NEW JERSEY PESTICIDE USE SURVEY

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ABSTRACT

The Pesticide Control Program (PCP) in the New Jersey Department of Environmental Protection (NJDEP) is responsible for the enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the New Jersey Pesticide Control Act. In order to carry out these responsibilities, accurate estimates of pesticide use are necessary. In 1986, PCP undertook a major survey of agricultural applicators in New Jersey. Understanding agricultural use of pesticides is important in assessing risks to terrestrial and aquatic environments because farmers are major users of pesticides.

New Jersey's pesticide regulations require certified applicators to maintain records of pesticide use and to submit that information to NJDEP upon request (New Jersey Register, 1985). In order to collect this type of information in a coherent manner, a survey of the certified applicators in the agricultural community was developed. Information requested by the survey included: the pesticide(s) used, the number of acres treated, the crop treated, the method of application, and the municipality where the pesticide was applied. A total of 176 active ingredients were reported. A total of 1,579,284 pounds of active ingredients was applied by 1,721 separate farming operations in New Jersey in 1985.

The data from this survey were summarized and entered into a geographic information system (GIS). Using the mapping capabilities of GIS, quantitative descriptions of the locations of pesticide applications in relation to areas where there are vulnerable aquifer systems, potable water intakes, endangered species, or other environmental concerns, can be obtained. This capability is particularly useful in reviewing applications for specialized pesticide use as well as in imposing restrictions on certain pesticides in areas where problems are likely to occur. In addition, the data is currently being used by the U.S. Geological Survey in planning projects to monitor pesticide residues in both ground and surface water. Because of the usefulness of this data, the survey will be repeated every three years.

KEY WORDS

Agriculture, Environmental Protection, Ground Water, Mapping, Pesticides, Regulations, Surface Water, Surveys.

INTRODUCTION

Prior to 1986 little data was available regarding the amounts and types of pesticides used by New Jersey's agricultural producers. In 1978 the New Jersey Department of Health attempted to estimate pesticide usage by having County Extension Agents estimate the acres planted with a particular crop and then relate that information with the pesticide loads for those crops (New Jersey

Department of Health, 1979). Although useful, the data were derived from estimates and were only available on a county basis. In trying to use these estimates for planning environmental monitoring projects, it was apparent that more accurate data, based on geographic units smaller than counties was needed.

Quantitative usage data is especially important in a state like New Jersey where the agricultural sector is complex. Even though New Jersey is the eighth smallest state, there are still 900,000 acres (18 percent) of land devoted to agriculture. Most of the agricultural land is devoted to crops, with livestock and nurseries accounting for the remainder. The agricultural industry in New Jersey produces 72 vegetable, 10 fruit, and 8 grain commodities. New Jersey ranks in the top five states in the country in the production of snap beans, cabbage, cranberries, blueberries, and peaches (New Jersey Department of Agriculture, 1986).

Because of the diversity of agricultural crops, there is a corresponding diversity in the amounts and types of pesticides used in growing those crops. Presently, there are 9,994 labeled pesticide products registered for sale in New Jersey (Pesticide Control Program, 1989), containing approximately 400-500 major active pesticidal ingredients. The Rutgers Cooperative Extension recommends the use of 177 active ingredients on New Jersey's major crops.

Several states such as California and Arizona estimate pesticide use based on figures from dealers sales records (H. Snow, Jellinek, Schwartz, Connolly, and Freshman, Inc. written commun., 1987). Wisconsin and Florida prepare annual reports based on surveying a percentage of growers in particular areas of the state (H. Snow, Jellinek, Schwartz, Connolly, and Freshman, Inc., written commun., 1987). Agricultural pesticide usage data is generated by surveys conducted by the U.S. Department of Agriculture, but these surveys are only conducted on major field crops (Gianessi, 1987). EPA does not attempt to survey agricultural pesticide usage, but uses existing information and sales figures (Gianessi, 1987). These data are useful in examining trends in pesticide use on major crops, but do not provide a complete picture. Furthermore, in a small state like New Jersey where a diverse agricultural industry is intermingled in rural, suburban, and even urban regions, this approach does not provide data that is specific enough to evaluate the impact of pesticides on sensitive areas.

The New Jersey Pesticide Control Act (NJAC 30:1-10) gives the Pesticide Control Program (PCP) in the New Jersey Department of Environmental Protection (NJDEP) the authority to request accurate pesticide use data from certified pesticide applicators. A farmer is primarily classified as a private applicator, or one who applies a pesticide for use on an agricultural commodity. Some examples are orchardists, dairymen, nurserymen, and greenhouse growers. Approximately 3000 private applicators are

registered with NJDEP.

In 1985 the PCP became interested in obtaining accurate information on the use of pesticides in New Jersey. With the emergence of issues such as groundwater contamination, protection of endangered species, and food safety, it became increasingly important that the State have information on the types, amounts, and areas where pesticides were being used. In order to answer this question a survey of the private pesticide applicators was initiated.

METHODOLOGY

In early 1986 a survey form was developed requesting the following types of information: the name of the pesticide formulation; the amount applied per season; the number of acres treated; the method of application; and the crop type. For simplification, crop type was divided into nine broad categories. A draft survey form was sent to 30 growers in order to test the ability of the farmers to accurately respond. As a result of this pilot study several important modifications were made to the form.

The revised survey form (Figure 1) was mailed to the 3117 registered private applicators. The applicators were requested to supply the information on the form as well as the name of the municipality where they farmed in 1985. New Jersey has 567 individual municipalities, and these municipal units provide the a basis for mapping on the geographic information system (GIS).

Survey forms along with an instructional letter and return envelope were sent to each person on the mailing list. After an eight week period over one third of the survey forms were returned. A second mailing from PCP was sent, this letter indicated that to date the survey had not been returned, a second form was included, and a statement regarding regulatory action would follow. This mailing prompted a response from an additional third of the applicators. A third, much stronger letter was sent to the remaining growers (429). After 30 days an inspector from the Enforcement Bureau within PCP scheduled a visit to the growers. A total of 160 Administrative Orders were issued by the Department for failure to complete and return the survey. Overall a total of 2957 replies were obtained. In some cases the applicator was deceased, no longer farming, or more than one certified applicator was associated with a farming operation. As a result the final data from the survey is based on 1721 separate farming operations.

PCP enforcement personnel conducted follow up investigation by making phone calls or visiting and inspecting farms in order to evaluate the accuracy of the data that was reported. Approximately 15 percent of the private applicators were visited in this quality assurance check. These inspections included reviews of farm application records, records of purchases, and

farm storage checks.

A data base was designed using D-Base III Plus (Aston Tate). Entry data included the applicator's identification number, the municipality farmed, the crop type, the formulation(s) used on that crop type, the total amount of formulation used, the method used to apply the formulation, and the number of acres treated. Sub-routines in the database identified the active ingredient(s) in the formulation(s) and calculated the number of lbs of active ingredients used. Upon receipt, the forms were logged in, checked, and entered into the database. The database entries were verified in a final quality assurance check.

RESULTS AND DISCUSSION

The survey of private pesticide applicators in New Jersey resulted in a database containing pesticide use information for the year 1985 from 1721 farming operations located in 243 of the State's 567 municipalities. This represents approximate 75 per cent of the farming operations in the state. Some smaller growers who do not use restricted-use pesticides such as those producing christmas trees, pleasure horses, wood lots, and other similar low input agricultural operations would be missed by this survey.

Figure 2 depicts the amount of pesticides used by the crop type. Tree fruits, field crops, and vegetables account for the majority of the pesticides used in New Jersey. The totals for each crop type are in general agreement with figures on pesticide recommendations for New Jersey agriculture (Hopfinger, 1985, Justin, 1985, Robson and Johnson, 1985). The survey design did not permit a direct comparison of total acres treated to reported crop production, since multiple applications of herbicides, fungicides and insecticides are carried out on the same crop acreage for the entire growing season. Future surveys will include a separate entry for the total acreage of each crop type.

For the year 1985 a total of 1,579,284 lbs of 176 active pesticidal ingredients was reported via the survey instrument. The breakdown by pesticide type is shown in Table 1. In New Jersey fungicides were the most widely used pesticide group, with elemental sulfur accounting for 55 percent of the amount reported. Herbicides and insecticides were the second and third most important pesticide groups. National pesticide use data based upon sales figures is available for 1984 (Aspelin and Ballard, 1984). A comparison of New Jersey use patterns with national use patterns is depicted in Figure 3. Nationally herbicides account for 61 percent of the pesticides used, while in New Jersey they account for 31 percent: insecticides account for 25 percent nationally, and 26 percent in New Jersey: and fungicides (other than elemental sulfur) account for 7 percent nationally, and 18 percent in New Jersey. These differences are due to the importance of fruits and vegetable crops in New Jersey

agriculture.

The major herbicides used in New Jersey agriculture in 1985 are listed in Table 2. These 10 chemicals account for 83.2 percent of the herbicides applied by farmers. Alachlor, metolachlor, atrazine, butylate, linuron, and cyanazine are important corn and/or soybean herbicides. Chlorthal-methyl, a preemergent herbicide, is widely used on sod farms and on vegetable crops. Dinoseb was formerly used as a herbicide on potatoes and legumes, but is no longer registered by EPA. Paraquat is an important herbicide in no-till agriculture, while 2,4-D is used on grain crops.

Table 3 contains the most important insecticides used in New Jersey agriculture in 1985. These ten insecticides account for 77.2 percent of the insecticides used. The most widely applied insecticide was parathion. Except for carbofuran, all the insecticides are primarily used for multiple applications to fruit and vegetable crops. For example, tree fruits may receive as many as 17 cover sprays throughout the growing season, many of which will include insecticides. Carbofuran is a soil insecticide used on field and sweet corn, vegetables, tree fruits, and strawberries.

Fungicides are very important to New Jersey's agricultural industry, where they are primarily used on fruit and vegetable crops. A list of the most widely used fungicides is compiled in Table 4. Sulfur is widely used in tree fruit production. It is primarily a fungicide, but also can function as an acaricide or as a plant nutrient. Elemental sulfur plus the remaining nine fungicides listed account for 94.7 percent of the fungicides used agriculturally in the State. The ethylene bisdithiocarbamate (EBDC) fungicides, mancozeb, maneb, zineb, were the most widely used organic fungicides. Unfortunately, the survey design did not allow us to compile separate information for these three pesticides, due to the respondents confusion about formulation names. This will be corrected in the upcoming survey by requiring the farmers to report the EPA registration number for each pesticide formulation reported.

One of the most important uses of this data is in planning environmental monitoring program. For example, atrazine is known to be a ground-water contaminant. Using the GIS system, the municipality level data on atrazine use can be overlain by information on the location of agricultural wells (Figure 4), in order to choose locations for ground-water sampling. This type of information combined with other data such as the location of aquifer outcrop areas, depth of wells, and well-construction characteristics was used in a ground-water survey conducted in New Jersey (Louis and Vowinkel, 1989).

Because the protection of drinking water is a major concern of NJDEP, pesticide use data is now being used to evaluate areas where non-point source runoff from agricultural areas might be

affecting surface water quality. Data from Ohio and Iowa (U.S. Environmental Protection Agency, 1984) indicate that runoff from agricultural land can lead to high concentrations of alachlor in surface water. Figure 5 shows the municipality level data for the herbicide alachlor, overlain by the locations of the surface water intakes. This type of information is currently being used to evaluate the impact of pesticide runoff on water quality in various drainage basins and sub-basins in New Jersey.

NJDEP is also using this data for other initiatives such as a study on the impact of long-term exposure of farmers to organophosphorus insecticides (Fenske, et al., 1989) and monitoring surveys of pesticide residues in fresh fruits and vegetables grown or purchased in New Jersey (Mattern, et al., 1989).

The PCP has also found this data beneficial in carrying out its regulatory functions. Use patterns on various crops have allowed New Jersey to tailor its pesticide regulations to the needs of the State. Information on alachlor use in New Jersey was an important part of New Jersey's decision to classify alachlor as a restricted-use pesticide in 1986, two years before EPA's restrictions. The new EPA initiative requiring states to develop ground-water protection strategies will also require data on pesticide use patterns. Information obtained from this and future use surveys will be important parts of New Jersey's approach to the protection of ground water. New Jersey is also required by EPA to develop a program to protect endangered species. Databases for particular species can be overlain on the use maps to target areas were the use of certain pesticides can threaten a particular animal or plant population. Finally, the PCP is responsible for the review and approval of Special Local Needs Labels and Specific Exemptions under Sections 18 and 24 of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act). Information on pesticide use patterns as well as information on potential environmental impacts are required prior to approval of these special labels.

CONCLUSIONS

In 1985 agricultural use of pesticides was estimated at 1,579,284 lbs of active pesticial ingredients, based on the results of the survey conducted by the PCP in NJDEP. Pesticides used on tree fruit, field crops and vegetables accounted for the majority of the agricultural use of pesticides.

The most widely used pesticides were elemental sulfur, the ethylene bisdithiourea fungicides, and alachlor. The distribution by pesticide type are 30.7 percent herbicides, 26.2 percent insecticides and 18.2 percent fungicides other than elemental sulfur. Because information on pesticide use patterns was gathered on a municipal level, maps of the data can be generated using a GIS system. Use of these maps in conjunction

with other environmental data has allowed New Jersey to develop monitoring and regulatory programs tailored to the specific needs of the state.

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Table 1. Types of Pesticides used in New Jersey Agriculture.

Pesticide Type	Number of active ingredients reported[1]	Number of lbs active ingredients used in 1985
Fungicides	35	651,080
Elemental Sulfur		363,644
Others		287,436
Herbicides	56	484,005
Insecticides	64	414,456
Fumigants	4	10,658
Growth Regulators	6	1,796
Other	11	17,289
Total	176	1,579,284

[1] Amount used was over 1 lb a. i.

Table 2. Important Herbicides used in New Jersey Agriculture in 1985

Herbicide	Lbs of active ingredient
Alachlor	91,515
Metolachlor	74,831
Atrazine	61,954
Butylate	58,893
Linuron	43,883
Cyanazine	25,080
Chlorothal-Methyl	15,688
Dinoseb	11,855
Paraquat	9,533
2,4-D	9,450

Table 3. Important Insecticides used in New Jersey Agriculture in 1985

Insecticide	Lbs of Active Ingredient
Parathion	51,445
Oil	48,376
Methomyl	45,135
Endosulfan	40,746
Carbofuran	33,770
Azinphos-Methyl	32,751
Carbaryl	22,606
Oxamyl	20,783
BT	13,621
Acephate	10,500

Table 4. Important Fungicides used in New Jersey Agriculture in 1985

Fungicide	Lbs of Active Ingredient
Sulfur	363,644
Mancozeb, Maneb, Zineb[1]	92,641
Captan	62,071
Captafol	25,216
Chlorthalonil	24,242
Ferbam	23,427
Metiram	17,837
Metalaxyl	7,419

[1] The survey was unable to differentiate between mancozeb, maneb, and zineb.

Figure 1. The New Jersey Pesticide Use Survey Form for 1985

FORM — P1
5/86

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF PESTICIDE CONTROL
1985 PESTICIDE USE SURVEY

Received _____
Reviewed _____
Computer _____
Misc. _____

YOUR MUNICIPALITY _____

NOTE: THESE ARE ESTIMATES FOR 1985 PESTICIDE USE

PESTICIDE NAME TRADE/COMMON	FORMULATION	AMT APPLIED PER SEASON	ACRES	* CROP CODE	** APPLIC. CODE
(Example) SEVIN	50 WP	400 lbs.	200	2	2

For Office Use

** **APPLICATION CODES**
1 = AIR
2 = GROUND

* **CROP CODES**
1 = TREE FRUIT
2 = SMALL FRUIT
3 = VEGETABLE
4 = FIELD CROP
5 = NURSERY
6 = GREENHOUSE
7 = SOD
8 = LIVESTOCK/POULTRY
9 = MISCELLANEOUS

PESTICIDE NAME TRADE/COMMON	FORMULATION	AMT APPLIED PER SEASON	ACRES	* CROP CODE	** APPLIC. CODE

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3 = VEGETABLE	7 = SOD
4 = FIELD CROP	8 = LIVESTOCK/POULTRY
	9 = MISCELLANEOUS

Figure 2. Total amount of active pesticidal ingredients applied to the different crop types

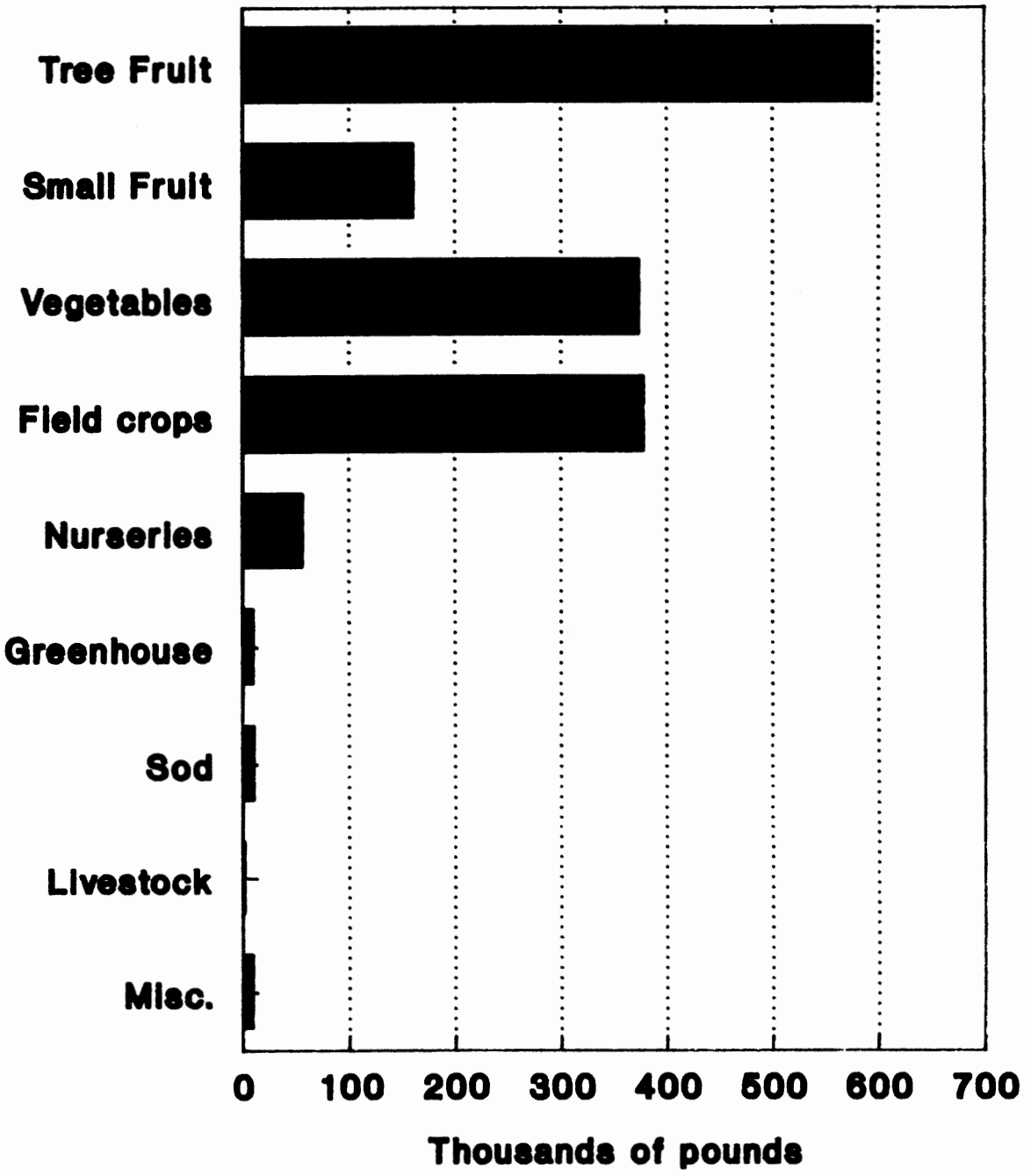

Tree Fruit
Small Fruit
Vegetables
Field crops
Nurseries
Greenhouse
Sod
Livestock
Misc.
0
100
200
300
400
500
600
700
Thousands of pounds

Figure 3. A comparison of pesticide use patterns in New Jersey and the U.S.

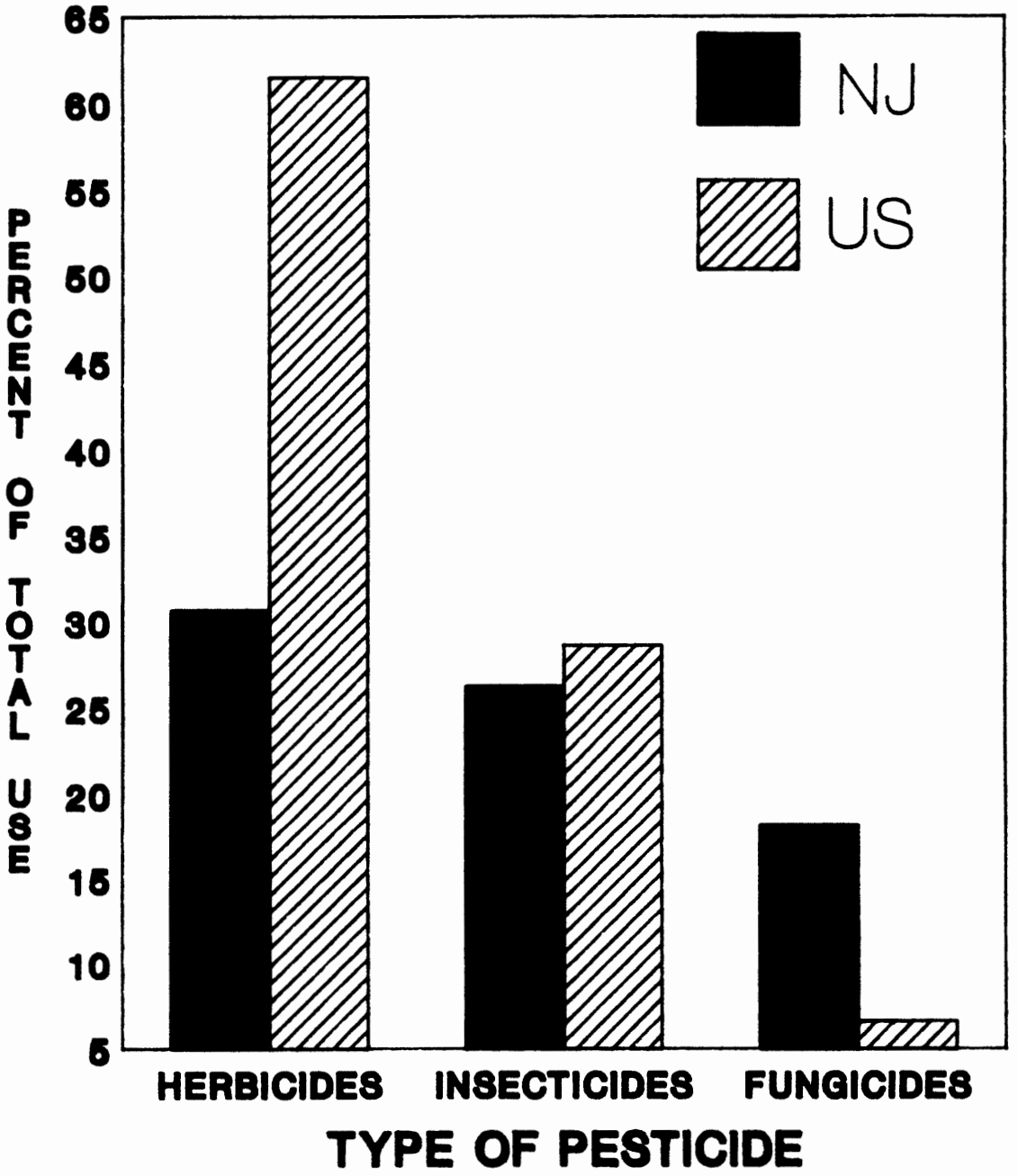

65
60
55
50
45
40
35
30
25
20
15
10
5
PERCENT OF TOTAL USE
NJ
US
HERBICIDES
INSECTICIDES
FUNGICIDES
TYPE OF PESTICIDE

Figure 4. Atrazine use patterns compared to the location of several agricultural wells

ALACHLOR

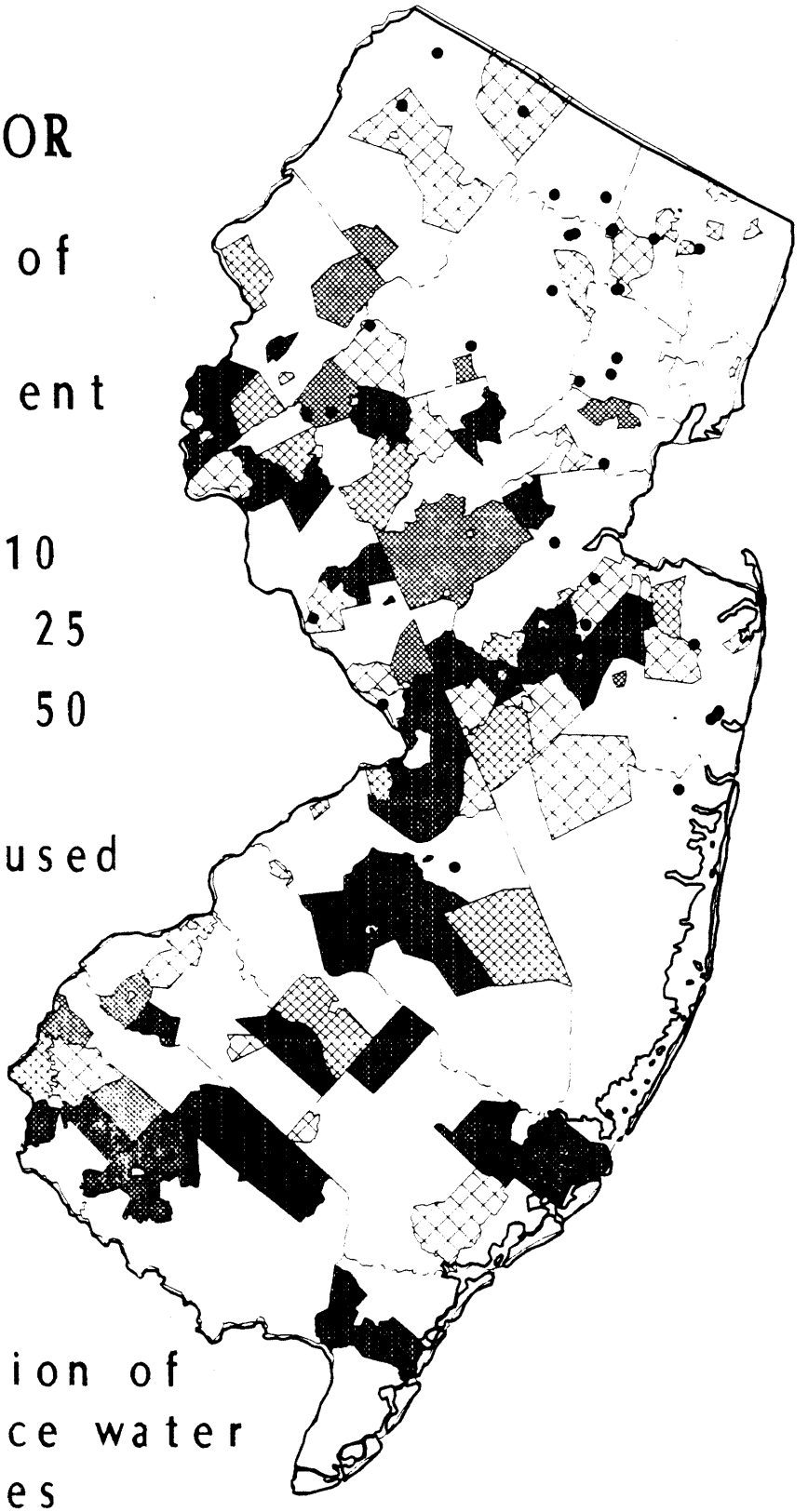
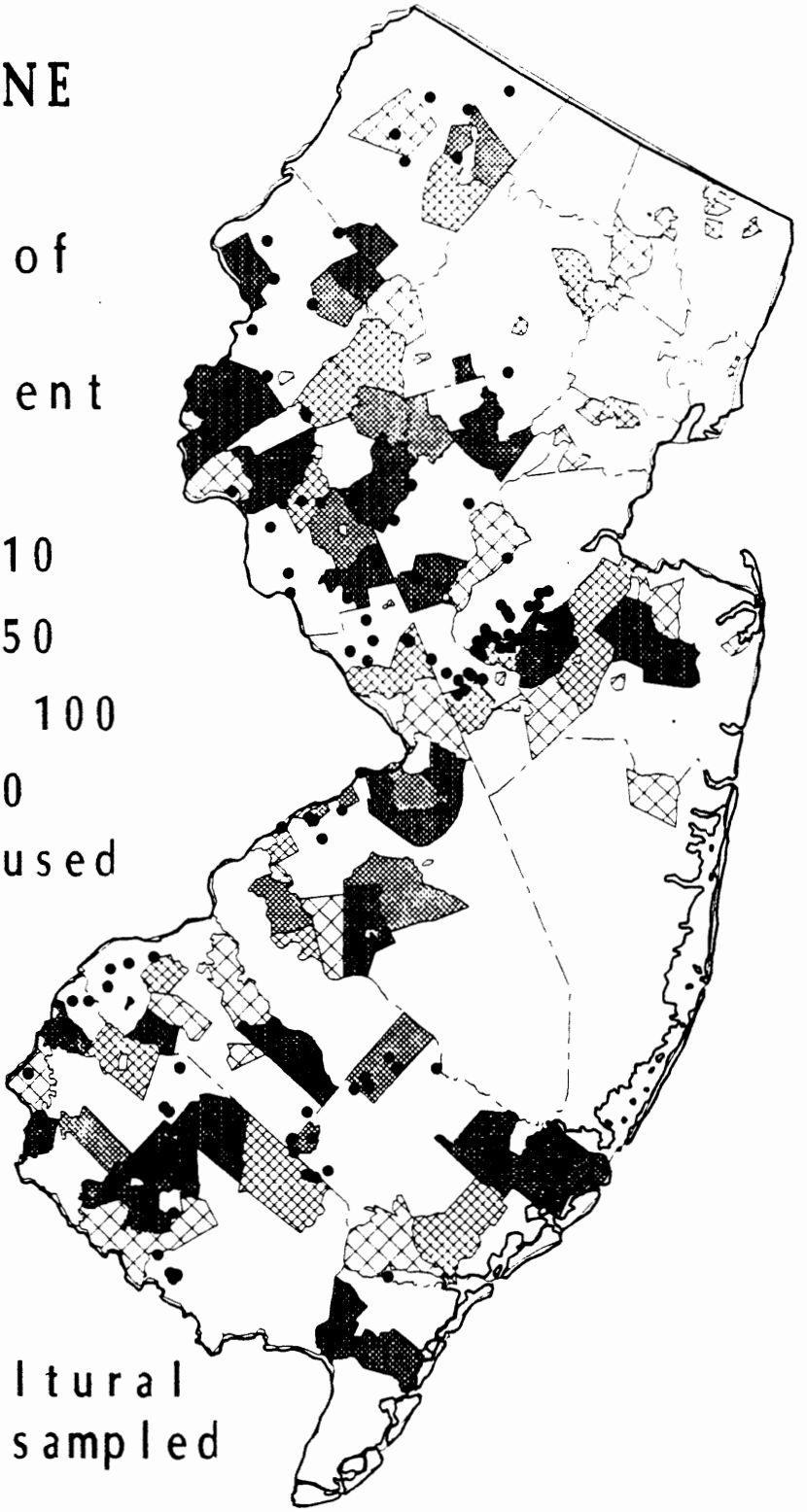

Amount of Active Ingredient (lbs)
1 - 10
10 - 25
25 - 50
› 50
Not used
Location of surface water intakes

Figure 5. Alachlor use patterns compared to the location of potable water intakes

ATRAZINE


Amount of Active Ingredient (lbs)
1 - 10
10 - 50
50 - 100
› 100
Not used
Agricultural wells sampled from 1986 to 1988