		September	3	56.0	21.58
		October	6	45.0	13.42
		Fungicide Total	**28**	**348.0**	**135.78**
	Herbicide	January	1	8.0	48.00
		February	2	15.5	69.75
		April	2	25.0	112.50
		May	1	7.0	31.50
		June	3	25.0	45.75
		July	3	28.0	57.00
		August	5	56.5	101.04
		September	3	17.0	50.16
		October	3	25.0	68.16
		December	3	26.0	66.00
		Herbicide Total	**26**	**233.0**	**649.86**
	Insecticide	January	8	37.0	24.03
		February	7	23.0	18.44
		April	19	164.0	80.87
		May	6	86.0	40.12
		June	6	77.0	35.77
		July	16	143.0	96.26
		August	20	236.5	129.78
		September	18	215.0	144.72
		October	12	85.0	58.53
		November	5	56.0	18.90
		December	10	58.0	50.97
		Insecticide Total	**127**	**1180.5**	**698.37**
		Cole Crops Total	**181**	**1761.5**	**1484.02**

Table 8, page 4

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 5 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Cut Flowers	**Fungicide**	January	1	1.5	0.75
		February	3	9.0	5.00
		March	12	83.0	139.06
		April	5	19.0	9.50
		May	23	131.0	94.99
		June	12	37.5	15.63
		July	6	11.3	5.06
		August	12	38.0	22.08
		September	14	52.5	38.77
		October	12	29.3	20.03
		November	4	6.3	3.09
		December	4	18.0	9.09
		Fungicide Total	**108**	**436.3**	**363.04**
	Herbicide	January	8	79.5	95.86
		February	1	2.0	9.00
		March	1	1.0	4.50
		April	4	30.0	52.97
		May	4	62.0	155.53
		June	4	29.5	40.54
		July	5	6.5	24.87
		August	1	1.5	6.75
		September	4	14.5	76.13
		October	3	17.5	68.25
		November	1	6.0	13.50
		December	4	12.5	65.63
		Herbicide Total	**40**	**262.5**	**613.51**
	Insecticide	February	2	7.0	1.75
		March	3	38.0	21.75
		April	11	43.5	8.82
		May	21	113.2	141.00
		June	5	9.0	5.63
		July	2	40.0	29.78
		August	2	2.0	0.41
		September	2	19.0	1.71
		October	3	25.5	13.54
		December	7	31.0	14.01
		Insecticide Total	**58**	**328.2**	**238.40**
		Cut Flowers Total	**206**	**1027.0**	**1214.95**

Table 8, page 5

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1991. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 5 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Lettuce	**Fungicide**	February	1	18.0	18.00
		March	3	33.0	35.21
		April	14	91.0	104.92
		May	14	194.0	218.38
		June	20	239.5	370.34
		July	23	223.5	267.68
		August	34	497.0	702.96
		September	25	372.0	543.21
		October	21	328.0	569.58
		November	1	10.0	24.00
		Fungicide Total	**156**	**2006.0**	**2854.29**
	Herbicide	January	2	16.0	20.00
		February	4	32.0	40.30
		March	1	20.0	20.00
		April	4	54.0	54.00
		May	4	41.0	25.00
		June	7	99.0	90.00
		July	2	22.0	13.50
		August	5	76.0	56.75
		December	1	18.0	27.00
		Herbicide Total	**30**	**378.0**	**346.55**
	Insecticide	February	1	18.0	13.50
		March	4	68.0	6.90
		April	19	90.0	31.84
		May	21	299.0	149.54
		June	43	492.5	191.06
		July	32	297.0	135.54
		August	37	520.0	208.37
		September	19	268.0	135.65
		October	15	225.0	60.64
		November	2	26.0	5.00
		Insecticide Total	**193**	**2303.5**	**938.05**
		Lettuce Total	**379**	**4687.5**	**4138.88**
		Grand Total	**849**	**8568.5**	**8143.80**

Table 9, page 1

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 6 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Beans	**Fungicide**	March	1	19.0	76.00
		April	1	13.0	72.80
		August	1	22.0	176.00
		Fungicide Total	**3**	**54.0**	**324.80**
	Herbicide	April	1	50.0	75.18
		May	1	45.0	41.46
		Herbicide Total	**2**	**95.0**	**116.64**
	Insecticide	March	2	38.0	14.12
		April	3	39.0	11.03
		July	2	66.0	26.04
		August	3	57.0	36.59
		Insecticide Total	**10**	**200.0**	**87.77**
		Beans Total	**15**	**349.0**	**529.22**

Table 9, page 2

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 6 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Celery	**Fungicide**	March	8	98.0	168.50
		April	15	152.0	289.05
		May	18	207.0	244.28
		June	1	20.0	31.30
		July	1	20.0	14.82
		Fungicide Total	**43**	**497.0**	**747.94**
	Herbicide	January	1	17.0	13.07
		February	1	10.5	15.72
		March	3	24.0	35.96
		April	3	37.0	55.39
		Herbicide Total	**8**	**88.5**	**120.15**
	Insecticide	March	5	64.0	40.50
		April	6	52.5	31.73
		May	13	139.5	89.49
		June	20	95.0	14.70
		July	1	20.0	3.75
		November	2	14.0	5.64
		Insecticide Total	**47**	**385.0**	**185.81**
		Celery Total	**98**	**970.5**	**1053.90**

Table 9, page 3

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 6 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Cole Crops	**Fumigants**	January	1	25.0	3159.74
		May	1	17.0	5342.62
		July	1	17.0	2148.62
		Fumigants Total	**3**	**59.0**	**10650.98**
	Fungicide	January	12	94.5	53.92
		February	11	76.0	36.86
		March	17	171.0	65.07
		April	7	86.0	36.69
		May	2	34.0	13.11
		June	1	17.0	6.55
		July	2	24.0	17.14
		September	4	77.0	80.34
		Fungicide Total	**56**	**579.5**	**309.68**
	Herbicide	January	2	27.0	121.50
		February	5	71.0	162.79
		March	4	21.0	68.25
		May	2	20.0	124.62
		July	4	22.0	88.26
		August	4	32.0	126.80
		September	1	4.0	18.00
		November	1	5.0	0.62
		Herbicide Total	**23**	**202.0**	**710.85**
	Insecticide	January	4	35.5	21.74
		February	14	114.5	57.13
		March	12	138.5	82.58
		April	34	302.0	150.63
		May	15	158.0	116.38
		June	23	250.0	132.96
		July	23	242.5	103.39
		August	16	199.0	91.66
		September	39	490.0	272.15
		November	8	74.0	62.41
		Insecticide Total	**188**	**2004.0**	**1091.03**
		Cole Crops Total	**270**	**2844.5**	**12762.53**

Table 9, page 4

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 6 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Cut Flowers	**Fumigants**	March	2	3.5	613.28
		May	2	6.0	960.00
		Fumigants Total	**4**	**9.5**	**1573.28**
	Fungicide	January	3	12.5	9.38
		February	8	58.5	33.63
		March	20	46.3	59.86
		April	23	78.5	71.95
		May	25	94.3	113.67
		June	30	142.0	168.72
		July	30	105.5	146.13
		August	10	51.0	39.04
		September	4	20.0	19.98
		December	2	7.5	7.50
		Fungicide Total	**155**	**616.0**	**669.84**
	Herbicide	January	4	55.0	18.58
		February	2	6.0	27.75
		March	4	20.5	107.63
		April	6	55.5	196.88
		May	2	18.0	53.92
		June	3	16.0	31.73
		July	5	10.0	52.50
		August	1	6.0	31.50
		September	1	4.5	23.63
		November	2	7.0	36.75
		December	4	58.0	11.61
		Herbicide Total	**34**	**256.5**	**592.47**
	Insecticide	January	2	8.0	1.61
		February	2	21.0	14.44
		March	5	42.0	172.95
		April	2	15.5	6.03
		May	10	46.0	21.70
		June	16	111.0	76.13
		July	7	21.3	5.86
		August	10	51.0	10.45
		October	1	14.0	14.70
		November	1	14.0	14.70
		December	4	49.0	27.48
		Insecticide Total	**60**	**392.8**	**366.03**
		Cut Flowers Total	**253**	**1274.8**	**3201.62**

Table 9, page 5

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1992. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 6 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Lettuce	**Fungicide**	January	1	10.0	10.00
		February	7	87.0	79.56
		March	16	156.0	220.10
		April	45	299.0	386.24
		May	23	203.0	284.30
		June	22	224.0	293.00
		July	23	191.5	279.10
		August	18	231.0	301.22
		September	32	448.0	667.61
		Fungicide Total	**187**	**1849.5**	**2521.14**
	Herbicide	January	3	26.0	21.58
		February	6	26.0	36.53
		March	8	37.5	40.00
		April	5	37.0	22.00
		May	3	23.0	31.50
		June	7	65.5	46.75
		July	7	91.5	89.75
		August	9	92.0	70.59
		November	1	4.0	4.00
		December	5	61.0	81.14
		Herbicide Total	**54**	**463.5**	**443.84**
	Insecticide	January	1	10.0	7.50
		February	5	58.0	44.05
		March	14	128.0	37.53
		April	72	281.9	118.41
		May	85	277.4	99.79
		June	128	402.5	145.04
		July	40	362.0	181.80
		August	38	478.0	255.38
		September	51	681.5	234.18
		Insecticide Total	**434**	**2679.3**	**1123.69**
		Lettuce Total	**675**	**4992.3**	**4088.66**
		Grand Total	**1311**	**10431.1**	**21635.94**

Table 10, page 1

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 7 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Beans	**Herbicide**	April	1	13.0	19.55
		May	3	37.0	67.40
		June	1	13.0	15.98
		Herbicide Total	**5**	**63.0**	**102.93**
	Insecticide	March	1	13.0	26.01
		June	1	15.0	7.20
		Insecticide Total	**2**	**28.0**	**33.20**
		Beans Total	**7**	**91.0**	**136.13**

Table 10, page 2

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 7 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Celery	**Fungicide**	February	4	60.0	54.44
		March	4	72.0	84.11
		April	6	108.0	122.03
		May	13	233.0	277.05
		June	6	94.0	181.06
		July	3	47.0	55.62
		September	1	6.0	2.08
		October	7	104.0	167.95
		November	1	10.0	13.04
		December	4	44.0	48.20
		Fungicide Total	**49**	**778.0**	**1005.59**
	Herbicide	March	2	37.0	55.39
		April	1	17.0	25.46
		May	2	29.0	43.42
		August	2	26.0	35.93
		September	1	11.0	16.48
		Herbicide Total	**8**	**120.0**	**176.68**
	Insecticide	April	4	74.0	63.14
		May	8	142.0	84.62
		June	3	47.0	45.83
		July	5	71.0	25.54
		August	1	11.0	2.20
		September	9	125.0	54.04
		October	10	173.0	86.36
		November	1	10.0	1.75
		December	1	11.0	1.37
		Insecticide Total	**42**	**664.0**	**364.85**
		Celery Total	**99**	**1562.0**	**1547.12**

Table 10, page 3

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 7 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Cole Crops	**Fungicide**	January	1	5.0	0.50
		February	1	14.0	14.60
		March	8	49.0	15.12
		April	2	12.0	8.37
		May	12	63.5	53.53
		June	1	5.0	5.00
		July	4	16.5	16.47
		August	4	34.0	13.59
		October	1	17.0	17.74
		November	1	18.0	18.78
		December	1	10.0	11.73
		Fungicide Total	**36**	**244.0**	**175.42**
	Herbicide	March	2	18.0	49.06
		April	1	6.0	1.20
		June	2	27.0	5.41
		July	4	27.0	62.10
		August	10	75.0	137.25
		September	2	21.0	9.51
		October	2	20.4	5.10
		November	2	15.0	4.60
		December	3	19.5	10.60
		Herbicide Total	**28**	**228.9**	**284.83**
	Insecticide	January	2	10.0	6.25
		February	1	14.0	14.00
		March	12	85.0	65.57
		April	4	24.6	26.34
		May	19	131.0	53.62
		June	7	89.0	83.74
		July	11	88.0	32.73
		August	27	249.5	116.64
		September	37	338.5	186.54
		October	24	212.5	85.55
		November	6	54.0	18.92
		December	16	88.0	61.66
		Insecticide Total	**166**	**1384.1**	**751.54**
		Cole Crops Total	**230**	**1857.0**	**1211.79**

Table 10, page 4

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 7 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Cut Flowers	**Fungicide**	March	2	17.0	15.00
		April	1	14.0	56.00
		May	1	2.0	0.20
		June	6	22.0	16.50
		July	12	51.5	33.60
		August	3	9.0	8.04
		September	5	78.0	17.36
		October	4	35.5	7.00
		November	1	2.5	1.00
		Fungicide Total	**35**	**231.5**	**154.70**
	Herbicide	March	3	11.0	52.00
		April	6	26.0	97.08
		May	3	13.0	68.25
		June	3	12.0	63.00
		July	3	14.5	76.13
		August	2	6.5	34.13
		September	1	4.0	5.25
		October	1	4.0	10.50
		November	1	4.0	5.25
		December	3	38.0	14.16
		Herbicide Total	**26**	**133.0**	**425.74**
	Insecticide	March	2	25.0	6.80
		April	22	78.0	17.38
		May	2	8.0	8.00
		June	10	49.5	19.00
		July	12	51.0	14.92
		August	4	18.0	6.19
		September	7	130.0	6.79
		October	6	66.0	2.76
		November	6	24.0	1.13
		Insecticide Total	**71**	**449.5**	**82.96**
		Cut Flowers Total	**132**	**814.0**	**663.40**

Table 10, page 5

The pesticide use by month for each crop and pesticide type (fungicide, herbicide, or insecticide) in the AUI in 1993. Given are the number of times each pesticide was applied, the number of acres treated, and the pounds of active ingredient applied. This table is a summary of the same data as in Table 7 but organized differently. Months not listed had no pesticide use for that crop and pesticide type.

Crop	Pesticide Type	Month	Num Apps	Acres Treated	Pounds of AI
Lettuce	**Fungicide**	February	8	82.0	148.00
		March	30	330.0	724.74
		April	35	302.5	426.30
		May	30	373.0	510.77
		June	49	626.4	1128.04
		July	30	316.7	514.90
		August	20	310.0	520.10
		September	10	162.0	390.13
		October	8	123.0	201.48
		November	1	18.0	57.60
		Fungicide Total	**221**	**2643.6**	**4622.07**
	Herbicide	January	1	18.0	27.66
		February	1	10.0	1.25
		March	3	18.0	5.50
		April	8	116.5	92.25
		May	7	63.0	38.50
		June	7	82.0	47.88
		July	3	37.0	37.00
		August	5	50.0	65.69
		September	1	8.0	9.00
		November	2	4.5	2.00
		December	4	37.0	43.00
		Herbicide Total	**42**	**444.0**	**369.72**
	Insecticide	February	2	21.0	19.69
		March	19	199.5	219.16
		April	38	335.5	160.78
		May	28	284.0	180.65
		June	38	503.2	203.54
		July	29	337.5	114.49
		August	46	669.0	268.15
		September	23	269.0	95.39
		October	11	145.0	71.92
		November	1	18.0	3.38
		December	6	24.0	1.62
		Insecticide Total	**241**	**2805.7**	**1338.75**
		Lettuce Total	**504**	**5893.3**	**6330.55**
		Grand Total	**972**	**10217.3**	**9888.97**

Table 11. Total pesticide use on all crops in each section of Lompoc Valley in 1991. Shaded rows refer to the AUI. Data from PUR.

Section	Num Apps	Acres Treated	Pounds of AI
S06N34W01	1	63	92.1
S06N34W05	383	2778	1280.3
S06N34W06	216	1565	542.3
S07N34W19	284	2528	738.1
S07N34W22	103	933	608.2
S07N34W23	1	40	58.5
S07N34W24	38	160	29.8
S07N34W25	77	1244	673.4
S07N34W26	1247	8163	1911.0
S07N34W27	199	2909	563.3
S07N34W28	205	1299	410.8
S07N34W29	728	3202	1385.2
S07N34W30	1677	14733	7436.8
S07N34W31	1088	11679	5211.5
S07N34W32	1039	11977	5516.9
S07N34W33	5	11	3.7
S07N34W35	257	1172	1487.1
S07N34W36	18	210	79.5
S07N35W20	1	40	22.2
S07N35W22	1570	23294	6067.9
S07N35W23	775	6222	1620.6
S07N35W24	242	1160	140.0
S07N35W25	652	9804	5312.2
S07N35W26	670	9004	4336.5
S07N35W35	516	6171	2997.9
S07N35W36	1327	16540	8099.8

Table 12. Total pesticide use on all crops in each section of Lompoc Valley in 1992. Shaded rows refer to the AUI. Data from PUR.

Section	Num Apps	Acres Treated	Pounds of AI
S06N34W01	0	20	29.2
S06N34W02	0	168	281.6
S06N34W05	408	4245	4217.5
S06N34W06	17	1070	285.3
S07N34W19	70	2022	869.8
S07N34W20	0	209	359.3
S07N34W22	141	2051	1143.1
S07N34W23	7	152	139.6
S07N34W24	452	5583	1272.1
S07N34W25	92	2117	7861.7
S07N34W26	194	3805	1526.5
S07N34W27	344	3886	1417.0
S07N34W28	165	2143	4230.4
S07N34W29	384	4216	8924.1
S07N34W30	873	12951	22756.2
S07N34W31	718	10846	24815.4
S07N34W32	642	9785	4557.6
S07N34W33	4	64	58.2
S07N34W34	7	240	45.7
S07N34W35	80	802	320.1
S07N34W36	25	842	147.5
S07N35W22	1108	22374	9417.9
S07N35W23	381	5677	1899.7
S07N35W24	202	2847	941.0
S07N35W25	599	10197	12005.6
S07N35W26	514	8530	33179.0
S07N35W35	198	2410	11038.8
S07N35W36	635	14776	33601.2