DATA BANK of PESTICI

in the San Joaquin Valley

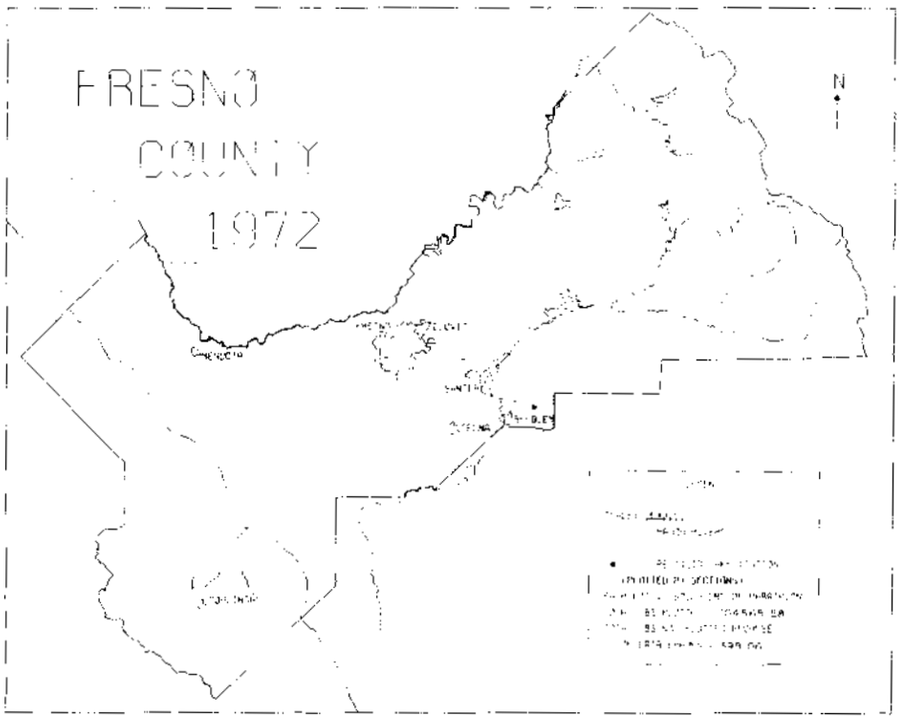
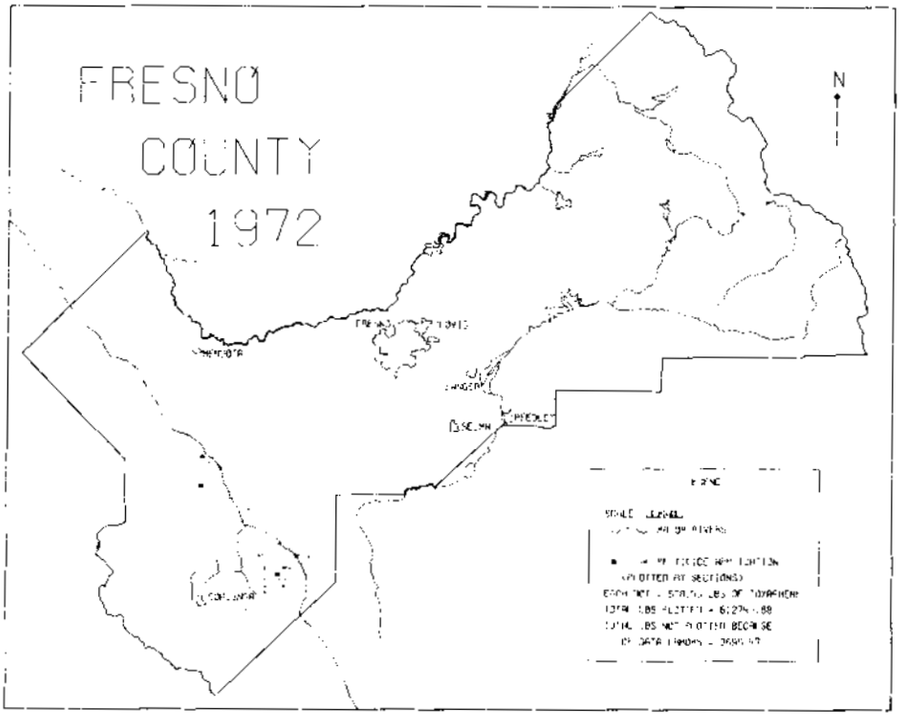


FIG. 1. REPORTED APPLICATIONS OF PARATHION IN FRESNO COUNTY, CALIF., 1972

FIG. 2. REPORTED APPLICATIONS OF TOXAPHENE IN FRESNO COUNTY, CALIF., 1972



THE FOOD PROTECTION and Toxicology Center of the University of California at Davis has accumulated information on pesticide use in California in the form of a computerized data bank. The data bank is one phase of a broader project to develop means of assessing the ecological impact of present and past pesticide use and of anticipating the consequences of alternative practices in the San Joaquin Valley.

The collection of data on pesticide usage was initiated in 1969 under Critical Research Funds of the University of California, because dairymen in the San Joaquin Valley were concerned about the sources of unacceptable levels of pesticide contamination found in milk and alfalfa samples from the southern San Joaquin Valley. An intercampus advisory committee, appointed to study the source and extent of the problem and to aid the dairymen, initially consisted of R. C. Laben (chairman), Animal Science, Davis; D. G. Crosby, Environmental Toxicology, Davis; G. F. Stewart, Environmental Toxicology, Davis; J. W. Biggar, Water Science and Engineering, Davis; R. L. Rudd, Zoology, Davis; J. E. Swift, Cooperative Extension, Berkeley; and J. P. Martin, Soil Science, Riverside. Questions which arose early in the discussions concerning the movement and fate of pesticides in the San Joaquin Valley could not be answered immediately, partly because data were not available on what, how much of, and where specific pesticides were actually being used in the area. Therefore the first phase of the project, entitled "A Study of Chemicals Released in the San Joaquin Valley," involved data gathering under the direction of J. Blair Bailey, Cooperative Extension Service, Berkeley.

A research planning project, utilizing the information in the data bank to explore the feasibility of the systems approach, was developed in 1970 by R. A. Fleck and D. P. H. Hsieh. This project, entitled "A Systems Approach to Controlling Pesticide Contamination in the San Joaquin Valley," received financial support from the National Science Foundation. The following year, the project was enlarged, with R. A. Fleck as project coordinator and supervisor of the data bank, and support was continued and

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In addition to monitoring and summarizing the use of pesticides and other restricted chemicals as required under the California Agricultural Code, the collection of Use Reports by the California Department of Agriculture has facilitated the establishment of a data bank. This data bank is the source of detailed information, hitherto not available, on when, where, and how the chemicals were applied throughout the state over an extended period of time (five years to date). It is now possible to prepare graphs showing trends and changes in pesticide use, and to estimate the pesticide load for simulation modelling of dissipation and decomposition of selected compounds. In conjunction with the mapping program, the information in the data bank has been used to graphically depict areas of heavy application. Therefore, suitable areas for field monitoring of pesticides can be selected for air and soil sampling studies. The data bank has also been used as an information source by various state and federal agencies, including the State Department of Water Resources, Environmental Protection Agency, Monterey Basin Monitoring Project, and several departments of the university.

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upgraded. The National Science Foundation grant recently has been renewed for two years.

The study at present consists of four sub-projects: (1) Data Bank Development, R. R. Painter, co-principal investigator, (2) Simulation Modeling, D. P. H. Hsieh, co-principal investigator, (3) Chemical Transformation of Pesticides in Air, D. G. Crosby and J. N. Seiber, co-principal investigators, (4) Surveillance and Estimation of Pesticidal Dissipation in Soils, R. G. Burau, co-principal investigator. In 1972, W. W. Kilgore and M. Y. Li, Department of Environmental Toxicology, became the project coordinators. In addition to acquiring information and determining trends in pesticide usage, the data bank provides information for other phases of the project to aid in work on such problems as determining the pattern and extent of pesticide usage in any desired area, testing the validity of simulation modelling, and locating suitable sites for air and soil studies. The data bank has also been used as an information source by other university and governmental agencies requiring information on pesticide use in California.

The Fresno County Agricultural Commissioner provided copies of the Pesticide Use Reports filed in Fresno County in 1968 and 1969. The reports were checked for completeness, verified, and the information was then coded and key-

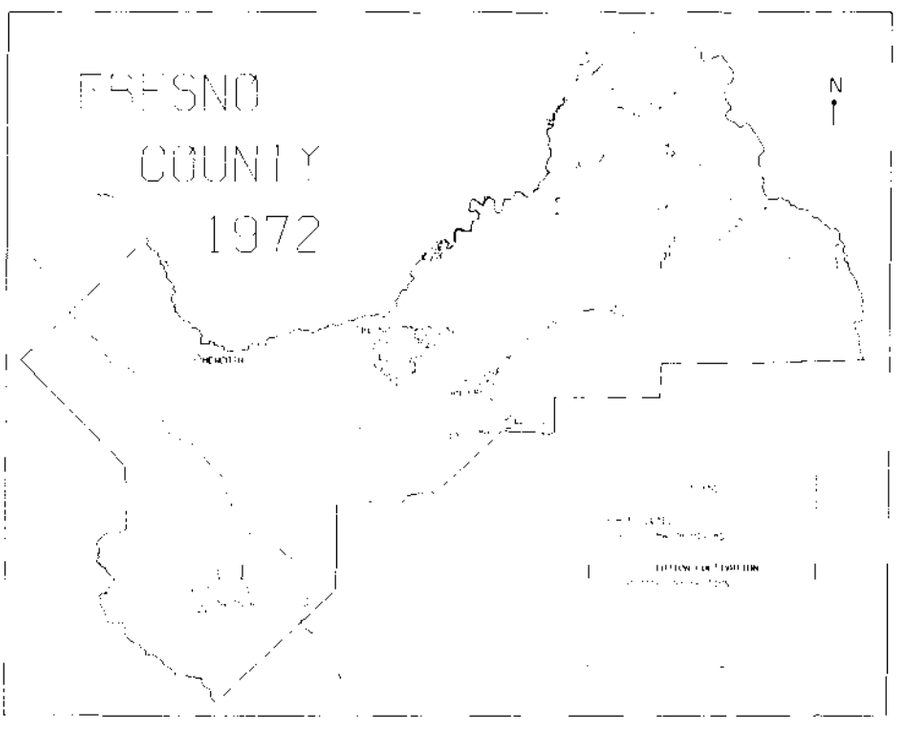


FIG 3. REPORTED APPLICATIONS OF CHEMICALS TO COTTON ACREAGE IN FRESNO COUNTY, CALIF., 1972

FIG. 4. USE OF CARBARYL IN FRESNO COUNTY

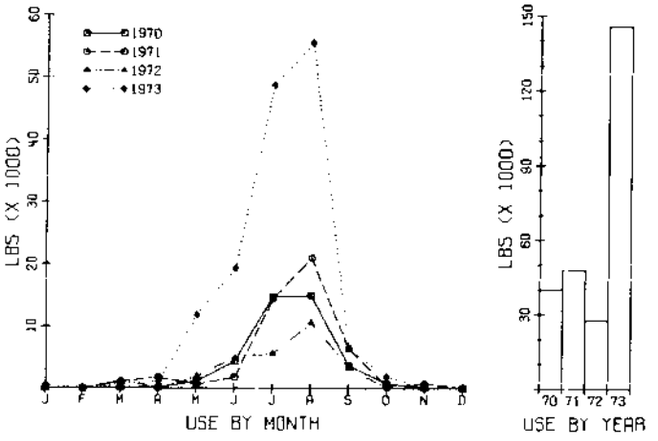
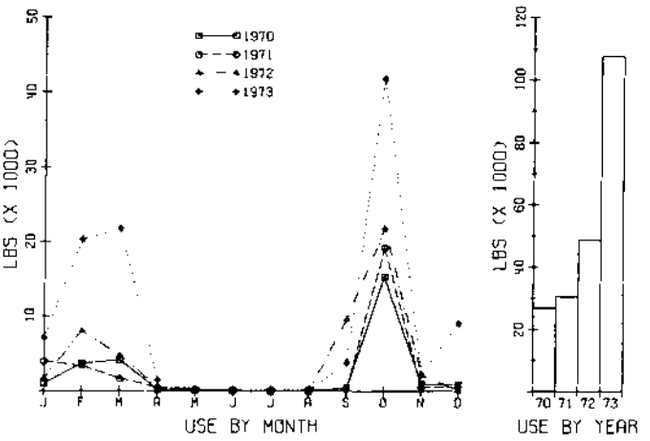


FIG. 5. USE OF PARAQUAT IN FRESNO COUNTY



punched for electronic data processing under the direction of W. O. Gauer, Environmental Toxicology, Davis.

The California Department of Food and Agriculture provided copies of computerized data from the state-wide Agricultural and Restricted Chemicals Use Reports it has collected since 1970. By 1974, the Food Protection and Toxicology Center data bank contained pesticide use records for all 58 California counties for the four-year period 1970 through 1973, plus records of pesticide use in Fresno County for 1968 and 1969. The data, stored on 45 reels of computer tape, detail more than 2 million applications of over 600 million pounds of chemicals on 135 million acres.

Each use report includes the formulation used, quantity applied, method of application (air, ground, other), commodity treated, location of use (county, township, and section), date of application, acres treated, purpose of usage (agricultural, structural, vector control, state highway, etc.), and applicator. Identification of the pests involved has been unreliable, and is no longer entered into the computerized records. The use reports are subject to certain limitations and errors, such as inaccurate or incomplete entries by applicator and errors in coding or key-punching. California Department of Agriculture personnel, who estimate 2 to 5 per cent errors, make corrections when possible. In addition, we have been able to identify and correct some errors through our verification and analytical procedures. The data on usage are incomplete, in that reports are not required for non-restricted chemicals applied by farmers on their own or neighbors' property, for pesticides applied to federal lands by federal operators, or for small quantities of pesticides sold for use by home owners or home gardeners. Despite these limitations, the registration and reporting system used in California since 1970 provides the only detailed records presently available documenting pesticide usage for the state, over a five year period.

Information on pesticides applied and commodities treated can be retrieved in many forms, including tabulations, summaries, graphs, and maps. Data can be retrieved for any area that can be located by township(s), range(s), and section within a county. The maps are prepared by using a Cal-Comp Plotter in conjunction with the computerized data. For example, figures 1 and 2 map where and how much parathion (figure 1) and toxaphene (figure 2) were reported applied in Fresno County in 1972. They show that parathion was used extensively in the central part of the county, whereas toxaphene was used primarily in the western section. Figure 3 illustrates another map which indicates every section where any chemical was reported applied to cotton acreage in 1972. Cotton acreage is treated with many types of pesticides, including insecticides, herbicides, and defoliants; the map consequently also shows where cotton was grown in Fresno County in 1972.

Graphs of yearly and monthly use of pesticides are aids in planning the timing for experiments requiring air and soil sampling in the field. For Fresno County the peak period of use of carbaryl (a carbamate insecticide) has been June, July, and August each year (figure 4). The graph also shows the increased use of carbaryl in 1973. The use of paraquat (a herbicide) has also increased steadily, with two peak periods of use (figure 5).

Figure 6, an example of information retrieved in tabular form, lists the major organophosphate insecticides used within a three-mile radius around one section in Kings County in 1973. A similar study was done for four agricultural valleys in southern California, each of which covered several townships.

Use of registered or trade names of pesticides is for identification only and does not constitute a recommendation.

FIG. 6. ORGANO-PHOSPHATE AND CARBAMATE INSECTICIDES APPLIED IN A 3-MILE RADIUS AROUND A DAIRY IN KINGS COUNTY IN 1973.

Insecticide	Pounds
Azodrin	281.41
Diazinon	481.75
Dimethoate	206.55
Imidan	693.00
Malathion	772.51
Methyl Parathion + Rel.	222.04
Naled + Rel. Naled	584.74
Parathion + Rel. Parathion	630.48
Phorate	1522.03
Systox	129.87
Disyston	333.07
Metasystox	25.98
Carbofuran	47.74
Temik	38.20
Methomyl	97.75

R. R. Painter is specialist and D. E. Wedge is programmer, Food Protection and Toxicology Center, Davis. *The Project receives major support under National Science Foundation Grant BMS-74-11783. Robert Cooper (deceased), Krista Black, Steve Hartman, Haji M. Jameel and Patricia Horrigan have also assisted in the verification and programming procedures. The authors express their appreciation to C. E. Erickson and Associates, Oakland, California, for permission to use their maps as an aid in the computer-produced map of Fresno County.*

PLANTS IN CALIFORNIA tree nurseries frequently display nutrient deficiency symptoms where methyl bromide is used as a preplant fumigant. These nutrient deficiencies—mainly zinc but sometimes phosphorus—cause poor plant growth and stunting. Part or all of certain nursery fields are sometimes lost because trees fail to reach minimum salable size.

Pot-culture experiments with peach seedlings have confirmed that plant nutrient problems are associated with methyl bromide-fumigated soils. Mixing both phosphorus and zinc with fumigated soil greatly improved growth in these experiments. The standard practice in most nurseries is to side-dress phosphoric acid and zinc chelate into the seedbed rows at planting time. This practice results in improved growth, but it does not completely solve all the nutritional problems. Zinc deficiency and stunted growth may still occur in young seedlings.

Other research has shown that certain strains of mycorrhizal fungi placed in methyl bromide-sterilized soil enhanced the ability of the seedlings to overcome nutrient deficiencies. It was also found that peach seedlings grown in methyl bromide-fumigated soils were devoid of mycorrhizal fungi, which are killed by the fumigant.

Mycorrhizal fungi live in a symbiotic relationship with plant roots. Studies have shown that this association can aid the plant by increasing water and nutrient uptake, while the fungus benefits from the increased availability of nutrients. In nature the roots of cultivated and non-cultivated plants are commonly infected with mycorrhizal fungi. One type, the vesicular-arbuscular (VA) mycorrhizae, occurs on more plant species than any other type and is present in many agricultural crops.

An experiment was conducted in a commercial nursery to test the merit of the symbiotic relationship. The field (Foster fine sandy loam) was fumigated with 360 pounds of methyl bromide per acre in the early fall of 1973, using the standard technique of fumigant injection followed immediately by polyethylene tarping. Peach seed (Red-leaf Lovell) was planted in November 1973. Treatments were: (1) fertilization with phosphorus and zinc; (2) phosphorus and zinc fertilization plus inoculation of VA mycorrhizal fungi; and (3) inoculation with VA mycorrhizal fungi, but no fertilization with phosphorus and zinc. There was also an untreated check plot. The experimental design was a randomized