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R. J. Walstrom

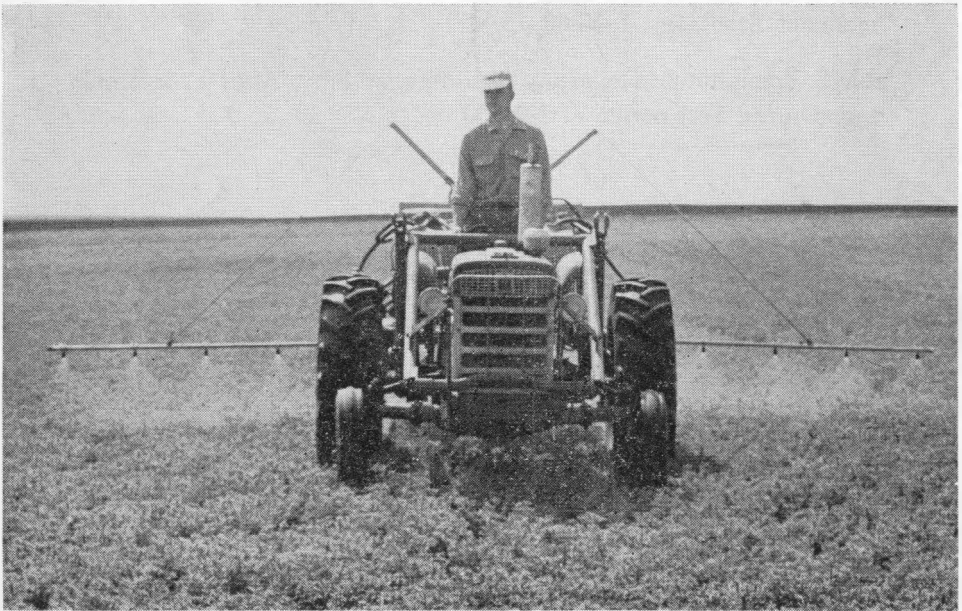
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Insecticides Increase Alfalfa Seed Production in South Dakota



ENTOMOLOGY-ZOOLOGY DEPARTMENT
AGRICULTURAL EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE, BROOKINGS

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Insecticides Increase Alfalfa Seed Production in South Dakota

By R. J. WALSTROM¹

Insecticide treatments increase alfalfa seed production. Since South Dakota ranks among the top states in acres of alfalfa harvested for seed, proper selection and application of insecticides is of considerable economic importance.

This publication reports results of tests conducted in the state during a 5-year period to determine the most economical and effective ways to control insects that reduce alfalfa seed yields.

PROCEDURE

Fields. A field of Cossack alfalfa located 1 mile north of Brookings was selected for the tests conducted in 1956 through 1959. Plots of one-half acre were used for each of three replicates for each treatment.

In 1960, a field of Ranger alfalfa 1 mile west of Brookings was used for the tests. The size of each plot in this field was approximately four-tenths of an acre. Again there were three randomly distributed plots for each treatment.

In both fields the randomized complete block design was used in the plot arrangements. All tests were conducted on second crop alfalfa.

Treatments. All insecticides were applied as emulsion sprays at the rate of 10 gallons of spray material

per acre. Where only one application was made, the treatment was applied when the regrowth was 4 to 6 inches high. In the two-application tests the second spray was applied when the plants were in the bud stage.

A Century trailer-type sprayer with booms was used to apply the materials. Nineteen different insecticides, combinations of insecticides, or variations in number of applications were tested against no treatment conditions. See table 1 for a list of these treatments.

Insect populations were determined for each treatment twice each week by taking 10 sweeps with a standard 15-inch diameter net in each plot. These insect collections were shaken into paper bags, placed in cyanide chambers, and then checked for numbers and species of insects present.

Harvesting. Seed yields were determined by cutting 10 randomized yard-square samples from each plot. These samples were individually bagged and air dried. The dried samples were threshed by running them through a 6-inch hammermill and then through a small office-type seed cleaner. Further hand cleaning, when necessary, was utilized to obtain a clean seed sample. These samples were weighed to the nearest tenth of a gram. Yields in pounds per acre were calculated by multiplying the yield from a yard-square sam-

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Table 1. Average Alfalfa Seed Yields for Different Insecticide Treatments at Brookings, South Dakota, from 1956 to 1960

Insecticide	No. appli- cations	Lbs. actual Insecti- cide per A. for each application	Cost per A. of insecti- cides used (dollars)*	Av. seed yield in lbs.per A.†	Av. value over check per A. (dollars) ‡	Av. increase or decrease in profit per A. (dollars) §
DDT plus Toxaphene	2	1.00 1.50	4.02	56.13	5.01	0.99
DDT plus Toxaphene	2	2.00 2.00	6.77	61.15	6.06	-0.71
DDT plus Toxaphene	1	1.00 1.50	2.01	45.79	2.84	0.83
DDT plus Toxaphene	1	2.00 2.00	3.39	41.35	1.90	-1.49
DDT plus Aldrin	1	1.00 0.25	1.55	57.84	5.37	3.82
DDT plus Heptachlor	1	1.00 0.25	1.62	54.09	4.58	2.96
DDT plus Dieldrin	1	1.00 0.25	2.05	64.91	6.85	4.80
Lindane	1	0.25	2.49	59.74	6.18	3.69
DDT plus Chlordane	1	1.00 1.00	2.55	59.63	5.74	3.19
Aldrin	1	0.25	0.50	49.61	3.64	3.14
Heptachlor	1	0.25	0.57	44.11	2.48	1.91
Dieldrin	1	0.25	1.00	51.97	4.13	3.13
DDT plus Lindane	1	1.00 0.25	3.54	58.87	5.58	2.04
Chlordane	1	1.00	1.50	44.80	2.63	1.13
Malathion	1	1.00	2.50	47.26	3.14	0.64
Malathion plus Heptachlor	1	1.00 0.25	3.07	45.00	2.67	-0.40
Malathion plus Heptachlor	2	1.00 0.25	6.14	66.31	7.14	1.00
Methoxychlor plus Heptachlor	1	2.00 0.25	5.57	57.79	5.36	-0.21
Methoxychlor plus Heptachlor	2	2.00 0.25	11.14	62.51	6.35	-4.79
Check				32.29		

*Insecticide costs are based on 1960 retail prices.

†Clean seed yields are averaged for 1956-1960 tests.

‡Seed prices figured at 1960 average price received by farmers of \$21 per 100 pounds.

§Cost of application not included.

ple in grams by the conversion factor 10.67.

Pollination. To insure a basic degree of pollination in the fields, 20 colonies of honey bees were arranged in a line through the center of each field. These colonies plus other colonies within one quarter of a mile of the fields gave a honey bee population equivalent to one colony per acre on the test fields.

Weather and Soil Data. Weather recordings for precipitation and maximum and minimum temperatures for June, July, and August of each year were obtained from the Agronomy Department's weather station located 1 mile east of Brookings. In addition, temperature and humidity recordings were obtained from a station maintained in the test fields in 1958, 1959, and 1960.

Soil samples were tested for each field by the Soil Testing Laboratory in the Agronomy Department.

RESULTS

Injurious Insect Control. The major plant bug species of insects determined from sweeping the plots were *Lygus oblineatus* (Say) and *Adelphocoris lineolatus*

(Goeze). *Adelphocoris rapidus* (Say) occurred only in small numbers each year. Plant bug populations for the six highest seed yielding treatments in the 5-year test are shown in figures 1 through 6 as averages of the combined *Lygus* and *Adelphocoris* species.

Grasshoppers did not develop as highly injurious populations in the fields during the years the tests were conducted. Major species involved were *Melanoplus differentialis* (Thos.), *M. femurrubrum* (DeG.), *M. bilituratus* (Walk.), and *M. bivittatus* (Say).

The pea aphid, *Macrosiphum pisi* (Harris), occurred in damaging numbers only in the 1956 tests. Yearly comparisons of populations of this pest are not made in this publication.

Leafhoppers of several species were generally abundant. The effects of control measures on total leafhopper populations are compared to seed yields in figures 1 to 6. Major species of leafhoppers were determined as *Macrostelus fascifrons* (Stal), *Aceratagallia sanguinolenta* (Prov.), and *Empoasca fabae* (Harris). Injurious insects also noted in the test fields were

Table 2. Precipitation Departure from Normal Since April 1 for Brookings, South Dakota, During the Test Period of 1956-1960*

Year	1st week in June	1st week in July	1st week in August	1st week in September
1956	-0.8	-0.5	+3.6	+3.8
1957	+1.3	+2.1	+0.1	-0.2
1958	-2.2	-1.7	-1.9	-3.2
1959	+2.8	0.0	+1.5	+1.9
1960	+0.9	+2.2	+0.8	+4.8

*Data from USDA Agricultural Statistician, Sioux Falls, South Dakota, as recorded in *South Dakota Weekly Weather, Crop and Livestock Report* 1956 through 1960.

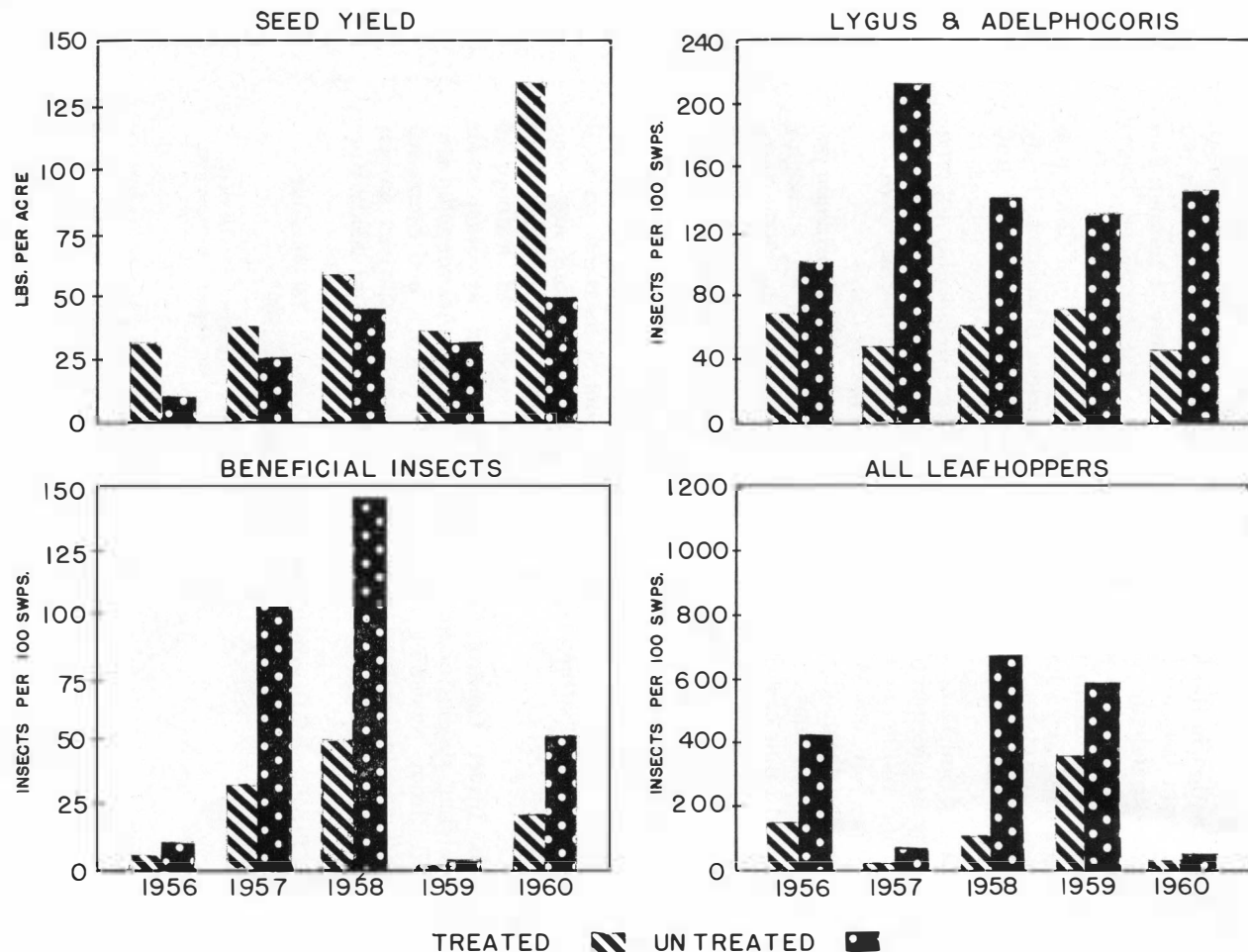


Figure 1. Alfalfa seed yields and seasonal averages of insect populations in plots treated with two applications of 2 pounds of DDT plus 2 pounds of toxaphene per acre compared with results from untreated plots. (Beneficial insects are totals of nabids and ladybird beetles.)

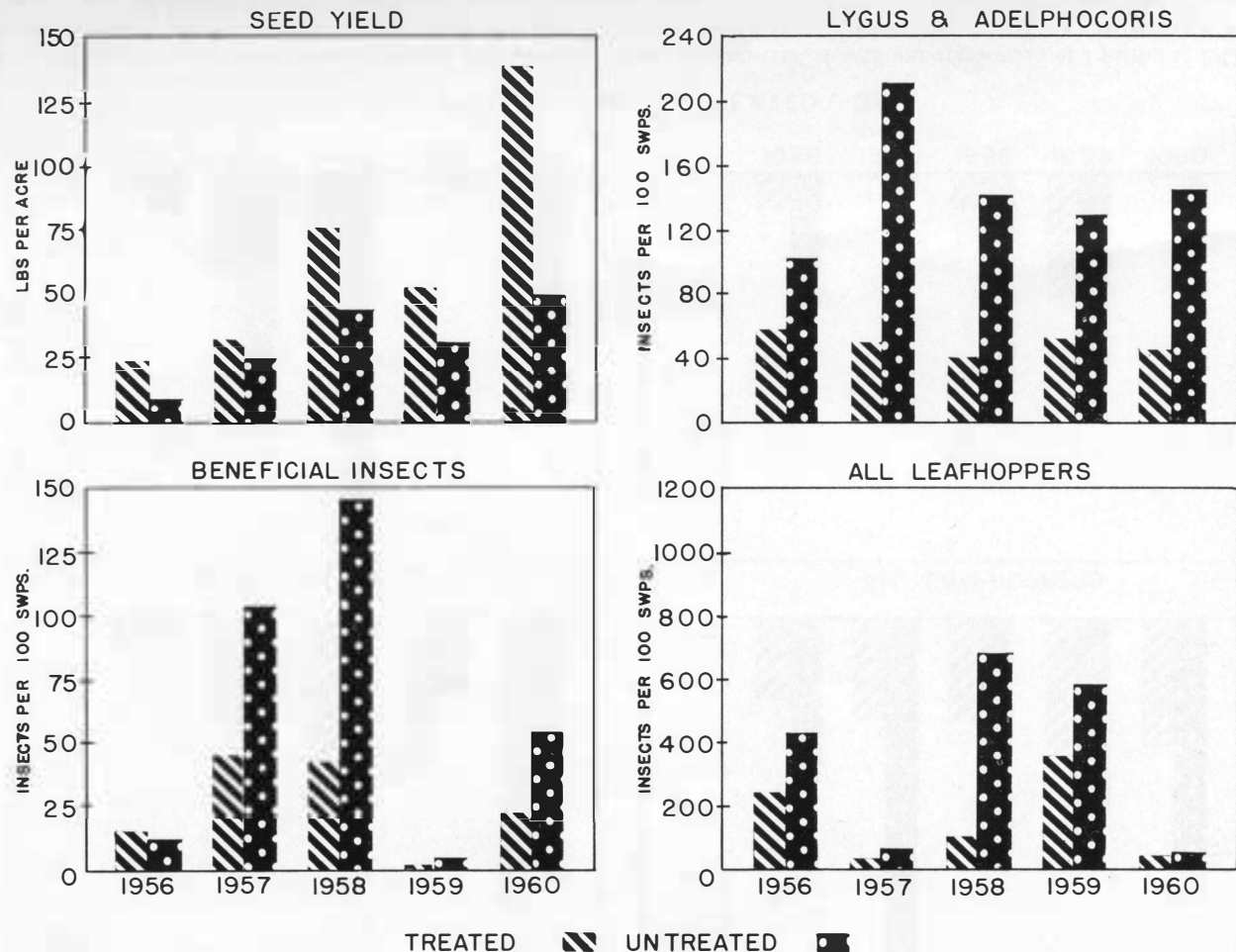


Figure 2. Alfalfa seed yields and seasonal averages of insect populations in plots treated with one prebloom application of 1 pound of DDT plus one-fourth pound of dieldrin per acre compared with results from untreated plots. (Beneficial insects are totals of nabids and ladybird beetles.)

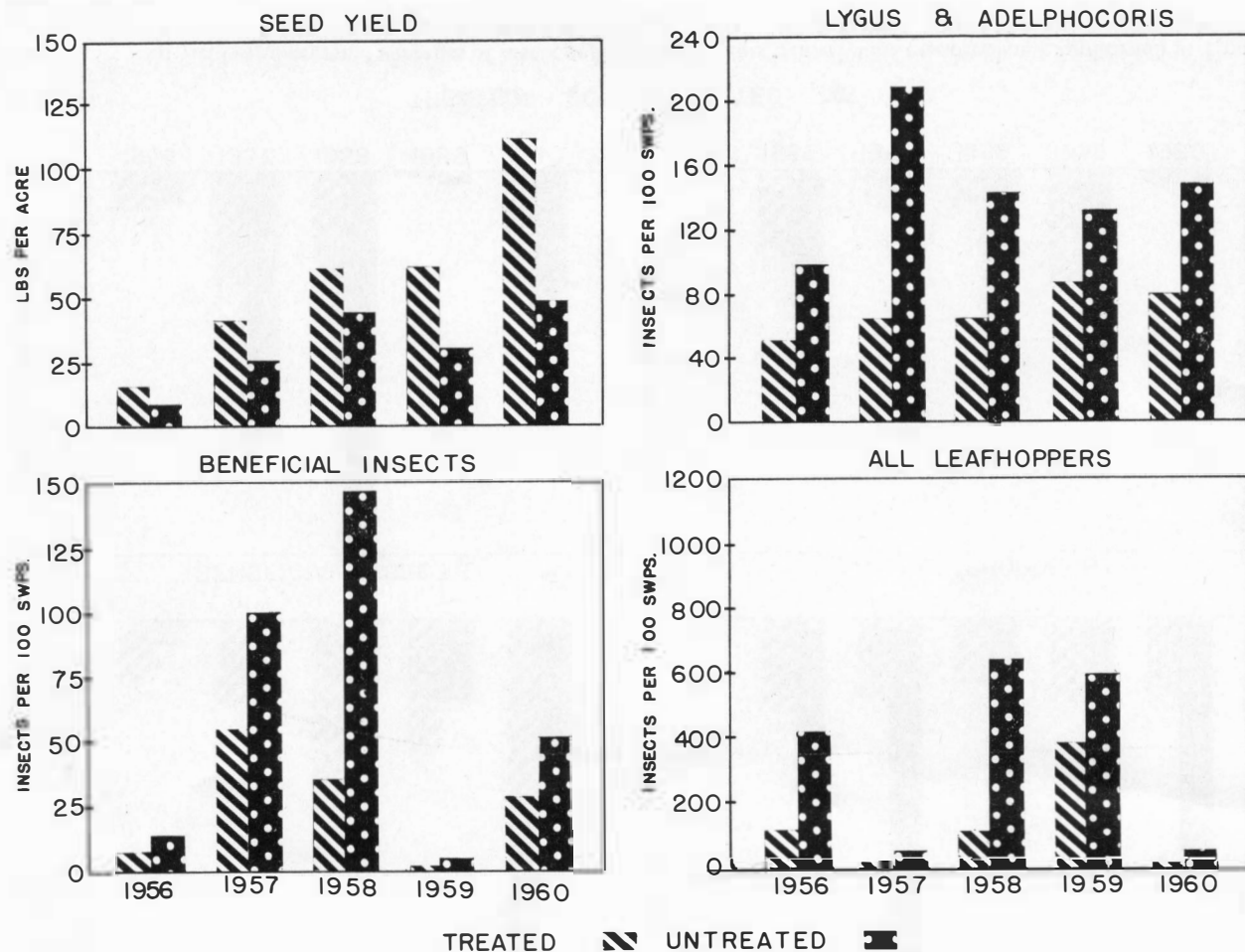


Figure 3. Alfalfa seed yields and seasonal averages of insect populations in plots treated with one application of 1 pound of DDT plus 1 pound of chlordane per acre compared with results of untreated plots. (Beneficial insects are totals of nabids and ladybird beetles.)

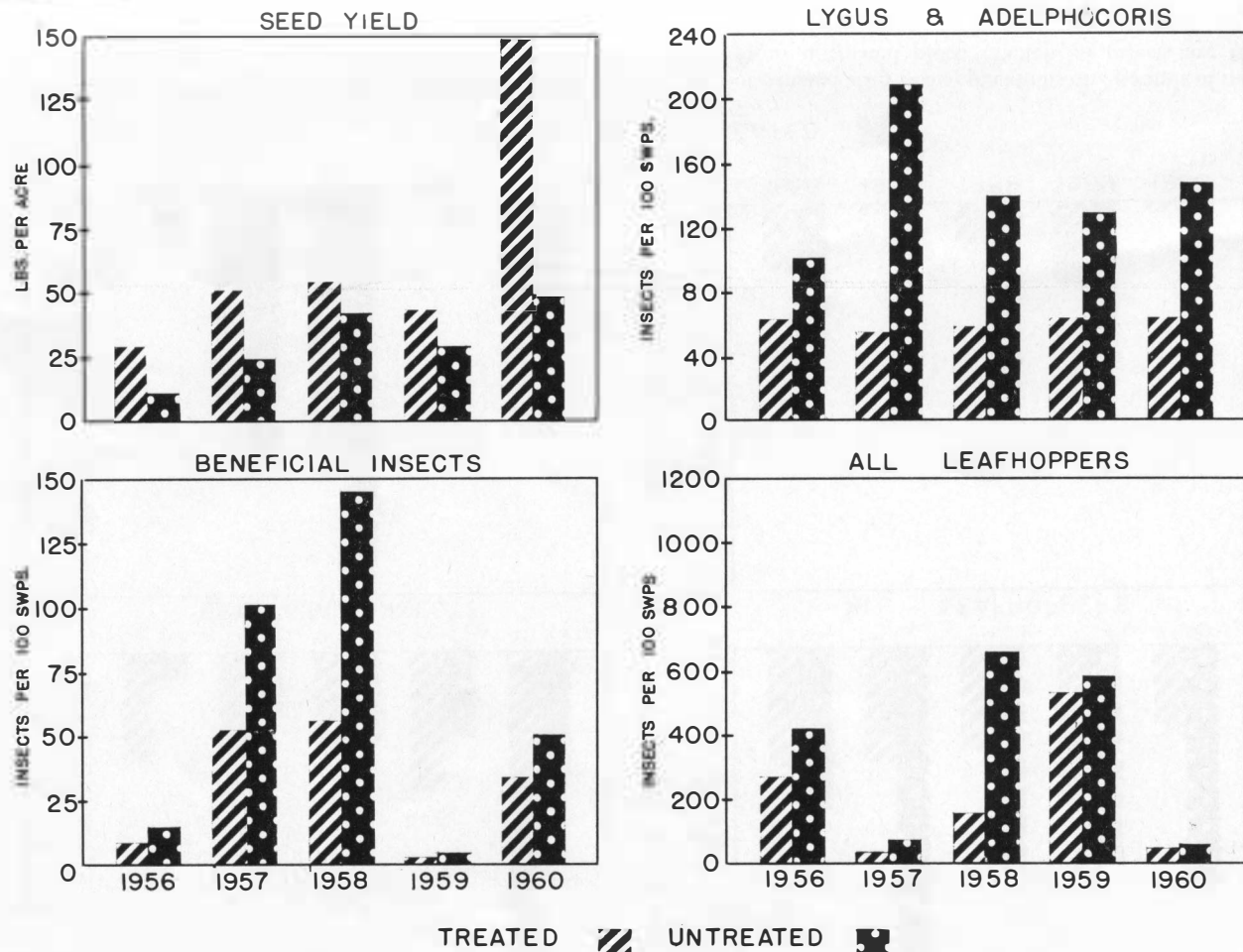


Figure 4. Alfalfa seed yields and seasonal averages of insect populations in plots treated with two applications of 1 pound of malathion plus one-fourth pound of heptachlor per acre compared with results from untreated plots. (Beneficial insects are totals of nabids and ladybird beetles.)

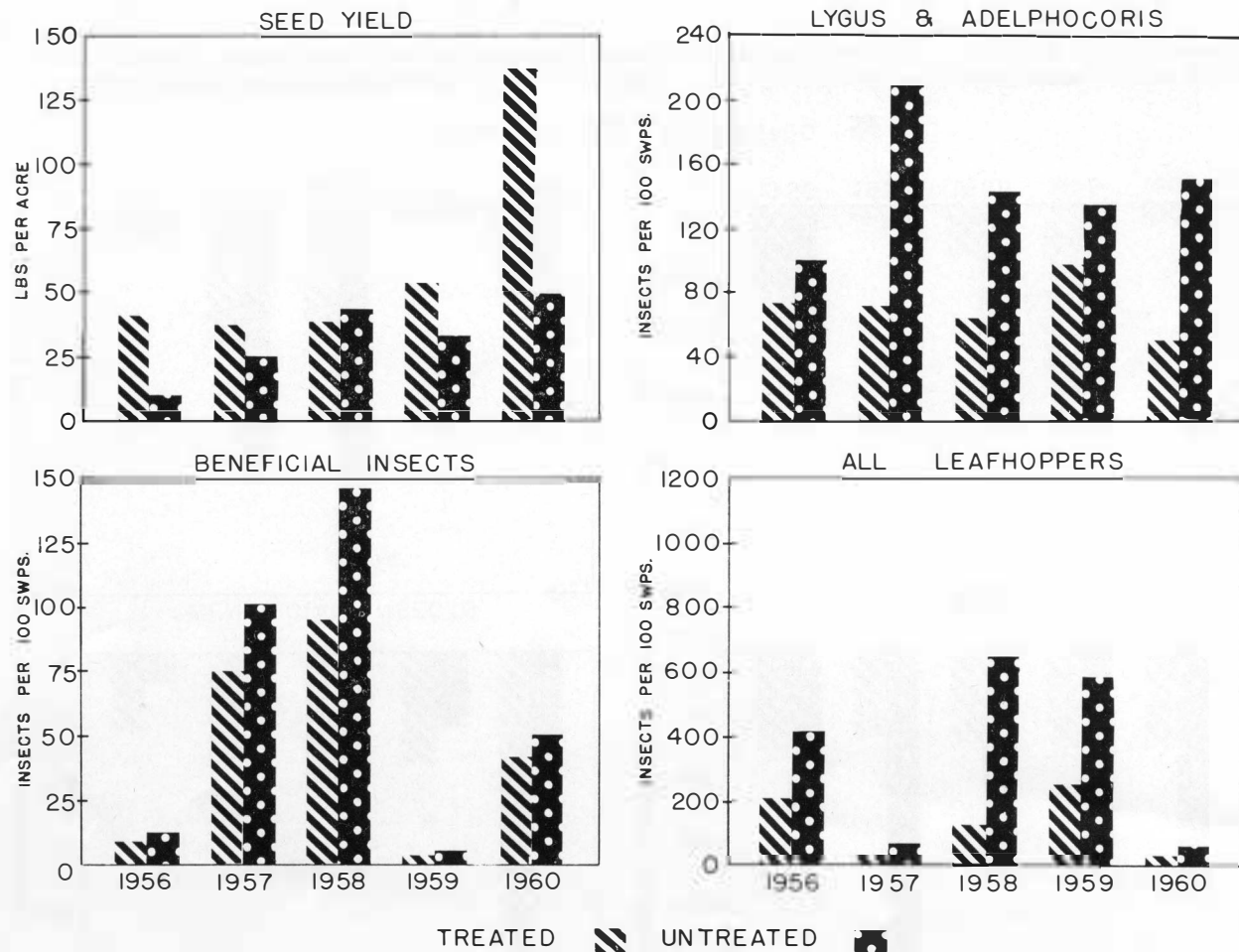


Figure 5. Alfalfa seed yields and seasonal averages of insect populations in plots treated with two applications of 2 pounds of methoxy-chlor plus one-fourth pound of heptachlor per acre compared with results from untreated plots. (Beneficial insects are totals of nabids and ladybird beetles.)

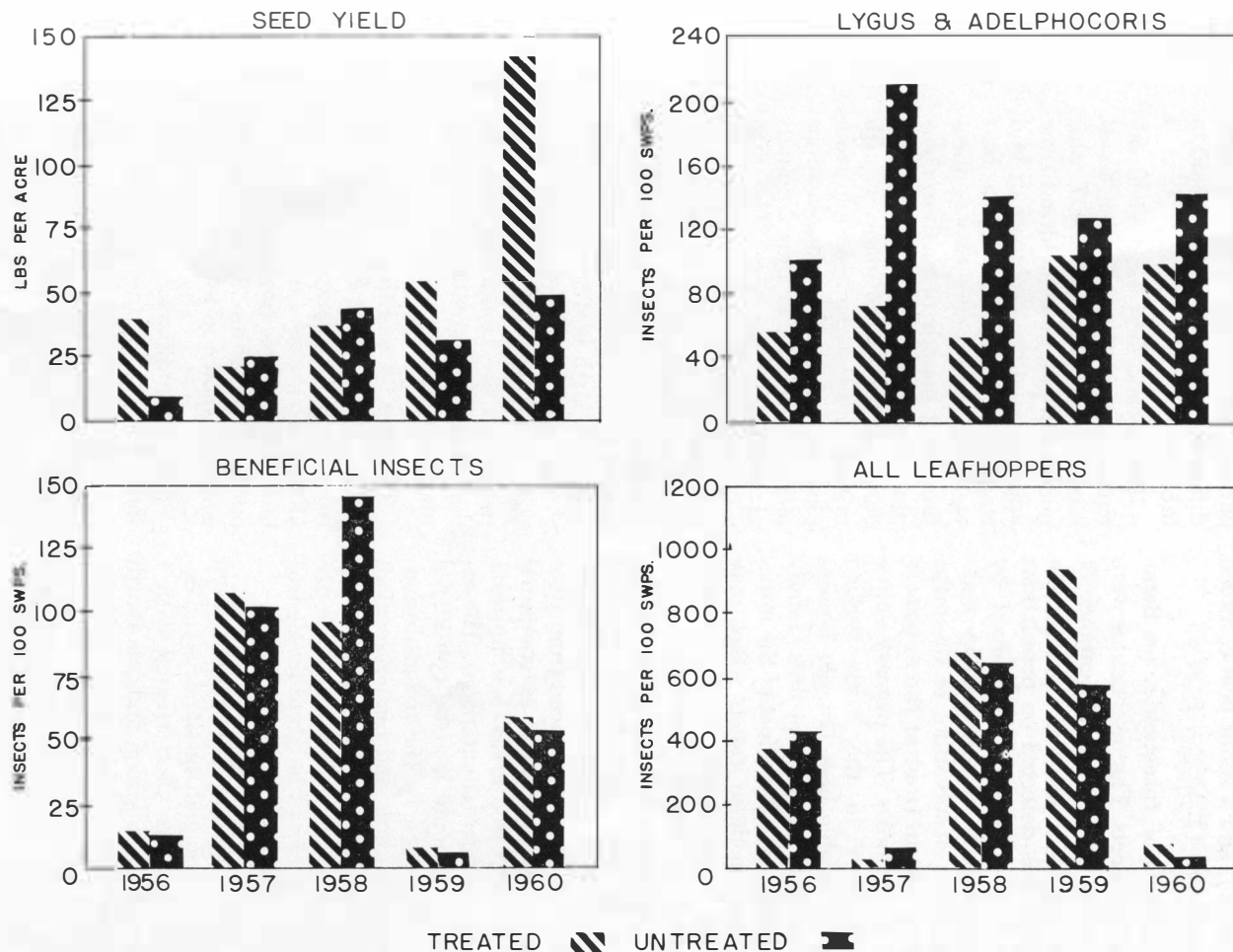


Figure 6. Alfalfa seed yields and seasonal averages of insect populations in plots treated with one pre-bloom application of one-fourth pound of lindane per acre compared with results from untreated plots. (Beneficial insects are totals of nabids and ladybird beetles.)

blister beetles, primarily of the species *Epicauta pennsylvanica* (DeG.), and a snout beetle, *Sitona scissifrons* (L.).

Effects of Insecticides on Beneficial Insects. The insecticides were applied prior to the appearance of the alfalfa blossoms. No injurious effect was detected on populations of honey bees as determined by checking the colonies and by making close observations of the areas for 6 feet in front of the entrances of the colonies. The primary native pollinators in the fields studied were bumble bees (family Bombidae) with a few sweat bees (family Halictidae). The effect of the insecticides on these insects which may have been nesting in the treated areas, was not determined.

Populations of ladybird beetles (predaceous beneficial beetles) and nabids (predaceous beneficial true bugs) were reduced from 10 to 60% in treated areas as compared with untreated areas. See figures 1 through 6 for comparisons. The reduction should also be considered as influenced by the reduced numbers of aphids and immature plant bugs available to these predaceous insects in the treated areas. The primary species of ladybird beetle was *Hippodamia convergens* Guer.

Seed Yields. The largest seed yield, averaged for the 5 years, occurred in the plots treated with 1 pound of malathion and one-fourth pound of heptachlor per acre at the 6-inch growth stage and again at the bud stage. This treatment produced an average seed yield of 66.31 pounds for the test period of 1956 through 1960, which was bet-

ter than a 100% increase over the yield of the untreated plots. Comparisons of average yields for the different treatments can be found in table 1.

The second best seed yield occurred where the per acre treatment was 1 pound of DDT plus one-fourth pound of dieldrin in one application at the prebloom or bud stage of growth. The third best yield occurred where two applications of 2 pounds of methoxychlor plus one-fourth pound of heptachlor per acre were made. Fourth in rank was the average yield from plots treated with two applications of 2 pounds of DDT plus 2 pounds of toxaphene per acre. The fifth best yield occurred where one application of one-fourth pound of lindane was applied per acre. One application of 1 pound of DDT plus 1 pound of chlordane per acre provided the sixth best seed yield.

The insect controls and seed yields obtained for the six best treatments are compared with the data from the untreated plots in figures 1 through 6.

Weather Conditions. Rainfall during the periods tested varied from above average precipitation all through the season in 1960 to below average precipitation throughout the 1958 season. These comparisons are shown in table 2.

Soil Conditions. Soil tests showed the soil in the field used for the 1956-59 test to be highly calcareous, with other readings for fertility showing medium to very high analyses. The field used in 1960 showed medium readings for available potassium and phosphor-

us. Comparisons of the averages for these fields showed the fertility level to be adequate for alfalfa.

CONCLUSIONS

Under South Dakota conditions, as indicated by this 5-year test at Brookings, the use of insecticides will provide profitable increases in alfalfa seed yields.

As shown in table 1, it is important to determine the cost per acre of the insecticides used. The increased cost of applying two treatments as compared to single applications should be considered. The purchase price of insecticides can be expected to change from year to year and from area to area within the state. It is therefore important to analyze costs each year before deciding on the insecticide treatment to use.

A good example of the need for

cost analysis is shown in table 1. The treatment consisting of two applications of 1 pound of malathion plus one-fourth pound heptachlor per acre gave the highest seed increase; however, at 1960 prices for insecticides and alfalfa seed the profit due to treating was only \$1 per acre. The second best seed yield occurred where the treatment was one application of 1 pound of DDT plus one-fourth pound of diel-drin per acre. This treatment cost was sufficiently less to provide a \$4.80 profit per acre from treating.

On a dry land farming basis the increases in seed yields due to insecticide treatments will vary with weather conditions. Under South Dakota conditions, such treatments can be expected to produce an increase over untreated fields every year with great increases in seed yields in years of ideal weather.

It is sometimes necessary to use trade names in reporting research. No endorsement of specific products named is intended, nor is criticism implied of products not mentioned.