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THE FARM DEMAND FOR PESTICIDES IN MINNESOTA

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Crop losses due to pests, coupled with shortages in farm labor and high operating costs, have led to increased use of pesticides (herbicides and insecticides) during the last 30 years. Many new products have been developed to apply before the crops emerge from the soil. In recent years farmers have spent more on pre-emergence pesticides for preventive purposes and relatively less on post-emergence pesticides.

The increased use of agricultural chemicals may cause side effects such as direct hazards to human and animal health, toxicity, possible death of fish and wildlife, toxic residues in raw farm products and in food, and various forms of environmental pollution. Agricultural chemical use has attracted much public attention. The intelligent use of pesticides is a concern not only to farmers but also the public.

Results of a recently conducted survey of pesticide use by Minnesota corn producers are presented in this issue. Survey data make possible an analysis of the factors affecting the use of pesticides, including how farmers use of pesticides changes as pesticide prices change.

Pesticide Use in Minnesota

According to the latest data[1] released by the Minnesota Crop and Livestock Reporting Service, Minnesota farmers applied herbicides or insecticides to almost 73 percent of their 1977 corn, soybeans, small grains, flax, hay, and sunflowers acres. Almost 94 percent of the soybean acreage received at least one application of either or both herbicides and insecticides. Some 93 percent of the corn acreage received at least one pesticide application that year.

Herbicides for weed control were the dominant type of pesticide applied to the crops, accounting for 86 percent of the total acreage treated (table 1). The remaining planted acreage was treated for insects. Most of those herbicides were applied to corn. Of the total acreage 44.8 percent was treated for weeds. There was 78.4 percent of the corn acreage treated with insecticides. Table 1 shows pesticide use on other crops.

Herbicide Use by County

It was anticipated that farmers in the dominant corn-growing areas buy and use the most pesticides. This is true of herbicides. Figure 1a shows the total amount sold in the state. South central and southwestern Minnesota counties such as Martin, Blue Earth, Rock, Watonwan, Brown, Renville, Cottonwood, Lyon, and Chippewa were heavy users compared with other

Table 1. Acreage harvested, minimum acreage treated by crop, and acreage treated by type of control, Minnesota, 1977

Crop	Acreage harvested (1,000 acres)	Minimum acreage treated[1] 1,000 acres	Minimum acreage treated[1] Percent[2]
Corn[3]	6,860	6,383	93.0
Soybeans	3,810	3,568	93.6
Small grains[4]	6,821	5,009	73.4
Hay, all	3,140	34	1.1
Flaxseed	220	156	70.9
Sunflowers	518	382	73.7
Sweet corn for processing	120	113	94.2
Green peas for processing	65.6	58	88.4
TOTAL	21,554.6	15,703	72.9

	Total acreage treated for[5] Weeds (1,000 acres)	Insects (1,000 acres)
Corn:		
Pre-emergence	5,151	2,246
Post-emergence	3,517	72
Total	8,668	2,318
Soybeans	4,405	36
Small grains	5,497	84
Hay, all	15	24
Flaxseed	156	1
Sunflowers	413	85
Sweet corn for processing:		
Pre-emergence	98	34
Post-emergence	26	325
Total	124	359
Green peas for processing	64	51
TOTAL	19,342	2,958

[1]At least this amount of acreage was treated with herbicides, insecticides, or both.
[2]Treated acreage as percent of harvested acreage for year.
[3]Acreage harvested for all purposes.
[4]All wheat, oats, barley, and rye.
[5]Includes multiple applications. Acreage treated more than once is counted for each application.

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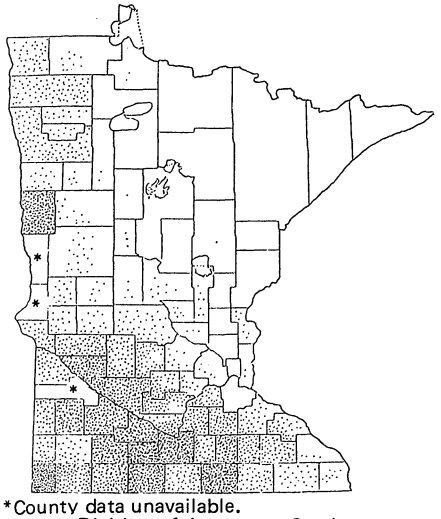
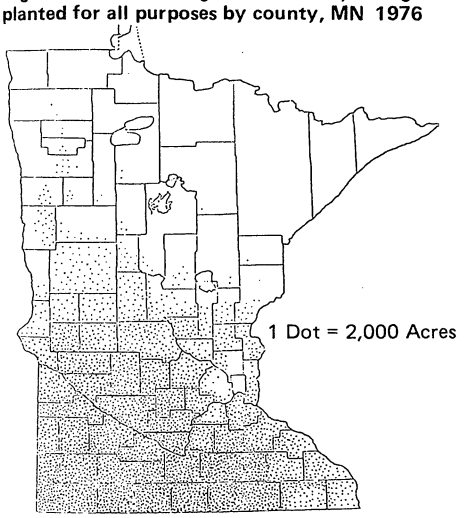
[1]*General Farm Use of Minnesota Pesticides: 1977,* November 1978.

Figure 1a. Quantity of herbicides sold in Minnesota, reported by county agricultural inspectors, 1976



*County data unavailable.
Source: Division of Agronomy Services, Department of Agriculture, State of Minnesota, March 1977

Figure 1b. Corn acreage distribution, acreage planted for all purposes by county, MN 1976



Source: *Minnesota Agricultural Statistics—1977,* Minnesota Crop and Livestock Reporting Service cooperating with Minnesota Department of Agriculture, May 1977.

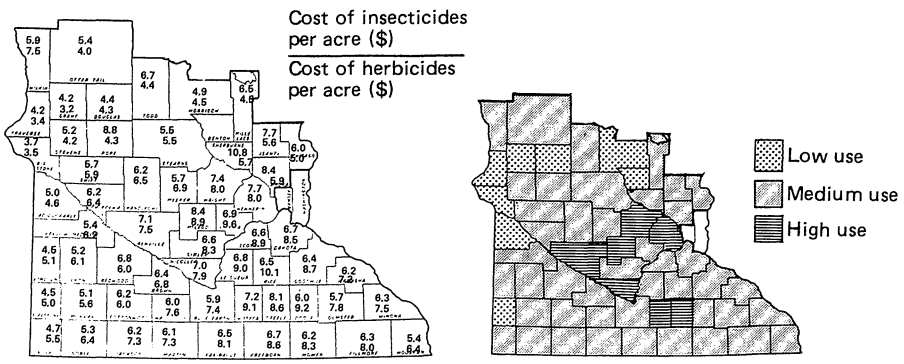
counties.[2] Herbicide purchases coincided with concentrations of corn acreage (figure 1b). No herbicides were reported sold in northeastern Minnesota where little corn is grown. Small amounts of herbicides were sold in both the northwestern and north central regions where there is only modest corn acreage.

Expenditures on Pesticides per Acre

Actual use of pesticides "per acre" may alert environmentalists and farmers alike. Toxicity results from a high per acre use of chemicals. Pesticide use per acre may also provide other information about pest resistance, price and quantities used, or differences in other demand factors for pesticides by crop or area. Figure 2 shows both expenditures on insecticides as well as herbicides used on crops by southern Minnesota farmers with 1974 sales of $2,500 or more. High use counties include McLeod, Waseca, Steele, Hennepin, Nicollet, Renville, and Wright. Low use counties include Big Stone, Grant, Traverse, Douglas, Benton, Morrison, Pipestone, and Lac Qui Parle.

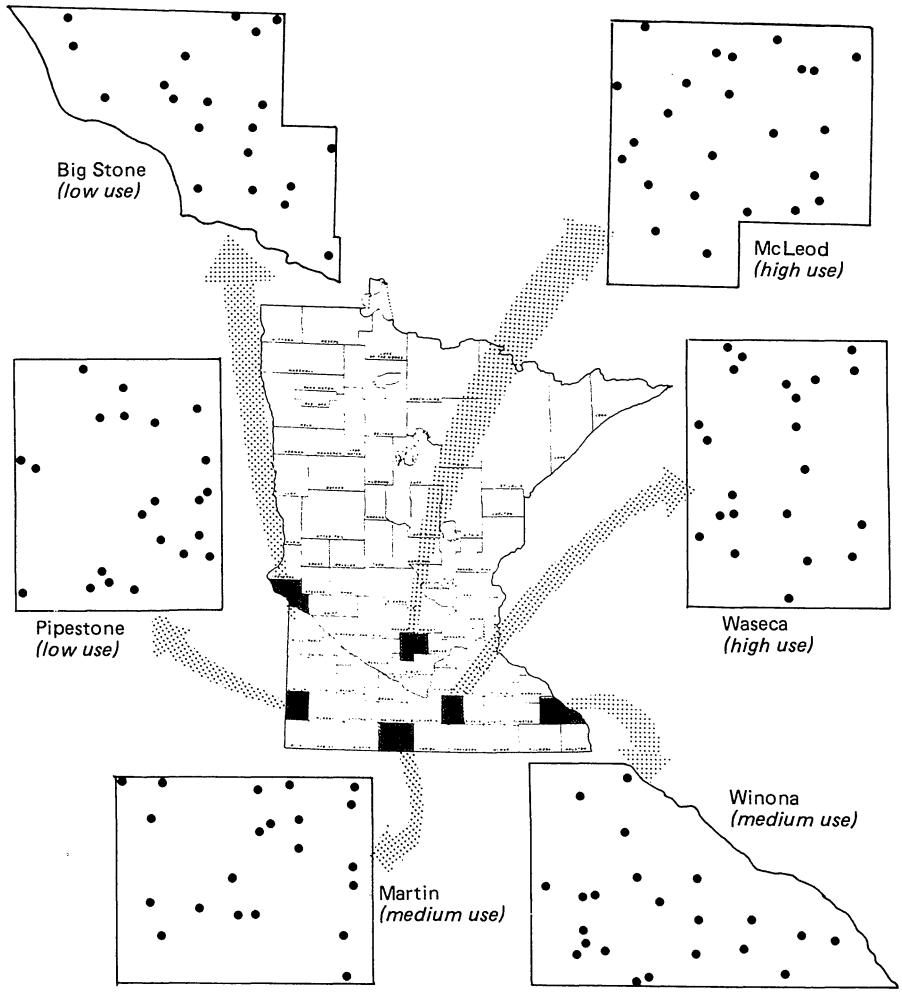
Looking at these expenditure patterns, environmentalists might ask

Figure 2. Cost of insecticides and herbicides used on crops per acre, selected Minnesota counties, 1974*



*Farms with sales of $2,500 and over in 1974; based on *Census of Agriculture,* U.S.Department of Commerce, Bureau of the Census, Minnesota:County Data, Vol. 1, Part 23.

Figure 3. Counties selected and sample farmers interviewed, Minnesota



[2]Clay County was the exception with unusually heavy sales reported.

whether more side effects from pesticides would be reported in counties of heavy usage. And are farmers in counties of heavy per acre applications aware of proper pesticide usage? Do they consider the economic impact pesticides have on their incomes? These and other questions were raised in a recent survey of pesticide usage among selected Minnesota corn producers.

Farm Survey of Pesticides

In February 1978, a survey of 130 randomly selected farms was conducted in six important corn-growing counties: Big Stone, Martin, McLeod, Pipestone, Waseca, and Winona (figure 3). Major descriptive features of those sampled include:

The average size of farmland owned and leased by farmers was 382 acres, of which 36.2 percent (138 acres) was in corn.

The average age of the farm operators was 49. About one-tenth of the producers were under age 35; another one-tenth were over 65. The farm operators averaged more than 26 years of farming experience.

The average education for the farmers was 11 years. More than 54 percent had high school or more education, and about 3 percent were college graduates.

More than 83 percent had attended at least one meeting regarding pesticide use in the prior 3 years. Although those farmers who attended meetings participated approximately twice per year, farmers living in counties where pesticides were heavily used attended more frequently than did farmers in counties of less use.

The 130 farms surveyed used 57,573 pounds of active-ingredient herbicides and insecticides on 44,491 acres in 1977. The farmers applied pesticides at an average rate of 1.29 pounds per acre per application. They used 3.2 pounds of pesticide per acre of corn.

About 88 percent of the total pesticides used on corn were herbicides; 12 percent were insecticides.

Eighty-four percent of the total herbicides used on corn was applied pre-emergence for preventive purposes.

The leading herbicide used was alachlor: about 41 percent of the total herbicides used on corn.

Most of the insecticides were applied before crop emergence. The leading insecticide was terbufos, accounting for 30 percent of the total insecticide use on corn.

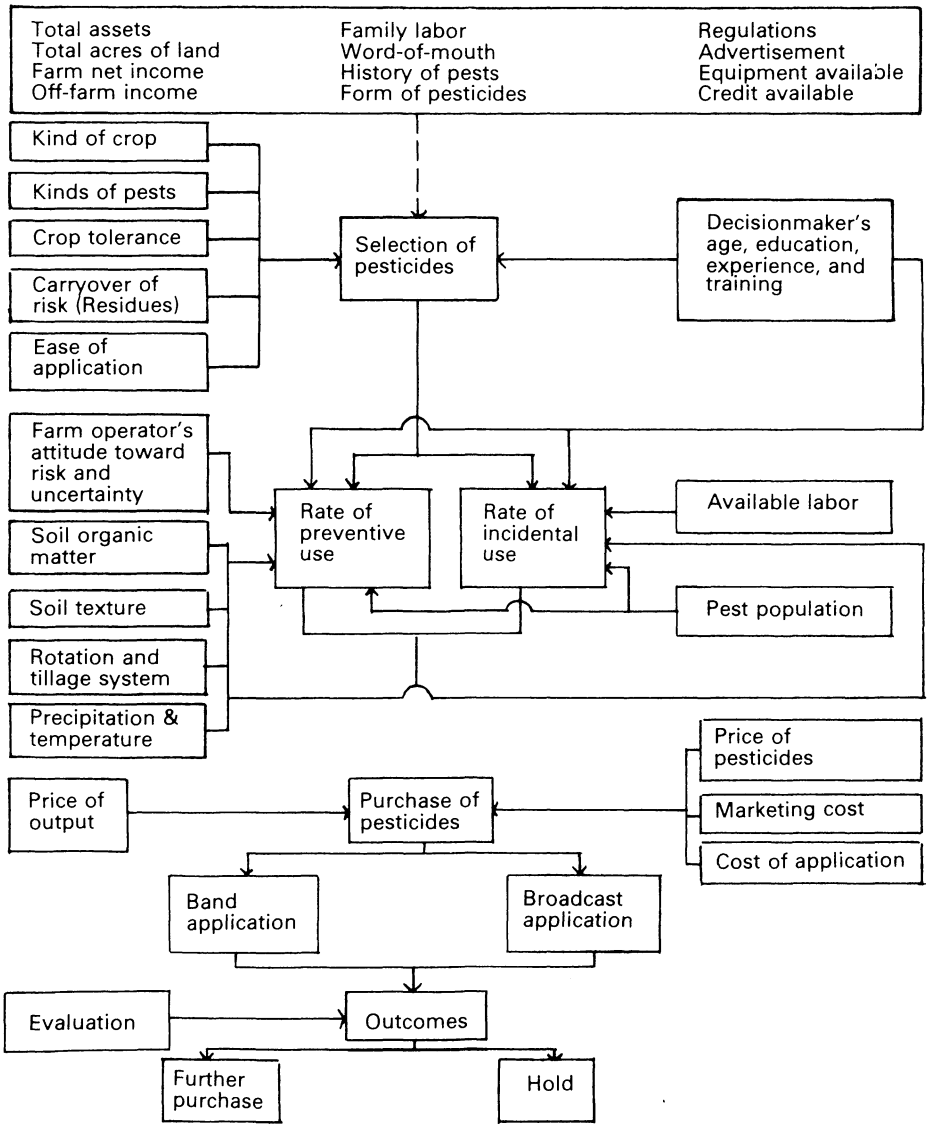
Farmers themselves applied more than 94 percent and 86 percent of the selected herbicides for pre-emergence and post-emergence use, respectively, and the other 6 percent and 14 percent, respectively, were custom applied by dealers selling herbicides.

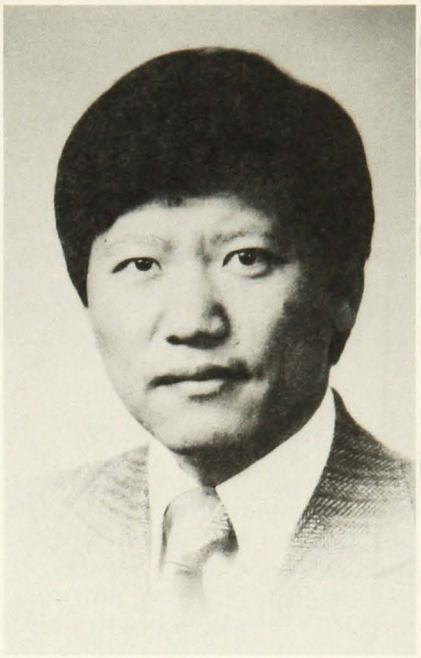
Most of the farmers indicated no adverse effects of pesticides. However, for those using atrazine, 13 percent indicated that atrazine damaged the next crop planted on the same land. For those using dicamba, 7 percent indicated that dicamba damaged neighboring crops. Finally, a few farmers indicated some adverse effects of 2,4-D, fonfos, and alachlor.

Factors Affecting the Use of Pesticides

To determine the important factors that affect the quantity of pesticides used on crops (by farmers), a farm operator's decisionmaking process for the purchasing of pesticides was developed (figure 4).

Figure 4. Farm operator's decisionmaking process for chemical pest control





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Based on this model, 20 factors were selected for statistical testing.

Many factors that possibly affect pesticide use did not show up as important influences. The statistical results indicated that the following factors, in order of importance, appear to be the most influential in these corn producers' use of pesticides:

1. acres treated (or acres of corn)
2. prices of pesticides
3. farm operator's attitude toward risk and uncertainty (measured by insurance premium paid for crop and farm liability insurance per acre of farmland)
4. pest population
5. 1978 repeat corn in the same land planted for corn
6. attendance at pesticide meetings provided by manufacturers or dealers
7. education of farmers
8. distance from farm to place of pesticide purchase
9. age of farm operator
10. expected price of corn
11. soil type

One discovery was that older farm operators with more education used less pesticides per acre of corn.

Price of pesticides was particularly important in purchasing decisions. Farmers do react significantly to the price of pesticides although expenditures for these chemicals are small compared with total production cost (2.7 percent in 1976). The survey showed that the price of pesticides, second to crop acreage, is the most important decisionmaking factor affecting the quantity of pesticides used.

Price Responsiveness

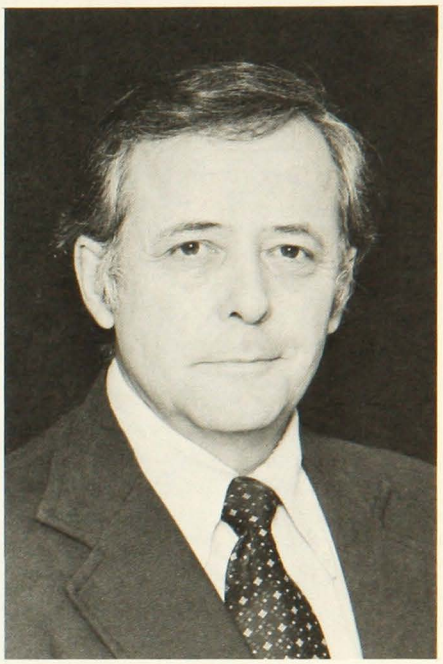
The quantity of pesticides used by farmers, as indicated in figure 4, depends on many factors. One of the key questions in the statistical analysis was whether farmers respond differently to prices in purchases of pre-emergence pesticides (for *preventive* purposes) than in their purchases of post-emergence (for dealing with *incidences* of pest infestation). In pre-emergence pesticide purchases, farmers might find substitutes if prices were high. But after crops were planted and growing, purchases of necessary post-emergence pesticides would probably be made even if prices were very high.

A similar question can be raised regarding specific pesticide products. If one of several pesticides is equally effective in controlling an infestation, farmers might switch from a higher-priced to a lower-priced pesticide. But if only one type of pesticide control is effective, a farmer would likely purchase the quantities needed even at higher prices.

To seek answers to these questions, the quantities of pesticides purchased by the farmers surveyed were statistically related to the "adjusted price" paid for them.[3]

The first statistical relationship tested was between *all* pesticides and an index of adjusted prices for each farmer in the survey. The statistical results showed that farmers *decreased* their purchases of all pesticides by *1.46* percent for every *1* percent *increase* in the adjusted price index. This suggests that the

[3]The 'adjusted price' equals the price paid for pesticides plus application costs (depreciation cost of sprayer and/or attachments, interest cost, insurance and housing cost, repair cost, fuel cost, and wages).



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farmers surveyed were quite responsive to price in terms of overall pesticide purchases.

Dividing the pesticides purchased into pre-emergence and post-emergence categories, farmer responsiveness to price changes differs. The farmers surveyed purchased *1.55* percent *less* pre-emergence pesticides for every *1* percent *increase* in the adjusted price of this type of pesticide. This means that the farmers were quite responsive to price changes in pre-emergence pesticides.

In contrast, the farmers exhibited less responsiveness to price changes in post-emergence pesticides. For a *1* percent *increase* in adjusted price, the quantity of post-emergence pesticides purchased *declined* by about *1* percent.

These statistical results, coupled with those regarding the pre-emergence pesticide category, tend to support the belief that there exist two *types* of pesticide purchasing behaviors (two different "demands"). The first type is the purchasing of pesticides for *preventive* purposes before the crop begins to emerge from the ground. In this situation, farmers may consider more alternatives to pesticide use (including not using any) if the price of these chemicals gets too high. The second type of purchasing, for use when a pest problem occurs, farm-

ers may not have given consideration to as many alternatives to pesticide use.

The statistical price-quantity relationships tested for individual pesticide products provided responsiveness results ranging from 0.44 to *1.84* percent purchase *decrease* in relation to *1* percent *increases* in price. It was found that the lower percentages (0.44) were obtained for pesticides that were post-emergence type and which were uniquely suited for particular pest control problems. Higher responsiveness percentages (1.84) were estimated for pre-emergence pesticides that could effectively control potential pest problems.

Conclusion

The survey results of selected Minnesota corn producers do *not* explain certain nationally observed trends in pesticide usage. Corn acres treated, pre-emergence, with herbicides rose from 11 percent in 1952 to 90 percent in 1976.[4] The use of insecticides (post-emergence) has also increased in terms of acres treated (from 1 percent to 38 percent), but not to the proportions recorded for herbicides.[5] While national pesticide prices are not regularly published, some current information suggests that herbicide prices have not increased as rapidly as insecticide prices.

While many factors may be responsible for an increased importance of pre-emergence pesticides in farmer production decisions, the apparent greater numbers of these alternative pesticides from which to choose is significant. To the extent that farmers can justify preventive pesticide purchases during production planning, it is reasonable to expect more future use of pre-emergence pesticide. And if this preventive use is effective, it is reasonable to expect a decline in the use of post-emergence chemicals that are directed at the control of similar insect and disease problems.

[4]Eichers, Andrilenes, and Anderson, *Farmers Use of Pesticides in 1976,* Agricultural Economic Report No. 418, ESCS-USDA, Washington, D. C., p. 8.
[5]Ibid., p. 14.

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