FOURTEENTH ILLINOIS CUSTOM SPRAY OPERATORS' TRAINING SCHOOL

SUMMARIES OF PRESENTATIONS

January 24-25, 1962

Urbana, Illinois

This training school is presented specifically for commercial applicators of agricultural chemicals by the University of Illinois College of Agriculture, Agricultural Extension Service, and Illinois Natural History Survey, but is open to all persons involved in the handling of agricultural chemicals. This school promotes the proper, timely and wise use of agricultural chemicals. We gratefully acknowledge the assistance of officers of the Illinois Association of Aerial Applicators and the Agricultural Spraying Association in planning the program. Abstracts in this manual bring to you the latest research information, but do not constitute positive recommendation unless so stated. Statements made herein are the responsibility of either the speaker or the institution he represents.

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HERBICIDE RESIDUES IN SOIL

J. E. Gieseking

The persistence of herbicides in soils will depend on their tendency to:

I. Decompose or change to biologically inactive forms.

  A. Hydrolysis.

    1. Saponification.

    2. Deaminization.

      a. Biological agents.

        (1) Bacteria.

        (2) Plants.

      b. Chemical agents.

      c. Photochemical processes.

  B. Hydration.

  C. Reduction.

  D. Oxidation.

  E. Decarboxylation.

II. Evaporate.

III. Leach.

IV. Adsorb on soil organic matter or on clays.

Soil organic matter and clays adsorb all herbicides. The energy with which these adsorption reactions take place depends upon the nature of the clay, the nature of the herbicide, the presence or absence of competing adsorbable materials, and the acidity or basicity of the soil.

Soil organic matter and the montmorillonitic clays have very high capacities to adsorb herbicides. The kaolinitic clays have low absorptive capacities, and the illitic clays are intermediate between the montmorillonitic and kaolinitic clays.

The clay minerals are predominantly negatively charged, and they therefore tend to attract, with considerable energy, those herbicide molecules that are positively charged.

Under acid conditions, the edges of the flaky clay mineral crystals tend to take on a positive charge whereby negatively charged herbicides may be adsorbed.

PRE-EMERGENCE CHEMICALS AND SOIL TYPES

F. W. Slife

Although rainfall is the most important factor influencing the results with pre-emergence chemicals, soil types are the second most important. Soil types determine the necessary rate of chemical, as well as greatly affect the rate of movement through the soil. Soil type may also be the major factor in deciding what chemical to use. It is now possible with our present pre-emergence chemicals to predict in what regions we will have the most success, and in the next few years we may be able to recommend chemicals on a more specific basis. These more specific recommendations will be a result of looking at the soil analysis to determine the amount of sand, silt, clay, and organic matter.

The general statements that are possible to make now are that the more soluble pre-emergence compounds, such as Randox, work best on clay soils medium to high in organic matter, while the more insoluble materials like Atrazine works best on sand, silt, or clay soils lower in organic matter. It is important not to interpret this as saying that Randox will not work on light soils or that Atrazine will not work on heavy soils. But both of these compounds have areas where they will work best; and if these areas can be more closely pointed out, the results of our weed control efforts will be much better.

It would appear that organic matter and clay content are the most important constituents that influence this effectiveness of our pre-emergence compounds, with organic matter the more important of the two.

The general statements that can be made at this time are as follows:

Randox--works best on clay soils with 3 percent or more of organic matter. It will usually not work on sandy soils but works reasonably well on sandy soils that are high in organic matter.

Atrazine--works best on clay, silt, loam, or sandy soils below 5 percent in organic matter. The most consistent results are on soils below 3 percent in organic matter.

Randox-T--same as Randox.

Amiben--no definite pattern has been established for this compound. Results have been comparable on light- and dark-colored soils.

NA PCP--works best on clay or silt loam soils below 3 percent in organic matter.

Alanap--works slightly better on lighter colored soils than on dark-colored soils.

2,4-D--works best on medium- to heavy-textured soils; usually causes injury on light soils.

PESTICIDES: FACTS AND FICTION

George C. Decker

In general, pesticides are agents used to suppress, control, or destroy pests. They can be heat, light, sound waves, microorganisms, mechanical devices, and other agents. However, chemicals are usually inferred when pesticides are mentioned.

There are some 40,000 trade-brand pesticides registered as 7,000 to 8,000 formulations involving more than 200 distinct chemicals.

Because pesticides are at least in some degree toxic to plant and animal life, a host of publicity seekers and others have tried to discredit their use. Failure of the press to balance innuendo and inaccuracies with straightforward facts has led to misunderstanding of the value of these materials.

Everyone involved in the sale and use of pesticides should understand the basic facts about them, their residues, and the many implications involved in their use to help avoid embarrassing incidents and counteract false propaganda.

Why use pesticides? Pesticides are as indispensable as mechanical tools. Without them many fruits and vegetables would disappear from the market, yield and quality of others would decline appreciably, and prices would rise drastically.

Pesticides have contributed greatly toward reducing production costs; their use has resulted in increased production, reduced losses, and reduced labor costs in grading and sorting. Because of these factors, food prices to the consumer have remained close to the over-all cost of production. The average consumer spends 20 to 25 percent of his income for food today, whereas at one time it was 60 to 70 percent. This is in the face of rising costs for packaging, transportation, marketing, and distribution. In the kitchen, the housewife discards less food because culling and trimming away rot, mold, and insect damage have been minimized.

Under present food inspection regulations, many foods now available would never reach the consumer without the use of pesticides. They would be discarded because of contamination by insects, rodents, molds, and rots. Today over three-fourths of the food seizures are attributed to filth and decomposition.

Man, by plowing the prairies, cutting down the forests, and draining the marshes, has far exceeded anything else in upsetting the balance of nature. The meager abilities of pesticides can have little effect on this upset. They can only suppress or control organisms that have gotten far out of balance in localized areas.

The most spectacular benefits in the use of pesticides have perhaps been in the field of public health, through control of the vectors of human disease. In most of our great wars, casualties attributed to insect-borne diseases have exceeded those caused by arrows, bullets, shrapnel, bomb fragments, and poison gas combined.

In 1943-44 DDT was dusted on the bodies and clothing of the entire civilian and military personnel of Naples. This treatment suppressed a typhus epidemic by controlling the lice that were transmitting the disease. In 1944 in Greece there were 4,000 deaths from malaria; in 1951, only 7. Adult and larval mosquito control made this decrease in death loss possible. The same principle holds true for the U.S.A.

Damage by insects and fungi to houses, clothing, works of art, fabrics, shade trees, ornamentals, and lawns is well known by home owners who accept pesticides to prevent these losses.

Hazards and safety in pesticide use. Some pesticides, such as nicotine, lead arsenate, mercuric chloride, etc., may be extremely toxic to animals (Table 1); others may be only mildly toxic, and some are non-toxic.

Toxicity is the capacity of a substance to produce injury; hazard is the probability that injury will result from use of the substance in the quantity and the manner of treatment proposed. There are occupational hazards and food contamination hazards; do not confuse them.

The World Health Organization, U.S. Public Health Service, the Food Protection Committee of the U.S.A. National Research Council, and the Ministries of Agriculture and Fisheries, Health and Food in Great Britain have reviewed pesticide usage and generally concluded that "the large-scale usage of pesticides in the manner recommended by manufacturers or competent authorities and consistent with the rules and regulations promulgated under existing laws would not be inconsistent with sound health programs, and although the careless or unauthorized use of pesticidal chemicals might pose potential hazards requiring further consideration and study, there is no cause for alarm."

Hayes of the U.S.P.H.S., in studies involving prisoners, used up to 200 times the amounts of DDT normally found on foods as residues and found no evidence of disease or other ill effects. Further studies in areas of extensive use of pesticides failed to show any correlation whatsoever with the incidence of illnesses (or any other debilitating effects) often attributed to them.

Residue tolerances established by law have a safety factor of 10 to 100. Poisoning from foods grossly contaminated by improper pesticide applications are few and far between. Eleven persons in a family became ill after eating mustard greens with 100 p.p.m. of a pesticide (in use for 50 years) when the legal tolerance was 2 p.p.m.; another family became ill after eating greens with 3,200 p.p.m. of a pesticide when the tolerance was 7 p.p.m. No deaths or permanent afflictions resulted.

Pesticides have a lower accident rate than drugs, household chemicals, solvents, and miscellaneous poisons (Table 2). From 1949 to 1955, 84 percent of the accidental deaths attributed to insecticides were caused by materials in common use before the days of DDT, and only 16 percent by those after DDT. Arsenicals were charged with 299 of the 518 deaths compared with 79 for insecticides introduced since 1946. There were 218 accidental deaths from three rodenticides in common use for many years.

Carelessness in storage poses the real hazard in pesticide use. In 1956 (Table 3) 152 deaths were attributed to pesticides; 94 (62%) were children under 10 years and 78 (51.3%) were under 4 years. Careless storage was the principal cause of fatalities due to pesticides--not pest control applications.

For safe use, read and follow the label.

Wildlife hazards. Despite the use of billions of pounds of pesticides on millions of acres of cropland, damage to wildlife attributable to these treatments has been relatively insignificant and in many cases undetectable. To quote from the most comprehensive and complete study of the problem: "Considered in its broadest scope, at the present time, pesticides seem to be only minor influents in nature compared to other factors in land and water development and use."

Some errors or side effects to wildlife may occur. There is no great sin in making an innocent mistake, but failure to recognize and correct such mistakes may be unpardonable.

Most of the significant wildlife losses recorded to date have involved eradication programs and excessive rates of pesticide application in aquatic and other sensitive wildlife habitats. In other cases the loss has resulted from experimental work.

When domestic animals are reportedly killed by pesticide drift into pastures, competent authorities are aware, and even the alert layman should realize, that these reports represent cases of delusion, deliberate or otherwise. Science has developed valid research data on the magnitude of residues resulting from pesticide use, the rate of dissipation, and the approximate tolerance of domestic animals to them. Pesticides far in excess of residues at application are fed over long periods to animals (Table 4). Pesticides are often accused of causing a whole host of afflictions to man and animal when there is no basis for such charge in science, logic, or fact.

Science is continually striving for break-throughs in control methods. Until they become established, man has no choice but to continue to use pesticides.

Table 1.--Toxicity and Other Characteristics of Some Common Insecticidal Chemicals Related to Safety and Hazards

Pesticide	Acute toxidity Approx. range, LD/50. Mg./Kg. Oral	Dermal	Relative rates of application DDT = 100	Persistence: 1--brief 5--long	Character of hazard: Ing.--Ingestion, Oper.--Operational
Botanical					
Rotenone	60-3,000	900-3,000	20-60	1	Remote
Pyrethrins	500-1,500	1,880	10-50	1	Remote
Nicotine	10-30	40-50	20-60	1	Ing. & oper.
Inorganic					
Lead arsenate	50-500	Slight	200-400	5	Ing.
Calcium arsenate	35-100	Slight	200-400	5	Ing.
White arsenic	5-100	Slight	In baits	5	Ing.
Sodium arsenite	10-50	35-100	In baits	5	Ing. & oper.
Chlor. hydrocarbons					
Methoxychlor	5,000-7,000	2,820-7,000	150-200	4	Remote
Chlordane	200-750	700-2,000	50-100	3	Ing.
DDT	110-250	2,500-3,000	100	4	Ing.
Lindane	85-200	50-1,000	10-50	2	Ing.
Toxaphene	60-90	80-2,300	150-200	4	Ing.
Dieldrin	40-65	60-90	10-50	3	Ing. & oper.
Aldrin	40-50	50-100	10-50	2	Ing. & oper.
Organo-phosphates					
TEPP	1-3	5-15	20-40	1	Oper. & ing.
Parathion	3-15	10-50	20-60	2	Oper. & ing.
Phosdrin	4-17	5-10	20-40	1	Oper. & ing.
Demeton	2-20	7-15	20-50	2	Oper. & ing.
Guthion	10-15	100-250	20-60	2	Oper.
Methyl parathion	10-35	50-100	20-100	2	Oper.
Malathion	480-1,400	4,000-5,000	75-150	2	Remote

Table 1A.--Relative Hazards of Exposure and Residues of Selected Pesticidal Chemicals (Strictly Hypothetical--to Illustrate a Point)

Insecticidal chemical	Relative toxicity		Relative dosage rate		Relative exposure hazard		Relative persistence		Relative residue hazard
Aldrin	2	x	1	=	2	x	1	=	2
DDT	1	x	4	=	4	x	2	=	8
Lead arsenate	2	x	8	=	16	x	4	=	64

Table 2.--Number of Accidental Deaths in the United States, 1956

Cause	Number	Percent
Miscellaneous	52,517	55.38
Motor vehicles	39,628	41.77
Poisonous substances	2,635	2.78
Pesticides	152	0.15
Total	94,780	100.00

Table 3.--Accidental Deaths in the United States (1956) Attributed to Pesticides in Groups Indicated

Pesticide	Number of deaths	Percent of total
Arsenic compounds	54	36
Other pre-DDT compounds	40	26
Miscellaneous and unnamed	30	20
Organo-phosphate compounds	16	10
Chlorinated hydrocarbon compounds	12	8
Total	152	100

Table 4.--Insecticide Residues (P.P.M.) Immediately and Two Weeks After Spraying at Normally Recommended Rates and Residues (P.P.M.) in Feeds Animals Have Consumed for Weeks (Indicated) Without Showing Any Serious Ill Effects

Insecticide		Methoxy-chlor	DDT	Dieldrin	Aldrin	Heptachlor
Rate used, pounds per acre		2	1 1/2	1/4	1/4	1/4
Initial residues, p.p.m.		125	100	20	10	10
Residues, 2 weeks, p.p.m.		15	10	1	1	1
Animals	Weeks			Rates Fed, P.P.M.		
Cows	18	7,000	200	75	40	200
Steers	16	--	100	25	25	25
Chicks	7	--	250	50	25	25
Rats	26	--	400	50	50	50

THE DEVELOPMENT OF ROOTWORM RESISTANCE IN NEBRASKA

G. T. Weekman

Three species of corn rootworms occurring in Nebraska are the western corn rootworm (Diabrotica virgifera), the northern corn rootworm (D. longicornis), and the southern corn rootworm (D. undecimpunctata howardi). All three species have been present in the state for many years, and since 1947 they had been easily controlled either by crop rotation or by relatively low rates of soil insecticide applied as broadcast sprays, row sprays, granules in the row, and/or insecticide fertilizer mixtures. The degree of control obtained in Nebraska was not unlike that obtained in neighboring states that were concerned with one or more of the same species.

During the late summer of 1959, a few scattered reports of incomplete control of the corn rootworm complex were received from some of the best corn-producing areas of the state. Since reports of alleged failure with soil insecticides are not uncommon, no particular significance was attached to those received during 1959. By June 1960 reports began to come in that much of the corn in the south-central region of the state was showing abnormally heavy root damage. By the first of July it became evident that the area involved was large and would include a major portion of the irrigated corn acreage of the state.

The large number of reports received during the early part of the 1960 season indicated that a serious problem had developed in the use of soil insecticide in Nebraska. It would have been easy under pressure of the times for the entomologist to say that the cause of the problem was insecticide resistance in the corn rootworm complex. However, a collective decision by the staff of the Entomology Department of the University was to proceed with caution but at the same time as rapidly as possible to isolate the cause of this "new rootworm problem." To initiate these investigations, a survey of species distribution and relative population abundance was needed.

The first rootworm species distribution survey in Nebraska was made during the late summer of 1948. It covered all the major corn-producing counties of the state (and was devised to determine the distribution and relative abundance of all three species of the insect). In 1948 the western corn rootworm was found to be the predominant species in the south-central region of the state west of a line drawn vertically through Grand Island. The eastern limit of its distribution was approximately 30 miles west of Lincoln. The northern corn rootworm was the dominant species over the rest of the corn-growing region to the east and north, with the southern species scattered throughout the state. The 1960 survey did show that the western species had spread eastward and become the dominant species in all counties in the state except several along the Missouri River and in the northeastern corner of the state. The 1961 survey indicates still further movement toward the northeast, with the limit of western distribution now roughly defined to include southern South Dakota, southwestern Minnesota, western Iowa, northwestern Missouri, and northern Kansas.

To further amplify the development of the rootworm problem in Nebraska, it is essential to understand the type of corn production practiced over the major portion of the problem area. Corn production changed rapidly in the state with the advent of deep-well pump irrigation, a development that has taken place largely since 1945. With irrigation in south-central Nebraska has come the continuous production of corn year after year with no crop rotation. This continuous production is in itself conducive to the development of large rootworm populations.

We now feel that this continuous cropping was largely responsible for the 1946-47 outbreak of rootworm populations in the state and has contributed to the recent failure of chemical controls. Since 1947 Nebraska has had the highest percentage of acres treated for soil insects of any of the major corn-producing states, and the treatment has been nearly continuous in many fields in central Nebraska. It is a well-known fact now that repeated exposures to minimal dosages of a single insecticide or family of insecticides will tend to select from an insect population a more resistant strain of that insect. With continued exposure the upgrading of the apparent resistance, once begun, occurs in a geometric ratio that rapidly outstrips all attempts to combat the pest with greater dosages of the same insecticide. With these facts in mind, it becomes obvious that resistance should be suspected in the problem area of Nebraska.

In 1961 Dr. H. J. Ball and I collected thousands of adult western corn rootworms from both central (the problem area) and eastern (non-problem area) Nebraska and subjected them to tests in an attempt to prove resistance to the chlorinated hydrocarbon insecticides. Data from these tests definitely indicate a marked difference in the susceptibility of the two groups of insects. Roughly, it takes 100 times more aldrin or heptachlor to kill adult western corn rootworms from the central area of the state than to kill this same species collected in the eastern part of the state. This we are calling resistance. It is necessary to point out that this apparent resistance is confined as yet to central Nebraska in an area producing corn from approximately 3.5 million acres. There is no evidence to indicate similar resistance outside this area or resistance in the other two species of corn rootworm in Nebraska.

STALK AND ROOT ROTS OF CORN

A. L. Hooker

Stalk and root rots are the most serious and widespread diseases of dent corn in Illinois. They cause substantial yield losses through premature killing and are responsible for much of the lodging in corn.

It is difficult to distinguish between stalk rots and root rots late in the season, since the same fungi may be associated with both stalks and roots. When stalks are killed, death and destruction of roots soon follow. Some of the fungi that cause stalk rots also infect the plant by way of the root system and start out as root rots. Organisms causing root rot early in the season, however, are usually restricted to the roots.

Early-season and summer root rots are caused by several fungi. These organisms live in the soil and attack the small feeding roots primarily. Later in the season the entire root system may be involved. Infected roots are yellow to brown and flaccid. Care must be taken to separate the effects of root rot from the root pruning and tunnels produced by the corn rootworm. Feeding injuries of this insect are commonly infected with root rot. Root rot, however, may occur in the absence of the rootworm. This disease is favored by cold, wet soils.

There are several different kinds of stalk rot, but in the corn belt Diplodia, Gibberella, and charcoal rot are the most common. The fungi causing these diseases do not attack young, physiologically active corn stalks, but only those approaching maturity. These fungi commonly invade the stalk from the soil and show the same general type of parasitism. Diplodia and Gibberella may kill the plants two or three weeks before they are fully mature, resulting in light-weight, poorly finished ears. In Illinois the result is an average statewide reduction of approximately 8.6 percent in yield. The most noticeable type of damage is stalk breakage and down corn, which causes harvesting difficulties. Stalk breakage may also result from corn borer tunneling. The effects of stalk rot and corn borer on lodging are difficult to separate when the two occur simultaneously in the same plant. Each may occur independently, however.

Diplodia stalk rot does not ordinarily appear until several weeks after pollination, and the infections continue until harvest. Scattered diseased plants die suddenly; the leaves take on a dull grayish-green cast like that caused by frost damage. Seven to 10 days later the stalks die. The lower internodes turn brown and are easily crushed. When the stalks are cut open, only vascular bundles are found to be intact, as the pith tissue in the stalk has disintegrated. The small black pycnidia, the fruiting structures of the fungus, which develop just beneath the surface of the lower internodes of dead stalks in the fall, serve to identify this disease.

The symptoms of Gibberella stalk rot and Diplodia stalk rot are similar except that in Gibberella rot a pink to reddish discoloration is often found in the pith of the stalk or roots. Gibberella seems to cause a more complete breakdown of the stalk than Diplodia. If the small, black, round fruiting bodies of Gibberella are produced, they are on the surface of the stalk and can be scraped off with the thumbnail.

Charcoal rot appears as plants approach maturity and is most abundant in hot, dry seasons. Stalks are killed and the interior of the lower internodes disintegrates and turns grayish-black. The disease can be distinguished from other rots by the presence of numerous small black specks, the sclerotia, which are scattered along the surface of the vascular strands in the lower internodes.

Factors that influence Diplodia and Gibberella stalk rot development are much the same. Stalk rot is usually increased by wet weather in August and September, especially if the summer was dry. Cool weather tends to favor Gibberella rot, while warm weather favors Diplodia rot. Winds and rain in the fall affect lodging. Loss of leaf area due to leaf blights and other causes increases infection. Stalk rot is generally most prevalent in soils that are high in fertility, especially if nitrogen levels are high and potassium content is low. Thicker planting rates increase stalk rots and stalk lodging. Corn hybrids vary considerably in their resistance to stalk rot and lodging.

Stalk rot and root rot diseases cannot be entirely controlled at the present time. Damage from them, however, can be reduced. Use of the more resistant hybrids is recommended. In years when leaf blights are prevalent, use of leaf-blight-resistant hybrids will help to reduce stalk rot damage. Hybrids that utilize the full growing season usually have less stalk rot than those that mature early. Balanced soil fertility is important; large amounts of nitrogen may require large amounts of muriate of potash to reduce stalk rot. Crop rotation, good cultural practices, moderate rates of planting, and avoidance of excessively high nitrogen fertility programs all help to reduce stalk rot damage. Efforts are being made to develop hybrids with greater genetic resistance. Conceivably, soil fungicides may be developed to control these diseases.

FLAME CULTIVATION RESULTS IN 1961

E. L. Knake

During 1961 considerable interest in flame cultivation was created in Illinois. Most of the promotional efforts were made by manufacturers and dealers handling flame cultivation equipment. It is reported that several hundred flame cultivators have been sold in the midwest during the past two years. Many of them have been purchased by L-P gas dealers interested in evaluating this practice.

If flame cultivation could be successfully used, it would mean a sizable potential market for L-P gas during the summer, when sales for heating purposes are low. L-P gas dealers in Illinois indicated a strong interest in evaluating this practice under Illinois conditions in 1961. Dealers in several counties cooperated with their county extension advisers in conducting evaluations. We also conducted some research at Urbana in 1961.

The major reason that farmers would be interested in flame cultivation is to control grass weeds in the crop row. For controlling weeds between the rows, conventional cultivation is still considered most satisfactory. Although the primary reason for cultivation is to control weeds, there are sometimes other benefits from cultivation, especially during some seasons on the finer textured soils. To control broad-leaved weeds in corn, post-emergence application of 2,4-D is still the most economical and practical approach in most areas.

Most flame cultivators in 1961 were equipped only with burners directed into the row, and no means was provided for controlling weeds between the rows. Several innovations were tried for flaming weeds between the crop rows with varying degrees of success. Conventional cultivation still appeared to be the most effective and economical means of controlling the weeds between the crop rows.

It has been suggested that where flame cultivation is to be used the seedbed be made quite level to allow proper application of the flame. Preparation of a very smooth seedbed is not compatible with minimum-tillage methods; and even if only the area over the crop row were to be left smooth, it would require some change in present practices at planting time.

To control early weeds it has been advocated that both weeds and corn be flamed when the corn is about two inches high. This practice was evaluated at Urbana in 1961. For the flame treatment corn was flamed twice on June 12 when it was 2 to 3 inches high and the weeds were just emerging. A two-row flame cultivator was used, with two burners directed toward each row. Speed was 1 m.p.h. and pressure was 28 pounds. The flamed plots were given no additional flaming, but flame plots as well as check plots were cultivated with a conventional cultivator. Treatments were replicated six times. Results are summarized in Table 1.

Table 1.--Flaming Corn When 2 Inches High vs. No Flaming--Urbana, 1961

	Yield	Stand	Percent lodging on 10/5	Height of corn on 10/5
	Bu./A.	Plants/A.		
Flamed	73.1	8,700	23.2	108.9 in.
Not flamed	84.6	10,000	11.9	108.1 in.

Under the conditions of this experiment flaming did give some improvement in weed control, but tasseling was delayed one to two weeks.

Another experiment was set up with various combinations of weed control practices in corn. Treatments and results are summarized in Table 2.

Table 2.--Evaluation of Flame Cultivation in Corn--Urbana, 1961

Treatments	Yield	Stand at harvest
	Bu./A.	Plants/A.
1. Check--no weed control	58.7	13,600
2. Corn flamed when 2 to 3 inches plus 4 flamings	77.3	13,400
3. Flame cultivation--4 flamings	80.6	13,400
4. Pre-emergence herbicide plus 3 flamings	82.1	15,000
5. Conventional cultivation	90.7	14,300
6. Pre-emergence herbicide plus conventional cultivation	92.8	15,200

Observations over the state indicate that proper application of heat will kill some species of weeds if the heat is applied when weeds are small and is applied often enough. Observations also indicate that corn has some tolerance to flaming after it is 12 inches high.

In Illinois weeds start growing at about the same time and at about the same rate as the crop. By the time corn is high enough to tolerate heat, the weeds are usually too large for most effective control by flaming. Flaming could be used to control weeds that start growing late in the season, but that is not our primary problem in Illinois.

For any weed control practice to be readily accepted by farmers, it should be relatively dependable, safe, and economical. If flame cultivation is to be considered for controlling weeds, it should be compared with other methods available for accomplishing the same objective.

Dependability--We do not know how often flame cultivation would satisfactorily control weeds, but in 1961 it did not appear to be as dependable as pre-emergence herbicides. Results with flame cultivation will vary with stage of crop and weed growth. Careful adjustment of equipment is required, and the land should be level.

Safety--If a farmer can safely handle anhydrous ammonia as a fertilizer and L. P. gas as tractor fuel or for heating, he should also be able to safely use a flame cultivator. More information is needed regarding safety so far as crop tolerances are concerned.

Economy--If 5 to 6 gallons of fuel were used per acre for each flaming at a cost of about 15 cents per gallon, the cost of 75 to 90 cents per acre for fuel would probably not be excessive if a serious weed could be controlled. Fuel for four flamings would cost about the same as a herbicide for pre-emergence band application. However, equipment attached to a planter for applying pre-emergence herbicides will cost only from $100 to $150, whereas a four-row flame cultivator will cost from $800 to $1,000.

Compared with pre-emergence herbicides, flame cultivation would require more expensive equipment and more trips over the field. Pre-emergence herbicides can kill weeds while fields are wet and equipment cannot move in them.

Herbicides for post-emergence control of grasses in corn may be just around the corner. If present farm sprayers prove suitable for applying such materials, investment in additional equipment may not be necessary.

Industry will probably continue research on flame cultivation under midwest conditions, but results thus far have not been satisfactory enough to recommend flame cultivation in Illinois at the present time.

FACE FLIES--1961

Steve Moore III

The face fly continued to spread southward in Illinois, severely infesting the area north of U.S. Rt. 50 (see attached map). Peak populations occurred in late June and July, whereas in the two previous years the highest populations had occurred in August. Approximately one-half million head of cattle were treated to control the face fly in 1961.

Several types of backrubbers treated with 5.0 percent toxaphene in oil were tested for effectiveness in controlling face flies and biting flies on beef cattle under various pasture conditions. Backrubbers (oilers) containing toxaphene provided reasonably good control of horn flies, only fair to poor control of face flies, and poor control of stable flies (Table 1). The best location for the backrubber is under a small shed in a pasture devoid of trees and brush.

Table 1.--Effectiveness of Backrubbers Treated With 5.0 Percent Toxaphene in Oil Against Face Flies and Biting Flies on Pastured Beef Cattle in Illinois, 1961

Type of backrubber	Percent reduction			
	Face flies	Horn flies	Stable flies	Horse flies
Head oiler	62	a/	a/	--
Canvas on gate	39	100	0	--
Burlap wrapped	32	83	18	--
Toxawick	26	82	10	--
Miscellaneous (Old Scratch, Best, Farnham, etc.)	14	40	12	--
Average	34	78	7	--
Average number flies per animal in untreated herds, June-August	31	69	8	0

a/ Only animal's head treated.

In brief, results of some of the other control studies conducted on the face fly in 1961 were as follows:

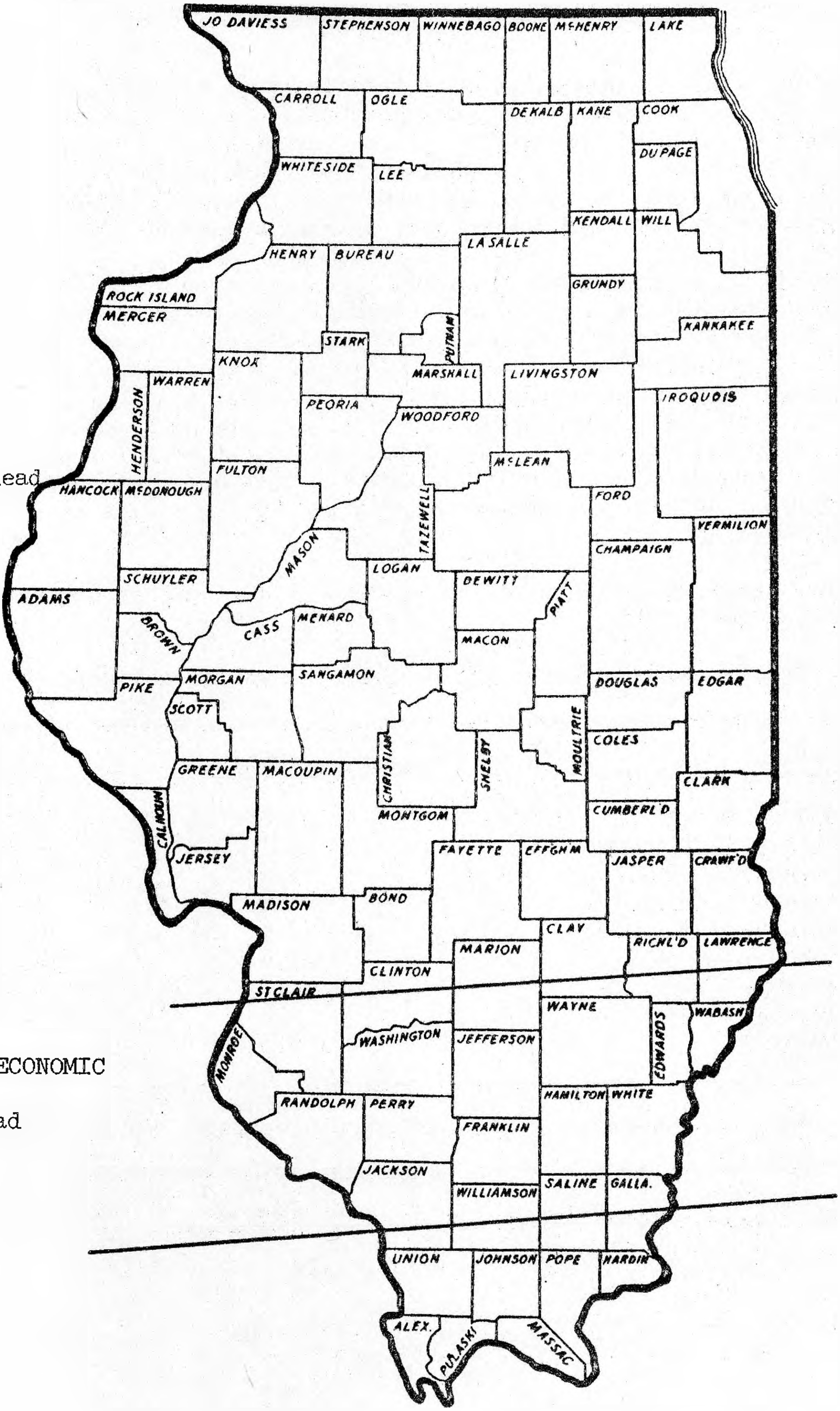
Sirup baits containing 0.2 percent DDVP, when properly applied, reduced face fly populations by more than 90 percent. Best results were obtained when the water in the standard corn sirup bait did not exceed 30 percent.

Repellent materials containing tabatrex, R-326, or Crag as the main constituent worked well for one to four hours, but treated cattle became infested before the end of the day.

Dibrom 4 percent dust for face flies was found to be highly irritating to the operator as well as to the cattle. The material performed poorly against face flies.

An automatic treadle sprayer containing 1 percent pyrethrins plus 10 percent piperonyl butoxide applied twice daily (1 ounce per animal) to dairy cattle reduced face fly populations 70 to 80 percent, horn fly populations 100 percent, and stable fly populations 60 to 90 percent.

DISTRIBUTION AND ABUNDANCE OF THE FACE FLY IN ILLINOIS, MAY-SEPT. 1961



SEVERE

10 - 75 per head

LIGHT TO NON-ECONOMIC

1 - 10 per head

NON-ECONOMIC

SOLVING NEBRASKA'S ROOTWORM PROBLEMS

G. T. Weekman

Field tests conceived prior to the time that actual resistance to the chlorinated hydrocarbon insecticides had been proved in Nebraska had to be broad in their approach to solve the problem of rootworm control. The problem area of Nebraska as pointed out in the previous presentation was confined largely to irrigated land that had been in continuous corn for more than five years. In this irrigated area two quite different methods of corn management are practiced.

The first method is based on the lister planter with its unique methods of cultivation, and the second on the surface planter familiar throughout most of the corn belt states. Since rootworm control is necessary regardless of the method of culture, both practices had to be included in all tests where possible. From a rather vast array of candidate and proved insecticides, a selected group was obtained for tests in 1961. When applicable, the experimental procedure was further expanded to cover all methods of application of insecticides for each material selected. The methods of application included winter application of granules, broadcast preplant sprays, row sprays at planting, row granules at planting, and sidedressing at lay-by.

Only the positive data will be given here and can be summarized briefly in the following tables:

Table 1.--Row Application of Granules--Surface Planting

Material	Percent root damage	Percent lodging
Heptachlor, 1/2 lb., 20%	97.7	35.2
Aldrin, 1/2 lb., 20%	92.1	44.6
Diazinon, 1/2 lb., 10%	43.2	12.6
Diazinon, 1 lb., 10%	4.2	2.8
Diazinon, 2 lb., 10%	2.6	6.2
Diazinon, 1/2 lb., 5%	21.4	14.7
Diazinon, 1 lb., 5%	18.6	6.2
Diazinon, 2 lb., 5%	7.6	4.1
Untreated	100.0	68.6

Table 2.--Row Application of Granules--Lister Planting

Material	Percent root damage	Percent lodging
Heptachlor, 1/2 lb., 20%	100.0	50.1
Aldrin, 1/2 lb., 20%	94.2	34.1
Diazinon, 1/2 lb., 10%	46.7	12.8
Diazinon, 1 lb., 10%	40.2	16.7

Table 2.--Row Application of Granules--Lister Planting (Cont.)

Material	Percent root damage	Percent lodging
Diazinon, 2 lb., 10%	12.6	2.1
Diazinon, 1/2 lb., 5%	53.9	7.4
Diazinon, 1 lb., 5%	21.5	2.8
Diazinon, 2 lb., 5%	21.9	3.6
Untreated	96.8	58.2

All of the above treatments were judged for effectiveness by two methods, the first a root rating based on the number of damaged roots in mid-July expressed in percent roots damaged, and the second based on the percent of plants lodged 30° or more at harvest.

The above data clearly show the effectiveness of granular diazinon over aldrin, heptachlor, and the untreated check. On the basis of these data, Nebraska is recommending, in the problem area only, an application at planting of 10 pounds of 10 percent granular diazinon for control of the western corn rootworm.

The data obtained from the remainder of nearly 1,000 plots indicate that granular diazinon is the only material tested that can be depended upon to give effective control of the rootworm in the problem area of Nebraska in 1962. Several related materials were not tested in 1961 that quite probably will prove effective. Several other materials under test have shown varying degrees of effectiveness and warrant further study in future work now planned at the University of Nebraska.

2,4-D FORMULATIONS, RATES, AND TIME OF APPLICATION

F. W. Slife

2,4-D is the most important weed chemical available today. In spite of many new compounds for weed control, the acreage treated with 2,4-D has not decreased. Various salts of 2,4-D were the first formulations that were widely sold. They included sodium, potassium, ammonia, etc. Although effective, they were not so effective as the amines and esters that were developed later. Today the esters and amines are most widely sold. In the past the most widely sold esters have been the volatile esters, amyl, butyl, isopropyl, methyl, and ethyl. In recent years low-volatile esters have been introduced and have replaced most of the high-volatile esters for brush control as well as for some crop spraying. The advantage of the low-volatile esters besides lower volatility is lower rates to achieve the same effectiveness.

Use of the amines of 2,4-D has increased recently. The advantage of the amines is that they are nonvolatile and are therefore preferred where volatility could be a problem to sensitive crops. In the past, the amines have cost more than the esters per acre treated.

There is a place for both ester and amine formulations of 2,4-D. The ester is more toxic to hard-to-kill weeds and brush, and the advantage of the amine is its nonvolatility. There is less need now for the high-volatile esters than in previous years.

Application rates need to be changed for each formulation and also for the type of broadleaf weed that is present. Unfortunately, the rates recommended for use in crops are based on what the crop will tolerate and not necessarily on what is needed to control weeds. Standard rates are 1/2, 1/4, and 1/6 pound of acid per acre for the amine, high-volatile ester, and low-volatile ester, respectively. These rates are sufficient to control major annual broadleaf weeds provided the 2,4-D is applied when the weeds are small and growing rapidly. When the weeds are more than 6 or 8 inches tall, many of them become more tolerant to 2,4-D. For this reason, 2,4-D used in corn should be applied when the weeds are small, regardless of the stage of growth of the corn. A surprising amount of corn is sprayed each year after it has tasseled. The maximum benefit is not being gained from this application because many of the tall weeds will not be killed and will produce seed. In addition, the competitive effects of the weeds have pretty largely taken place.

It is important to remember that 2,4-D does not give the same results from year to year. This is not because the chemical has changed, but rather because the susceptibility of the weeds changes with different environments. The weeds are most sensitive to 2,4-D when they are growing rapidly.

TROUBLE-SHOOTING EQUIPMENT FAILURES IN APPLICATION OF CHEMICALS

Wendell Bowers

It is not practical to list all of the troubles likely to occur in the application of chemicals, but some of the more common ones are included in the following outline:

Band and Broadcast Spraying

I. Pump loses capacity.

A. Suction strainer clogged.
B. Air leak in suction line.
C. Worn rotor or bearings.
D. Pump partly clogged.

II. Pump loses suction.

A. Suction strainer clogged.
B. Tank empty or suction line not on bottom of tank.
C. Air leak in suction line.
D. Collapsed suction hose.
E. Pump air-locked.
F. Pump worn or seals leaking.

III. Noisy pump.

A. Pump turning too fast.
B. Air leak in suction line.
C. Partly clogged suction strainer.
D. Worn bearings.

IV. Pressure regulator sluggish.

A. Sticking caused by dirt.
B. Regulator may be O.K. but gauge is sluggish.
C. Regulator may be damaged.

V. Pressure too high (common in band spraying).

A. Insufficient by-pass provided.
B. Pump turning too fast.
C. Pump too large.

VI. Pressure too low.

A. Too much by-pass.
B. Pump turning too slowly.
C. Pump too small.
D. Pump has lost capacity (see I and II above).

VII. Nozzle rates do not check with indicated pressure.

A. Pressure gauge is inaccurate.
B. Screens clogged causing pressure loss.
C. Nozzles are partly clogged.
D. Lines from regulator too small.
E. Nozzles may be worn or damaged.

VIII. Uneven rate applied by different sections of the boom.

A. Line screens may be plugged.
B. Different-sized hoses to boom.
C. Nozzles may be different sizes or have different rates due to clogging, damage, or wear.

IX. Excessive drifting.

A. Nozzles too small, producing fine particles.
B. Too high pressure spray patterns tend to disintegrate and drift at pressures in excess of 40 p.s.i.
C. Too much wind.
D. Improper nozzles for job.

X. Uneven nozzle pattern.

A. Nozzle may be damaged--never use a metal object to clean a nozzle tip.
B. Nozzle or nozzle screen may be partly clogged.
C. Insufficient agitation of wettable powder.

<u>Problems peculiar to wettable powders</u>

I. Nozzles plug constantly.

A. Insufficient agitation of solution--may need a larger pump with more by-pass capacity.
B. Screens in nozzles may be too fine--use 100-mesh screen or larger with most wettable powders.

II. Screens plug.

A. Same as I. Wettable powders following emulsion sprays in same sprayer may cause coagulation. Always clean a sprayer thoroughly when changing sprays.

III. Rapid pump wear.

A. Some pumps are not recommended for wettable powders, particularly soft metal gear pumps and rubber impellers.
B. Insufficient agitation or mixing of solution.

Granular Applicators

I. Inconsistent in application rate.

A. Rate will naturally vary somewhat from day to day and from one field to another.
B. Metering gate may be corroded or rusted, or there is too much play in metering device.
C. Application speed is not consistent.
D. Moisture condensation in granules--keep granules dry.
E. Rate gauge on applicator is not always consistent--follow instructions in manual carefully.
F. Hoppers may be tilted.
G. Agitator may be reversed.

II. Uneven application in row.

A. Sagging hose from applicator to bander.
B. Agitator turning too slowly.
C. Field is too rough.
D. Bander may have broken clamp or is loose.
E. Bander is not level.

III. Grinding of granules.

A. Agitator turning too fast.
B. Agitator has turned when metering gate is closed.
C. Worn or loose agitator shaft.
D. Agitator is reversed.

IV. Improper band width.

A. Adjust height of bander.

V. Rate varies between hoppers.

A. Some variation can be expected--check rate constantly for each hopper.
B. Wear or corrosion in hopper bottom, agitator, or metering mechanism.

Further information on application equipment for chemicals is included in the following University of Illinois circulars:

Circular 791--Band Spraying Pre-Emergence Herbicides.
Circular 837--Calibrating and Maintaining Spray Equipment.
Circular 839--Calibrating and Adjusting Granular Row Applicators.

REVIEW OF CHEMICAL AQUATIC WEED CONTROL

Robert C. Hiltibran

Aquatic weed control research was continued during 1961 by the Illinois Natural History Survey. Seventeen preparations were tested to determine their effectiveness on about 22 different aquatic plants. Included in this work were chemical preparations and weed species not used before.

During 1960 an attempt was made to remove cattails from the shoreline of a 14.5-acre lake with either dalapon or amino triazole in combination with mechanical methods (i.e., hand pulling the small shoots). The area was checked through the 1961 growing season to remove surviving plants or regrowth. The results of this test were satisfactory. During 1961 a test was started to eradicate cattails from two ponds. Only chemical methods were used. Fine-leaved cattail is the predominant species in one pond; to date dalapon and amino triazole appear to give good control of this weed. During 1961 liquid 2,4-D was used to control cattails with good results.

A test to remove curly-leaved pondweed, Potamogeton crispus, from a two-acre pond by using endothal was started in 1960 and continued during 1961. The stand of pondweed was removed in May and September 1960 and again in May 1961. By late August 1961, some curly-leaved plants had appeared, and these also were removed. However, on November 16, 1961, a few curly-leaved plants were still present. While eradication was not complete, the weed population has been considerably reduced. The infestation was treated as early as possible to prevent seed production and thereby reduce the possibility of reinfestation. Pondweed has an extensive root system, and reinfestation may occur from the root system as well.

There has been considerable interest in the use of granular preparations for the chemical control of aquatic weeds. The apparent lack of suitable equipment for distributing the granular preparations in water has not prevented their development and promotion. For several years liquid sodium arsenite was widely used to control many aquatic weed species. Thus, most of the application experience has involved liquid preparations. Our experience in applying granular preparations to large areas had not been very satisfactory compared with the ease of applying liquid preparations. During 1961 we therefore undertook to compare the effectiveness of granular and liquid herbicide preparations. Although factors beyond our control obscured some of the results, we were able to make these observations: On curly-leaved pondweed, 0.8 ppm. liquid endothal appeared to be as effective as the granular preparation. Previous results of applying equal rates of liquid and granular endothal on sago pondweed indicated that both preparations were effective; however, effects of the treatment were apparent earlier in areas treated with the granular than with the liquid preparation. While granular endothal has been effective in controlling water milfoil, the liquid preparation has had no effect. Preliminary work has also been done with 2,4-D, 2,4,5-T, and Silvex liquid and granular preparations.

Kursal L and Kursal G, developed by Dow Chemical Company, were approved for aquatic weed control during 1961. The active ingredient in these preparations is the potassium salt of Silvex (2,4,5-TP). These preparations were found to be effective on some aquatic species. These species and the rates of application are given below.

One problem is the toxicity of the various herbicide preparations to fish populations, as well as to members of the fish-food chain. Bioassays conducted in our laboratory show that bluegills can survive 21-day exposure to herbicide preparations applied at the following rates:

Endothal	100 ppm.
G. 2,4-D	3 ppm.
Liquid Silvex	3 ppm.
Potassium salt of Silvex G	10 ppm.
Dalapon	50 ppm.
Amino triazole	21 ppm.

For dalapon, amino triazole, and potassium salt of Silvex, these were the highest rates used; but for endothal, G. 2,4-D, and liquid Silvex higher rates were found to be toxic to bluegills.

At present there is considerable interest in the bottom-soil build-up of herbicides and the effect of the various herbicides on water quality. We have investigated the length of time for which endothal remains toxic in water. In plastic enclosed areas, 10 ppm. of endothal could not be detected by the flaxseed bioassay after 96 hours, but the effects will remain in water for several days.

Below are some suggested rates for applying chemical preparations to control various aquatic weeds:

Group and species	Chemical free acid equivalent	Rate of application	Remarks
Emergent			
Water willow *Dianthera* spp.	Potassium salt of Silvex (L)	1/2 cup/gal.	Wet foliage thoroughly
	Potassium salt of Silvex (G)		
	Liquid 2,4-D	1/2 cup/gal.	"
	Amine 2,4-D	1 cup/gal.	"
Arrowhead *Sagittaria* spp.	L. 2,4-D	1/4 cup/gal.	"
	Amine 2,4-D	1/4 cup/gal.	"
	Potassium salt of Silvex (L)	1/4 cup/gal.	"
Cattails *Typha* spp.	L. 2,4-D	1/2 cup/gal.	Add detergent and wet foliage thoroughly
Bulrush *Scirpus acutus*	L. 2,4-D	1/2 cup/gal.	Wet stems thoroughly
	G. 2,4-D	1 lb./430 sq. ft.	

Group and species	Chemical free acid equivalent	Rate of application	Remarks
Submerged			
Water milfoil *Myriophyllum* spp.	2,4-D G	2 ppm.	
	Potassium of Silvex (G)	3 ppm.	
	" " " (L)	3 ppm.	
Fine-leaved pondweed *Potamogeton foliosus*	Endothal (L)	1 ppm.	
	Endothal (G)	1 ppm.	
Curly-leaved pondweed *Potamogeton crispus*	Endothal (L)	1 ppm.	
	Endothal (G)	1 ppm.	

CROP PLANTING IN RELATION TO WEED CONTROL

W. O. Scott

Summer annual weeds constitute the major weed problem in Illinois. They germinate in the spring and produce seeds before the crop is harvested in the fall. Examples of summer annual weeds are giant foxtail, pigweed, lambsquarter, velvet weed, cocklebur, crabgrass, jimson weed, and annual morning glory. Only a small percent of the seeds of these weeds that are in the soil germinate each year. The rest are dormant and will germinate in later years.

Because these annual weeds produce seeds in late summer or early fall, they are naturally dormant and will not germinate until they go through the winter with freezing and thawing. Some are ready to germinate the next spring. They will begin germination as soon as the soil temperature is around 50° F. The majority of the weed seeds that are going to germinate will do so during the six weeks that follow. In central Illinois, for example, seed germination starts about April 15 to 20, continues at a rather constant rate until June 1, and then decreases rapidly. Only a small proportion of weed seeds germinate during June, July, and August.

It follows, then, that early planting will cause more weeds to germinate after the crop is planted than plantings made near the end of May. In the later plantings, many of the weed seeds will have germinated earlier and will have been destroyed by seedbed preparation. Most farmers will not delay planting corn until the first of June to avoid the weed problem, but they should avoid extremely early planting because the weed seeds will germinate more rapidly than the crop.

It seems logical that the greatest benefits from use of pre-emergence treatments will come in early-planted fields where few weed seedlings have been destroyed before planting.

PROGRESS REPORT ON THE ILLINOIS 2,4-D LAW

J. J. Jeffers

On July 22, 1959, the Illinois Legislature passed House Bill 1475, which concerned the use of 2,4-D, 2,4,5-T, and MCP, to become effective in the spring of 1960. The following information is based on two years of experience with this legislation and its application in various areas of Illinois.

In brief, the 2,4-D and Related Herbicides Act confers upon the Department of Agriculture the responsibility of making rules and regulations governing the use of these chemicals. At the request of the county board or ten or more commercial fruit or vegetable growers, the Department shall determine by public hearing whether actual damage has resulted from the use of these chemicals and may enact regulations governing their use if such damage is evident. These regulations are in force for two years from the date of enactment.

In accordance with this procedure, regulations were enacted in Cook County on June 5, 1960, and in Lake, Kane, McHenry, and Kendall on June 10, 1961. These regulations were as follows:

Regulation 1--No 2,4-D or related herbicides (2,4,5-T or MCP) of the high-volatile esters shall be used in these counties.

Regulation 2--2,4-D and related herbicides of the low-volatile ester or amine forms may be used provided that they are applied with sufficiently low pressure and the wind velocity is such that the chemical will not be carried to susceptible crops.

On June 24 the following regulations were enacted in Hancock County:

Regulation 1--The ester forms of 2,4-D, 2,4,5-T, or MCP shall not be used within the townships of Nauvoo, Appanoose, and Sonora, nor in Sections 1-24 of Montebellow township, of Hancock County during the period of time beginning with the first day of April and ending with the first day of November.

Regulation 2--The amine form of these herbicides may be used at any time provided that they are applied with 20 pounds or less pressure and the air movement at time of application is away from susceptible crops.

Hancock County regulations were for the purpose of preventing injury to grapes, while in the other counties mentioned the purpose was to protect vegetables.

Regulation by a state agency is not a popular idea among users of these herbicides. Hearings held in the six counties mentioned indicate that there has been damage by these materials ranging from very slight to heavy. In many cases the source of the spray material cannot be determined, at times because there are a large number of users in the immediate area and also because damage often does not become evident until some time after the material has been released into the air. The problem of fixing responsibility for such damage is so complicated and unsure that some insurance companies have refused to assume liability for use of the ester forms of the herbicides mentioned.

To further complicate the problem, the 2,4-D and Related Herbicides Act applies only to the user of these herbicides and not to the formulator, manufacturer, or retailer. Any form of these materials may legally be sold, but only certain forms are legal to use in these defined areas. The burden, then, is entirely on the user, but we feel that this does not completely relieve the seller of moral responsibility to sell his product to do a job well, with the safety factor foremost in mind.

In addition, since the incidence of herbicide damage (largely 2,4-D) seems to be increasing each year, it seems logical to assume that the manufacturer and formulator of 2,4-D and related herbicides should pay particular attention to the manufacture of materials which will give the most effectiveness with the greatest margin of safety. In particular, we feel that the long-chain, low-volatile ester formulation and the amine and sodium salt formulations should completely replace the high-volatile esters used in the past. This shift may meet with some resistance because of cost to the user and reluctance to change, but we believe it is highly desirable to prevent future restrictive legislation on these very important weed control tools.

Violators of the regulations which have been set up in the six counties are subject to prosecution by local law enforcement officials and fines not to exceed $1,000. These regulations do not relieve the user of responsibility for damage he may inflict, even if he applies the herbicides in accordance with the regulations. In our two years of experience with these regulations, we have not had a single incidence requiring legal action of any kind. This indicates that either the regulations are being followed and are effective or else no one knows how to make complaint.

In conclusion, we are satisfied with the operation of the 2,4-D law because it keeps restrictions to a minimum. Severe regulation of herbicide use is undesirable and can be avoided by the acceptance of proper responsibility by the user, the manufacturer and formulator, and the retailer or salesman. Of course, the user still assumes the greatest responsibility here, in that he alone is liable for his mistakes in applying these materials. If he errs, he will be petitioned for damages and then may be handicapped by future regulations on his use of herbicides. We hope this series of events can be avoided.

RECOMMENDATIONS FOR WEED CONTROL IN CORN AND SOYBEANS FOR 1962

E. L. Knake

Corn

Considerable progress has been made in recent years in the development of pre-emergence herbicides for corn. These pre-emergence herbicides should not be considered replacements for good cultural practices, but they are efficient and effective "chemical tools" to supplement other weed control practices. The pre-emergence herbicides are particularly helpful where serious weed problems, especially annual grasses, exist.

The following pre-emergence herbicides are recommended for corn in Illinois in 1962. Atrazine or Randox is preferred.

Atrazine controls both annual grasses and broad-leaved weeds. Corn has very good tolerance to it. It has a long enough residual to control weeds during most of the season. It requires a little more rainfall than the more soluble materials, but under heavy rainfall conditions its effectiveness is not destroyed. It has performed especially well on soils that are low in organic matter.

Winter grain should not be sown on fields where a spring application was made, but except for silage corn and sweet corn very little corn is harvested in time for seeding grain in the fall. In some cases injury to spring oats has been reported.

Avoid residue problems by using the recommended rate for the soil type. Especially when broadcast applications are made, use care not to duplicate applications by overlapping or making extra passes on field ends when turning or emptying the applicator.

Simazine is preferable to atrazine on sandy soils.

Randox controls annual grasses but not broad-leaved weeds. Corn has relatively good tolerance to it. Since it is more soluble than atrazine, it requires less rainfall to make it work, but under heavy rainfall conditions it may be leached too deeply for most effective control. Randox has performed especially well on the darker soils with relatively high organic matter. It has a definite place where such annual grasses as the foxtails are serious. Take precautions to avoid irritation to skin and eyes. Granules will help reduce the irritation problem but not eliminate it.

2,4-D ester is primarily for control of broad-leaved weeds but may give some control of annual grasses if sufficient rain falls within a few days to a week after application. Corn may be injured if heavy rains occur soon after treatment. Do not use 2,4-D ester on sandy soils. The amine form of 2,4-D is not recommended for pre-emergence application, since it is more subject to leaching than the ester form.

Randox-T is a mixture of CDAA (Randox) plus TCBC (trichlorobenzyl chloride). The TCBC improves control of broad-leaved weeds considerably, but observations thus far indicate some possible difficulty with crop tolerance, particularly under heavy rainfall conditions, and toxicity to soybeans the year following application to corn has not been fully determined. The precautions for avoiding irritation are the same for Randox-T as for Randox.

Eptam is recommended for controlling seedlings of Johnsongrass or wild cane only in areas where these weeds are a problem. It may be broadcast or banded and should be worked into the top inch of soil with a harrow or rotary hoe. Although some damage may occur to corn from Eptam, it is not nearly so severe as the damage from Johnsongrass or wild cane.

Post-emergence application of 2,4-D in corn is still one of the most economical practices we have for controlling broad-leaved weeds in corn. Where susceptible broad-leaved weeds, such as pigweed or morning-glory, are the major problem, post-emergence application of 2,4-D is preferred to any of the pre-emergence applications.

Soybeans

The development of herbicides has been slower for controlling weeds in soybeans than in corn. Although we still do not have satisfactory chemicals to recommend for post-emergence applications in soybeans, several pre-emergence materials now offer considerable help.

The following pre-emergence herbicides are recommended for soybeans in Illinois for 1962. Amiben or Randox is preferred.

Amiben had label clearance at the beginning of the 1961 season only for use on soybeans raised for seed, but it now has clearance for soybeans moving through regular market channels. Although this herbicide is relatively new, results of research and field use have been very encouraging. Amiben controls both annual grasses and broad-leaved weeds. In the 1961 county demonstrations it ranked above all other materials, giving good or fair weed control at about 85 percent of the locations. The granular form will probably not be available commercially until 1963.

Randox is recommended for control of annual grasses in soybeans. The comments indicated under Randox for corn apply also for soybeans. Do not use Randox-T for soybeans.

Alanap can give good control of annual grasses and many broad-leaved weeds when moisture is adequate. But when heavy rains occur soon after application, damage to soybeans may result, causing some stand reduction. Since Alanap alone does not give good control of smartweed, a mixture of Alanap and CIPC (2 pounds active of each) may be used to improve control of smartweed, but this mixture probably does not decrease the possibility of injury to soybeans. Both granular and liquid forms of Alanap will be available in 1962.

Sodium PCP is not new, but it did not have label clearance for pre-emergence use on soybeans until just prior to the 1961 season. It will be marketed under at least two trade names--Napclor and Weedbeads. The latter material may be applied dry as granules or the "beads" may be dissolved in water for spray application. Sodium PCP controls broad-leaved weeds better than grasses. It has performed better on soils relatively low in organic than on those higher in organic matter. Since dusts and sprays cause sneezing and are irritating to nose, throat, and eyes, take necessary precautions when using it. This material is sometimes called "penta," but for soybeans be sure to use sodium pentachlorophenate and not the wood preservative pentachlorophenol. A rate of 20 pounds of active material per acre is suggested. This rate may be decreased by a few pounds on lighter soils and increased by a few pounds on darker soils.

Dinitro (DNBP) is one of the older materials still available for pre-emergence use on soybeans. It gives better control of broad-leaved weeds than grasses. Since it is irritating and can cause yellow staining of materials it contacts, it should be handled carefully. Dinitro may be applied soon after planting or just before soybean emergence. It should not be used on sandy soils. Dinitro is available in both liquid and granular form. The suggested rate is 7 1/2 pounds of active per acre.

THE INSECT SITUATION FOR 1962

H. B. Petty

In general, insects were more abundant in 1961 than in 1960. As a result, control had to be stepped up. The extent of treatment of field crop insects is shown in Table 1.

Table 1.--Acres of Field Crops Treated With Insecticides and Estimated Profit From Treatment, Illinois, 1961

Crop and insect	Acres treated	Estimated profit*
Clover and alfalfa		
Cloverleaf weevil	32,715	$ 49,072
Potato leafhopper	15,473	23,209
Meadow spittlebug	24,041	24,041
Sweet clover weevil	7,697	76,970
Pea aphid	81,740	81,740
Corn		
Soil treatment	2,573,812	7,721,436
Cutworm	92,699	463,495
European corn borer	42,428	169,712
Corn flea beetle	12,269	61,345
General		
Grasshopper	500,754	2,003,016
True armyworm	30,954	154,770
Total	3,414,582	$10,828,806

*Excluding treatment costs.

Soil insecticide use increased this year despite a decrease in corn acreage--2,573,812 acres were treated compared with 1,891,399 in 1960.

The types of treatment and the percentage of total acres treated are shown in Table 2. The increase in amount of fertilizer-insecticide combinations is probably due to use of liquid fertilizer and bulk blending.

Table 2.--Percent of Acreage Treated With Soil Insecticides Applied in Various Combinations, 1957-61

Year	In fertilizer	As spray	As granules
1957	71	23	6
1958	52	28	20
1959	44	26	30
1960	29	23	48
1961	35	21	44

During the winter months or very early spring, 86,800 acres were treated with soil insecticides. This new timing was developed by J. H. Bigger, and for the first time last year was tentatively recommended for large-scale field trials. Failures to control black cutworms with winter applications were called to our attention.

Other failures occurred in preplanting applications where large wireworms were not controlled with 1 1/2 pounds of insecticide.

Grasshoppers were abundant this year, and insecticides were applied to almost ten times as many acres as in 1960, mainly in the northern two-thirds of the state.

Pea aphids were also more abundant than in 1960, particularly in the western area, where some alfalfa and red clover fields were killed. Control in general came too late.

Cutworms were not so severe as in 1959 and 1960. Only 71,586 acres of corn had to be replanted this year compared with 151,665 in 1959 and 115,294 in 1960.

Armyworms were found throughout the state in small to moderate numbers. Usually, with such a general light infestation, some large areas are very heavily infested, but this year only a few areas were infested sufficiently to warrant insecticide control.

Method of application: Methods of applying insecticides were about the same as those of previous years except that airplane applications increased because of winter application of soil insecticide and increased grasshopper control measures (Table 3).

Table 3.--Percent of Total Field Crops Treated by Commercial and Private Applicators in Illinois, 1954-61

	Percent of total acreage treated		
	Airplane	Ground application	
Year	application	Commercial	Individual
1954	18.3	20.2	61.5
1955	24.8	29.0	46.2
1956	24.8	24.8	50.4
1957	16.4	30.1	53.5
1958	3.0 10.8	19.5 28.3	77.5 a/ 60.9 b/
1959	2.6 9.5	14.5 18.6	82.9 a/ 71.9 b/
1960	5.6 17.5	11.9 14.0	82.5 a/ 68.5 b/
1961	7.4 20.5	12.0 12.4	80.6 a/ 67.1 b/

a/ Includes soil insect control, not previously included in these estimates.
b/ Exclusive of soil insect control.

Outlook for 1962

Corn borers: Populations did not increase this year. First-generation populations were generally lower than in 1960 (Table 4), and the overwintering population is not so large. The highest population is overwintering in the north-central section (Map 1, Table 5). In this area planting and weather conditions favoring corn borer survival could lead to infestations warranting use of insecticides.

THE INSECT SITUATION FOR 1962

H. B. Petty

In general, insects were more abundant in 1961 than in 1960. As a result, control had to be stepped up. The extent of treatment of field crop insects is shown in Table 1.

Table 1.--Acres of Field Crops Treated With Insecticides and Estimated Profit From Treatment, Illinois, 1961

Crop and insect	Acres treated	Estimated profit*
Clover and alfalfa		
Cloverleaf weevil	32,715	$ 49,072
Potato leafhopper	15,473	23,209
Meadow spittlebug	24,041	24,041
Sweet clover weevil	7,697	76,970
Pea aphid	81,740	81,740
Corn		
Soil treatment	2,573,812	7,721,436
Cutworm	92,699	463,495
European corn borer	42,428	169,712
Corn flea beetle	12,269	61,345
General		
Grasshopper	500,754	2,003,016
True armyworm	30,954	154,770
Total	3,414,582	$10,828,806

*Excluding treatment costs.

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1955	24.8	29.0	46.2
1956	24.8	24.8	50.4
1957	16.4	30.1	53.5
1958	3.0	19.5	77.5 a/
	10.8	28.3	60.9 b/
1959	2.6	14.5	82.9 a/
	9.5	18.6	71.9 b/
1960	5.6	11.9	82.5 a/
	17.5	14.0	68.5 b/
1961	7.4	12.0	80.6 a/
	20.5	12.4	67.1 b/

a/ Includes soil insect control, not previously included in these estimates.
b/ Exclusive of soil insect control.

Outlook for 1962

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Table 4.--First- and Second-Generation Corn Borer Populations

	Oct. 1957	July 1958	Oct. 1958	July 1959	Oct. 1959	July 1960	Oct. 1960	July 1961	Oct. 1961
Northwest									
Ogle	50	25	124	11	211	18	160	5	49
Whiteside	65	19	165	10	184	6	76	1	131
Bureau	77	--	--	10	208	5	36	5	107
Mercer	171	47	164	2	100	1	132	5	111
Average	91	30	185	8	176	8	101	4	100
Northeast									
Boone	59	4	36	5	64	11	75	3	47
DeKalb	40	17	99	6	200	1	57	2	136
LaSalle	115	--	--	12	120	0	55	3	141
Average	71	10	68	8	128	4	62	2	108
East									
Kankakee	63	9	48	1	107	5	59	3	133
Iroquois	44	1	47	2	61	12	122	7	109
Livingston	--	13	93	3	85	3	129	5	59
Champaign	25	2	24	1	3	1	13	0	5
Average	44	6	53	2	64	5	81	4	76
Central									
McLean	18	4	134	6	118	5	247	1	79
Logan	34	1	98	1	12	2	54	1	18
Average	26	3	116	4	65	4	150	1	49
West									
Knox	102	13	203	4	108	26	135	4	53
McDonough	78	38	149	3	65	13	193	1	48
Average	90	26	176	4	87	20	164	3	51
West-Southwest									
Christian	55	1	73	2	36	15	114	2	21
Sangamon	83	1	35	1	14	1	90	1	13
Macoupin	99	1	50	1	127	36	192	3	72
Greene	--	1	40	1	69	13	234	7	30
Average	79	1	50	3	62	16	158	4	34
Over-all av.	67	13	107	4	100	9	114	3	72

Average First- and Second-Generation Corn Borer Populations (11-County Comparison)

Year	First generation	Second generation
1954	--	--
1955	67	570
1956	94	203
1957	6	63
1958	16	103
1959	5	109
1960	9	117
1961	3	82

Table 5.--Corn Borer Fall Population Surveys in 36 Counties, 1954-61
(County Averages Expressed in Borers per 100 Stalks of Corn)

	1954	1955	1956	1957	1958	1959	1960	1961
Northwest								
Jo Daviess	140	609	110	90	94	114	68	46
Winnebago	171	414	201	43	57	83	131	51
Ogle	422	852	148	50	124	211	125	49 49
Whiteside	340	401	292	65	165	184	76	131
Bureau	325	270	90	77	158	208	36	97
Mercer	763	382	408	171	164	100	132	111
Average	360	488	208	83	127	150	95	81
Northeast								
Boone	98	334	106	59	36	64	75	47
Lake	103	243	127	57	57	39	24	12
DeKalb	324	541	186	40	99	200	57	126
DuPage	134	395	104	111	55	59	65	34
Will	445	435	97	39	36	75	92	76
LaSalle	289	532	225	115	101	120	55	127
Average	232	413	141	70	64	93	61	70
East								
Kankakee	519	600	86	63	48	107	59	133
Iroquois	511	839	88	44	47	61	122	109
Livingston	677	887	127	21	93	85	129	59
Vermilion	323	840	135	30	34	11	41	14
Champaign	104	622	283	25	24	3	13	5
Average	427	758	144	37	49	53	73	64
Central								
Peoria	515	300	198	114	81	53	160	121
Woodford	524	343	169	97	168	121	205	122
McLean	490	628	161	18	134	118	247	49
Logan	140	291	211	34	98	12	54	18
Macon	98	359	404	31	31	28	29	12
Average	353	384	228	59	102	66	139	64
West								
Henderson	382	424	305	189	146	87	136	117
Knox	240	434	353	102	203	108	135	53
Hancock	224	215	94	244	192	64	278	35
McDonough	330	323	183	78	149	65	193	48
Adams	79	107	58	159	138	175	207	62
Brown-Cass	131	248	110	87	98	109	91	41
Average	231	292	184	143	154	101	173	59
West-Southwest								
Sangamon	38	238	208	83	35	14	90	13
Christian	17	117	227	55	73	36	114	21
Madison	4	53	50	45	29	33	111	77
Average	20	136	162	61	46	28	105	37
Southwest								
St. Clair	21	14	74	45	9	9	38	13
Average	21	14	74	45	9	9	38	13
East-Southeast								
Moultrie	23	225	122	27	53	9	29	6
Clark	20	47	16	10	16	27	20	12
Jasper	1	16	52	3	18	16	49	53
Lawrence	--	36	2	10	31	29	41	8
Average	15	81	48	13	20	20	35	20
AVERAGE, ABOVE 36 COUNTIES	256	378	161	70	86	79	98	59
AVERAGE, ALL COUNTIES SURVEYED	182	282	143	66	73	74	101	56

Grasshoppers: If there are no hard, beating rains during June hatching, we can expect a moderate to severe infestation of these pests (Map 2).

Chinch bugs: Moderate infestations may occur in a limited area in eastern Illinois if drought should develop in late May and early June (Map 3).

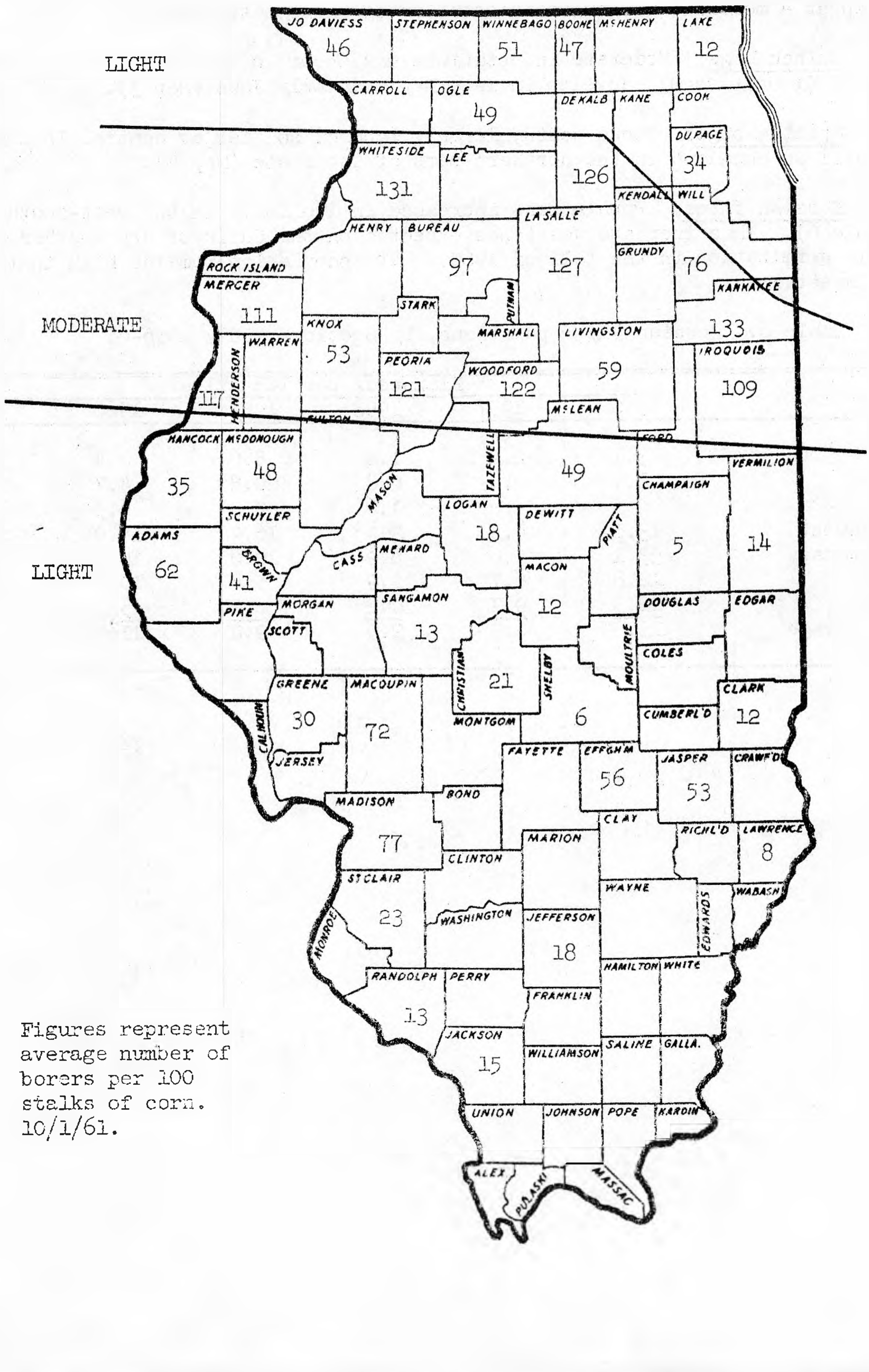
Spittle bugs: These pests, largely ignored so far as control is concerned, will be abundant in the northern part of the state (Map 4).

Hessian flies: Populations increased in 1961 only in the west-southwest area (Table 6). This increase was to be expected on the basis of dry weather and poor early germination in the fall of 1960. The population remains high in the west-southwest area.

Table 6. Hessian Fly Populations, by Sections, July 1956-61

Section	Flaxseeds per 100 tillers					
	1956	1957	1958	1959	1960	1961
West	3.1	2.2	1.6	8.0	4.4	1.5
Central	1.4	2.0	0.8	20.8	4.7	2.0
East	--	--	1.6	0.8	6.9	1.5
West-southwest	13.1	4.9	3.4	16.4	18.0	21.2
East-southeast	33.1	7.6	6.2	10.0	10.0	3.8
Southwest	12.8	6.7	2.9	5.4	10.7	7.7
Southeast	22.3	9.7	0.2	6.2	15.7	3.6
State average	15.5	6.3	2.9	9.2	11.4	8.0

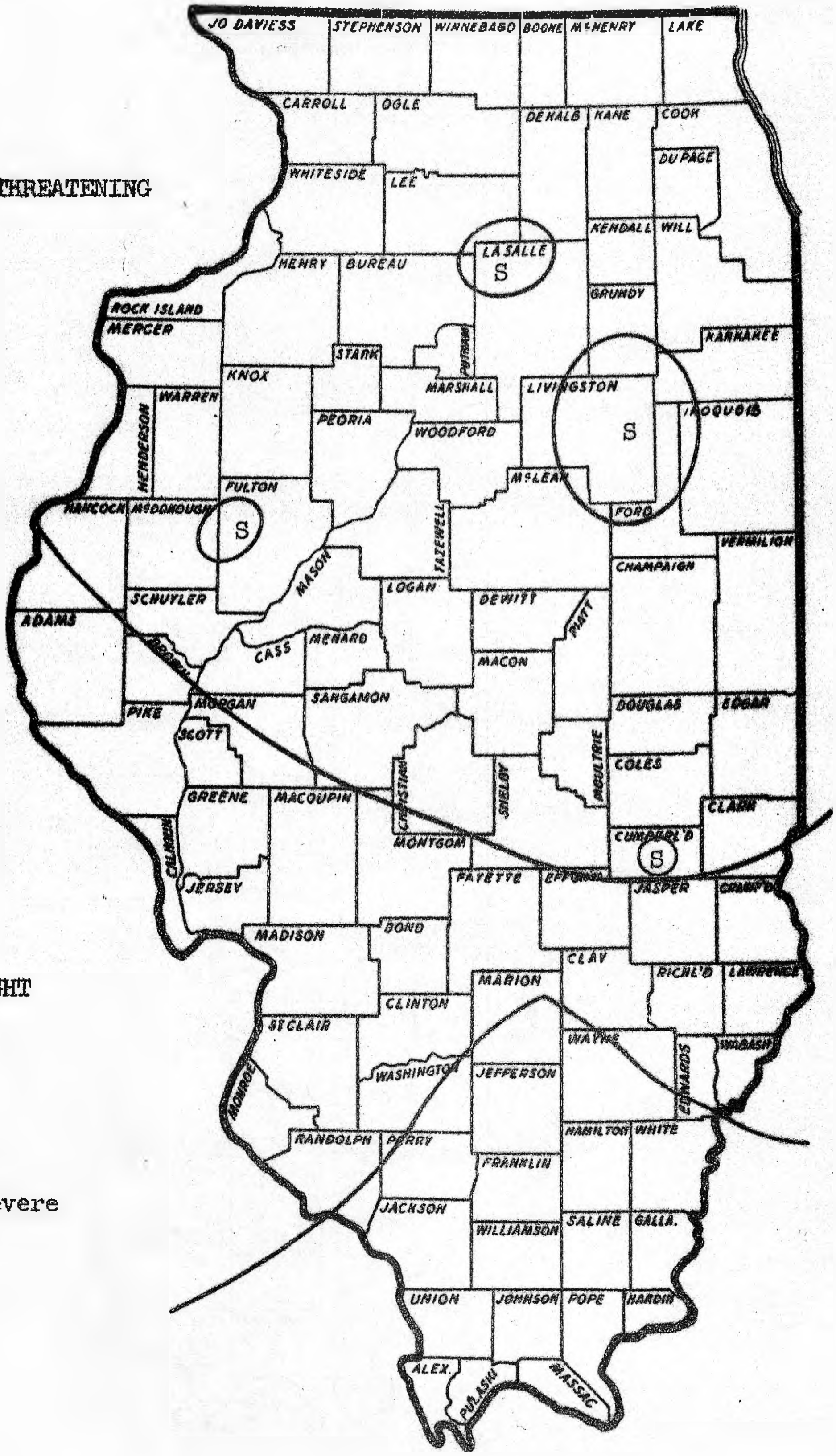
MAP 1.--EUROPEAN CORN BORER PROSPECTS, 1962



Figures represent average number of borers per 100 stalks of corn. 10/1/61.

MAP 2.---GRASSHOPPER PROSPECTS, 1962

MODERATE TO THREATENING

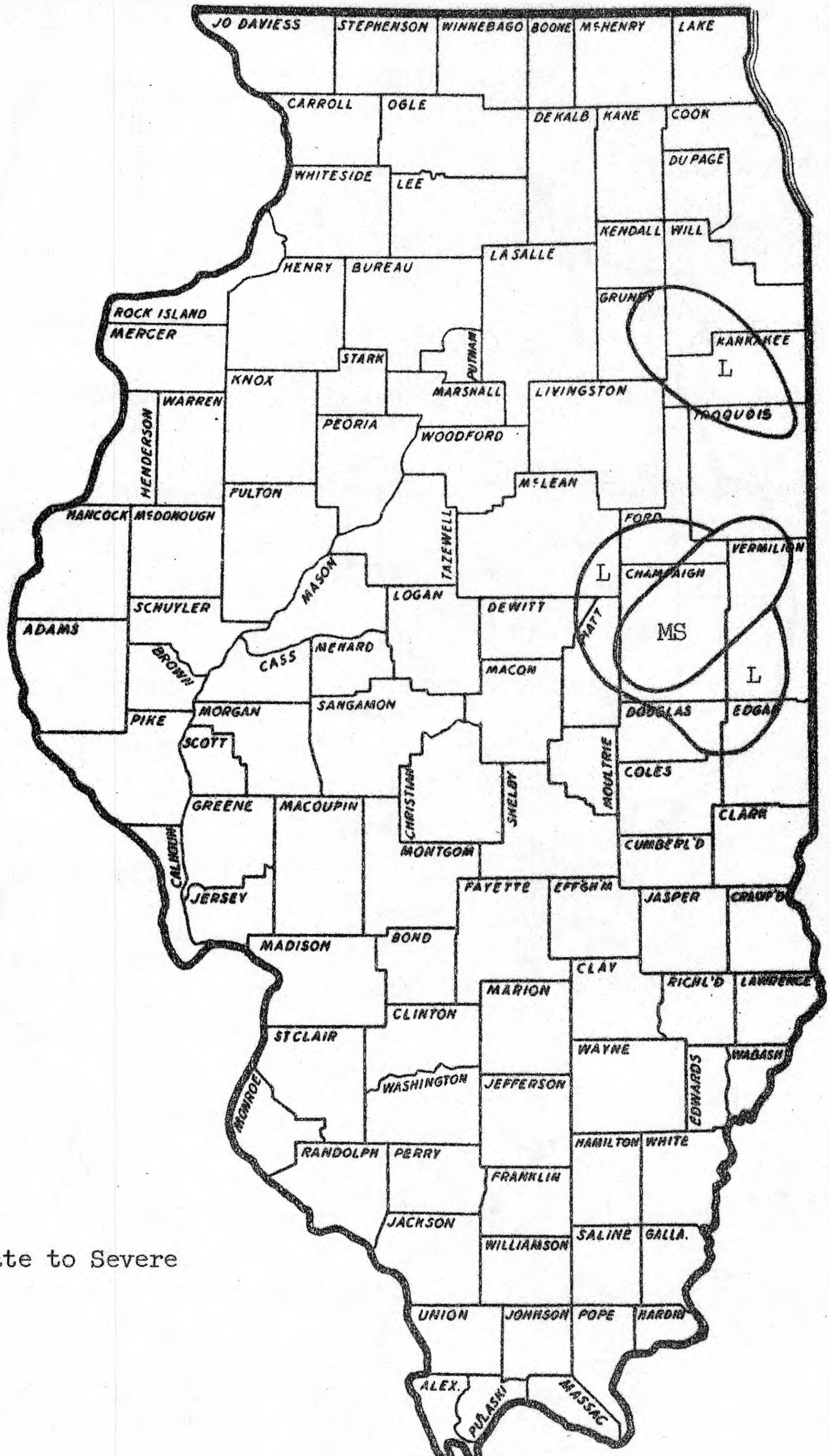


LIGHT

CODE:

S = Severe

MAP 3.--CHINCH BUG PROSPECTS, 1962

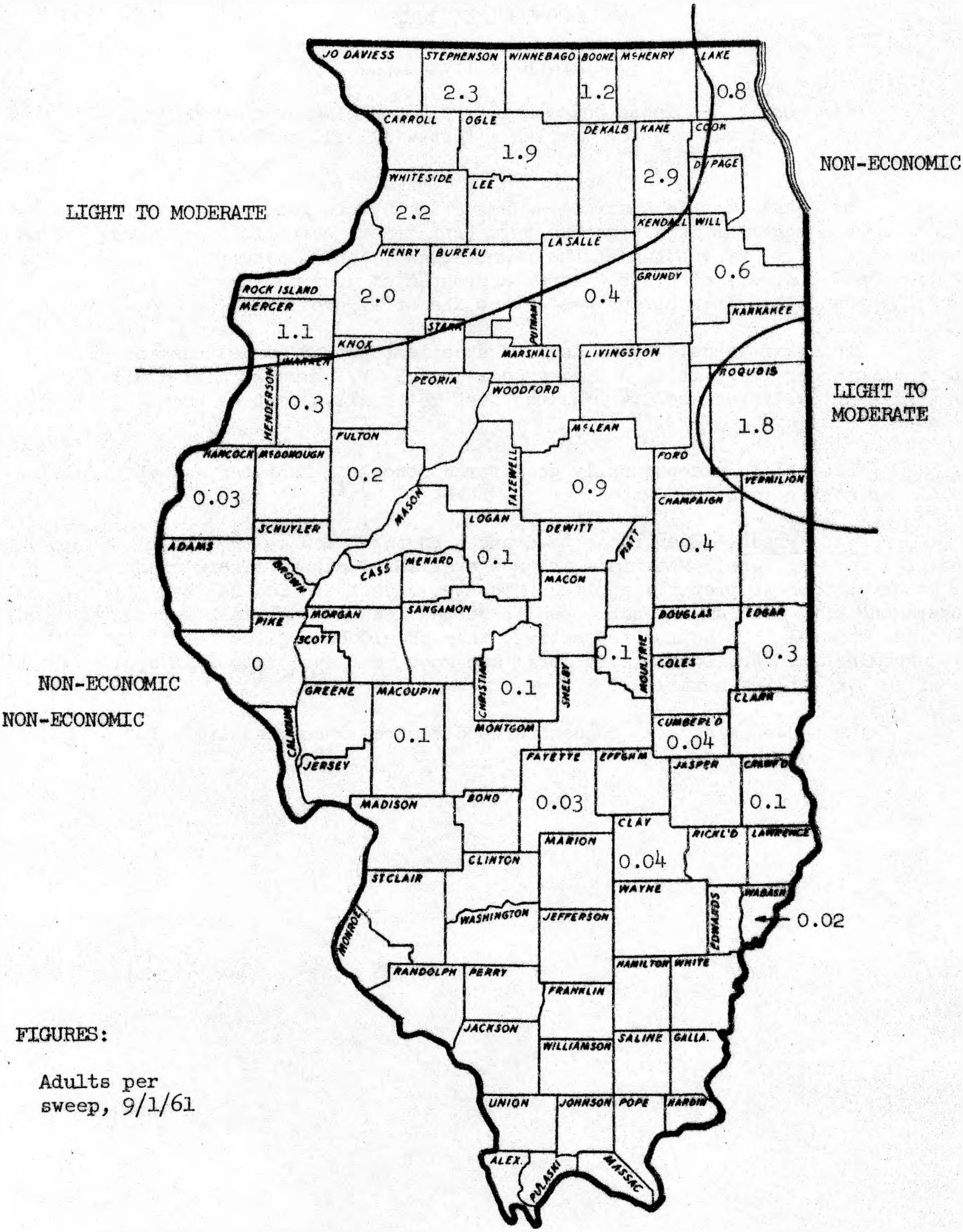


CODE:

L = Light

MS = Moderate to Severe

MAP 4.--SPITTLEBUG PROSPECTS, 1962



WEED CONTROL IN TURF

F. W. Slife

Weed control in lawns and other turf areas has advanced rapidly within recent years. Chemicals are now available that will kill most of the weed problems in grass.

The first step in controlling weeds in turf is good management. The result of good management is a vigorous turf that offers competition to weeds. Good management consists of cutting at the right height, fertilizing properly, watering properly, and controlling pests. After a program of good management, there are chemicals that will clean up any weeds that are still present.

Broadleaf Weeds. 2,4-D does an excellent job on dandelions and plantain, but on some other weeds it is not so good as 2,4,5-TP, commonly called Silvex. Silvex will eventually replace 2,4-D as the best material to control broad-leaved weeds in lawns.

Endothal is exceptionally good for controlling knotweed and white clover, two of our most common lawn weeds.

Grass Weeds. The greatest advances in turf weed control have been made with crabgrass killers. Materials are now available that eliminate crabgrass for the entire season if properly applied. The two newest are Dacthal and Zytron. These along with calcium arsenate seem to be the leading materials for pre-emergence crabgrass control. To be most effective, they should be applied before the crabgrass germinates. Applications in April are good, but even late fall applications are effective for the next year.

The table on page 43 condenses weed control recommendations for turf.

Weed pest	Chemical	Trade name	How used	Remarks
Chickweed and Henbit	2,4,5-TP	Numerous	Post-emergence. Fall and/or early spring applications.	Controls most weeds susceptible to 2,4-D.
Crabgrass	Dacthal	RID	Pre-emergence.	- - - - - - - - - - - - - - - - - - - -
	Calcium arsenate	Numerous	Pre-emergence.	May thin grass.
	Lead arsenate	Numerous	Pre-emergence.	- - - - - - - - - - - - - - - - - - - -
	Chlordane	Halts, etc.	Pre-emergence.	Reduces mole activity.
	Zytron	Zytron	Pre-emergence.	- - - - - - - - - - - - - - - - - - - -
	Disodium methyl-arsonate and related arsonates	Sodar, Methar DSMA, Benzar DiMet, AMA, Clout, etc.	Post-emergence. Spray or granular.	Rate must be reduced under high temperatures and drought conditions.
Dandelions, dock, plantains, and most other broad-leaved weeds	2,4-D 2,4,5-T 2,4,5-TP	Numerous Numerous Numerous	Post-emergence. Spray or granular application. Fall and spring applications required.	Will injure flowering and vegetable plants and ornamental shrubs. Use only amine salt.
Foxtails, barnyard grass, and other annual grasses	Disodium methyl-arsonate and related arsonates	Sodar, Methar, DSMA, DiMet, AMA, Clout, Benzar, etc.	Post-emergence.	Two applications at weekly intervals usually necessary.
Knotweed	2,4,5-TP	Numerous	Post-emergence while knotweed is young.	Use amine at 2X rate for dandelions, etc.
	Endothal	Penco Endothal Turf Herbicide	Post-emergence.	Knotweed is difficult to wet. Add wetting agent.
Nimblewill	Endothal	Penco, Endothal, Turf Herbicide	Post-emergence.	Two applications needed at 10-day intervals (results variable).
	Zytron	Zytron	Post-emergence.	Two applications needed (results variable).
White clover	2,4,5-TP Endothal	Numerous Numerous	Post-emergence.	Repeated applications may be necessary for eradication.
Wild garlic and onions	2,4-D	Numerous	Post-emergence. Fall and spring applications.	Use low-volatile ester at 2X rate for dandelions. Will require three or more years to eradicate.

NOTE

READ THE LABEL. FOLLOW MANUFACTURER'S DIRECTIONS CAREFULLY. EXCESSIVE RATES WILL CAUSE INJURY TO LAWN GRASSES.

CHEMICAL CONTROL LAWN GRASS DISEASES

Malcolm C. Shurtleff

The accepted standard for fine lawns (and golf course fairways, parks, parkways, cemeteries, and other turf areas) has risen steadily in recent years. This change has come largely from continued research in turf culture, such as watering, fertilizing, and other maintenance practices, grass mixtures, and introductions of new grass strains, plus new weed, insect, and disease control chemicals.

Lawn grasses (primarily bluegrasses and fescues) are attacked by more than 100 disease-causing organisms. Injuries vary considerably from year to year and even within a given season. The prevalence of diseases depends on such factors as temperature, humidity, rainfall, soil texture and drainage, grass varieties or species, turf vigor, presence or absence of thatch, and such cultural practices as watering, fertilization, mowing, and aerification.

Lawn grasses and the fungi that cause plant disease are both living organisms that require nutrients, moisture, and sunlight. The fungi are different, however, in that they cannot make their own food like living grass plants, but must obtain it from either living or dead plant material. When fungi attack living plants, they cause disease.

When disease strikes your lawn or turf area, several interrelated phenomena must have occurred: presence of a disease-producing organism, presence of a susceptible grass, and correct temperature, moisture, state of turf vigor, and other factors that tended to favor the disease-producing fungus over the grass host. Turf disease, then, is the end result of the interaction between a disease-producing fungus and a grass. In this case the fungus happened to get the upper hand.

Generally speaking, steadily growing grass that is established and maintained according to recommended management practices is less likely to become seriously injured by disease attacks than grass that is not.

The severity of turf diseases may be kept to a minimum by following as many of these practices as you find practical:

1. Provide for adequate drainage when establishing a new turf area.

2. Follow a recommended fertilizer program. During hot weather, do not use excessive rates of fertilizers that are high in quickly available nitrogen.

3. If possible, do not clip bluegrasses or fescues too closely--1 1/2 to 2 inches in the spring and fall and 2 to 3 inches during midsummer are usually recommended. Shorter clipping encourages a shallow root system. Creeping grasses, such as Zoysia, Bermuda grass, and bent grass, may be clipped 1/2 inch or less.

4. Mow frequently so that no more than one-third of the leaf surface is removed at any one time.

5. In dry weather water three or four hours or more per setting so that the soil will be soaked to a depth of 6 inches or more. Repeat in one or two weeks if the weather remains dry. Avoid overwatering and waterlogging the soil. The grass should be dry before evening. Remember that the more often grass is wet and the longer it remains wet, the greater will be the chance of a disease problem. The reason is that most fungi need moisture in order to penetrate grass leaves and stems and cause disease.

6. Remove clippings whenever possible. Nearly all parasitic fungi are capable of thriving in the damp mulch from clippings or thatch. Do not allow clippings to accumulate more than one-fourth inch deep. Frequent mowing will help.

7. Prune or remove dense trees and shrubs that shade or border turf areas. This improves air circulation and light and helps to dry off the grass much more quickly.

8. Use a grass mixture. Diseases spread and build up more rapidly in a pure stand of a single grass than where two or more grasses are mixed together.

9. Identify the disease correctly and apply the recommended fungicide spray when symptoms are first evident. The new broadspectrum fungicides, such as Ortho Lawn and Turf Fungicide, Thimer, Tersan OM, Kromad, Actidione-thiram, and Panogen Turf Spray, are all effective for a number of the major turf diseases. We believe these are the chemicals that the home lawn enthusiast should use.

10. Spraying is the preferred method of applying turf fungicides. You can use compressed air, knapsack, wheelbarrow-type force pump, trombone-type force pump, or power sprayers to deliver as little as 2 1/2 gallons per 1,000 square feet (for controlling leaf spot, rust, and powdery mildew) or as much as 10 gallons per 1,000 square feet (for controlling snow molds, dollar spot, and melting out). The higher rate is usually used in hot weather to reduce injury from mercury-containing fungicides or other chemicals apt to cause burning. Turf injury may often be avoided by spraying in early evening, applying half in one direction and half in the opposite direction.

For a more complete discussion of lawn diseases, get a copy of "Lawn Diseases in the Midwest" from your county extension office or the Department of Plant Pathology, 218 Mumford Hall, University of Illinois. The circular has 10 color plates of prevalent turf diseases and discusses a number of causes of poor turf that either resemble disease or that lead directly to disease. A summary of diseases controlled by various fungicides is given on the next page.

Chemical Control for Lawn Grass Diseases

Disease	Suggested chemicals to use	Remarks
Leaf Spot, Melting-Out	Thimer, Tersan OM, Ortho Lawn and Turf Fungicide, Actidione-thiram, Zineb, Kromad, Panogen Turf Spray	Start applications in early spring when leaf spot is first seen. Repeat at 2- to 3-week intervals during wet seasons in spring and fall.
Dollar Spot	Thimer, Tersan OM, Ortho Lawn and Turf Fungicide, Actidione-thiram, Kromad, Panogen Turf Spray	Attacks occur in warm (60° to 85° F.), moist weather in spring, early summer, and fall.
Powdery Mildew	Sulfur, Karathane, Actidione-thiram	Most prevalent in spring and fall in shady, damp locations. If serious, affected turf may winter-kill.
Rust	Actidione-thiram, Zineb	Water and fertilize to keep grass growing steadily during dry weather.
Snow Molds, Snow Scald, Fusarium Patch	Thimer, Tersan OM (apply once in late fall), Panogen Turf Spray	Attacks occur under snow at edge of melting snow, or during cold, drizzly weather. Avoid late fertilizer applications.
Seed Rot, Seedling Blight	After planting, apply seedbed spray of Kromad, Thimer, Tersan OM, Ortho Lawn and Turf Fungicide, Panogen Turf Spray	Plant fresh, best-quality seed in well-prepared, fertile seedbed. Avoid over-watering after planting. Avoid low spots in seedbed.
Fairy Rings	Thimer, Tersan OM, Panogen Turf Spray applied monthly in holes 1/2 to 1 inch in diameter, 4 to 5 inches apart, and 6 to 8 inches deep in the ring of stimulated grass and about 6 inches outside the ring.	Control is difficult and not always satisfactory. Aerifying, fertilizing, and watering break up the dense mycelial growth in the soil and "mask" the fairy rings.
Slime Molds	Same as for leaf spot, where practical	Nonparasitic; will soon disappear. Wash or rake away.

TURF INSECTS

H. B. Petty

Establishing and maintaining a good turf, whether in a lawn or on a golf green, involves some knowledge of insects and their control. Condensed insecticide recommendations are included on the back of the summary of proceedings.

Chiggers, ants, ground-nesting wasps, snails, slugs, and a host of others are nuisances but are rarely major pests. Grubs, webworms, leafhoppers, cutworms, armyworms, chinch bugs, and earthworms can be destructive at times.

Several species of grubs, such as the true white grub, annual white grub, Japanese beetle, etc., may damage turf. Although adults of these species differ in both appearance and life cycles, the damage they do is similar. When large spots of sod die during the summer and fall, turning back the sod will show that the U-shaped grubs have completely consumed the root system. On established turf, apply aldrin, dieldrin, heptachlor, or chlordane, and water it in. To obtain the best penetration, apply as a spray during wet weather. For new seedings apply the insecticide and work it into the soil before seeding.

Earthworms of various species may mound up balls of mud in lawns, causing them to be uneven as well as muddy. Although we sometimes hear the prediction that agricultural insecticides will eliminate earthworms from farms, I defy anyone to tell us how to worm-proof sod with anything less than 10 pounds of chlordane per acre. This amount will provide relief for most of one season.

Webworms of several species may seriously damage well-watered sods during periods of drought. The moths concentrate their egg-laying in these areas and thus provide an abnormally high population in a limited area. The gray to cream-colored worms have black spots. They cut the blades of grass and pull them into a silk-lined burrow, where they devour them. Flooding may bring some of the worms to the surface and is the best method of finding them. Damage appears as brown areas that have a shaved appearance.

In using DDT sprays, first water the turf thoroughly, let it dry, then spray to run-off, and do not irrigate for 72 hours.

Leafhoppers may become serious pests after use of chlordane, dieldrin, aldrin, or heptachlor. Light applications of DDT will usually control them.

CHEMICAL GRASS MOWING ON HIGHWAYS

B. J. Butler

Chemical mowing refers to the use of growth inhibitors to reduce or eliminate mechanical mowing of plant growth. Roadside mowing is a major item in the nation's highway maintenance budget. The interstate system is adding about 27 acres per mile to the large acreage already mowed. A large percentage of both old and new roadsides is quite expensive to mow because of steep side slopes, signs, guard rails, trees, shrubs, drainage structures, etc. Consequently, the cost of mowing an acre of roadside for a year is many times higher than the cost of mowing an acre of farm land. Highway officials have been looking for ways to reduce these costs. One recently accepted practice is control of weeds with 2,4-D. Another practice that is being closely examined is the use of growth inhibitors.

Several chemical compounds have been found that inhibit the growth of various plant species, but only one, maleic hydrazide, has been used in large-scale tests and is being used in roadside cover maintenance programs. An inhibitor used on roadsides must work on a large variety of plants. Maleic hydrazide, or MH-30 as it is commercially known, in proper concentration in a growing plant, prevents cell division. It must be sprayed on an actively growing plant and hence gives the best results if applied in the first few weeks of grass growth in the spring or the last few weeks of growth in the fall. Because it is slowly absorbed through the plant leaves, it must be applied at least 12 hours before a rain. It will not inhibit annual weeds or grasses emerging after treatment; therefore 2,4-D spraying has usually been continued where maleic hydrazide has been used.

MH-30 has been most satisfactory at rates of 4 to 6 pounds of active ingredient per acre. Rates below 4 pounds have not consistently inhibited growth for a long enough period, while rates over 6 pounds often cause undesirable browning of foliage. The browning will disappear in a few weeks, however. MH-30 is usually applied in water, with 50 gallons or more of the solution applied per acre.

In view of the narrow range of suitable application rates, an even application is desirable. Broadcast spray booms, off-center nozzles, and air-blast sprayers have been successfully used to apply the chemical to roadsides. Broadcast spray booms permit an even application, but obstacles hinder their use. Off-center nozzles are not affected by obstacles, but are limited in width of coverage and even applications are difficult to obtain. Air-blast sprayers permit coverage of wide roadsides, steep areas, etc., but permit more drifting. Except for the loss of chemical, drifting is not a serious problem, as it does not cause plant damage like 2,4-D but only temporarily slows growth. On food crops, the residue tolerance for MH-30 is 150 ppm.

Several highway departments, including the Connecticut State Highway Department, have worked with maleic hydrazide for many years. Through the efforts of Mr. William Greene, state landscape engineer, Connecticut started using this chemical on a larger scale in 1959. In the past three years, 2,200 acres have been treated, primarily on hard-to-mow areas. On fill areas in urban sections along the Connecticut turnpike, MH-30 has controlled grass growth each year for three years. Mowing costs previous to treatment were $70 per acre; use of the chemical has reduced costs about 50 percent. Several other eastern states are now using it on a limited scale in hard-to-mow and frequently mowed areas where the savings in mowing costs will more than offset the considerable cost of the chemical.

Several midwestern states, including Illinois, experimented with maleic hydrazide in 1961 and will probably make trial applications again in 1962. When properly used on carefully selected areas, this chemical, even though it is fairly expensive and subject to several limitations, has been shown to be capable of reducing roadside cover maintenance costs. Chemical mowing with MH-30 or other yet undeveloped or undiscovered chemicals will probably increase, since mechanical mowing costs will continue to rise with the trend toward higher levels of maintenance.

A POISON IVY CONTROL PROGRAM

E. L. Knake

Each year many persons who enjoy the outdoors suffer from poison ivy. During 1962 the College of Agriculture plans an intensive program to help the public recognize and learn to control this menace.

Materials available from the College of Agriculture will include the following:

1. A colored slide series with 36 frames, "Identification and Control of Poison Ivy," may be purchased as a double-frame filmstrip for $1.25 for single copies or $1.00 each in lots of 10 or more from Jack Everly, Extension Editorial Office, College of Agriculture, University of Illinois, Urbana, Illinois.

2. A circular, "Control Poison Ivy," will be available from the Information Office, College of Agriculture, Mumford Hall, Urbana, Illinois. Quotations may be requested for quantity orders.

3. A 60-second and a 20-second film will be available for public service spot announcements on TV.

4. Illustrated news mats and news stories will be available to editors of newspapers and other publications.

These educational aids illustrate the identification of poison ivy primarily by its leaflets in groups of three with much variation in shape.

Although "brush killer" (a mixture of 2,4-D and 2,4,5-T) and "Ammate" are available for control, primary emphasis is placed on control with amitrole, which is most effective.

For treating small patches, amitrole is available in convenient aerosol cans.

For treating with a small hand sprayer, mix 3 level tablespoons of the commercial preparation containing 50 percent amitrole with one gallon of water. For large areas, mix one pound of the 50 percent material in 25 gallons of water.

Apply amitrole any time after the leaves have reached their full size. Do not allow amitrole to contact desirable vegetation.

With very effective chemical control now available for poison ivy, there is little excuse for this pest near homes, camps, parks, beaches, golf courses, and other recreational areas. We hope that you will consider promoting poison ivy control in your community in 1962.

DAIRY FARM FLY CONTROL

Steve Moore III

Our objective during 1960 and 1961 was to compare certain types of fly control programs commonly used by dairy farmers to determine, on a cost-performance basis, the best type of program for the average dairy farmer.

Nine dairy farms on production-testing programs, located in three southwestern Illinois counties, were used in these demonstrational tests in 1961. A similar study was conducted in 1960 in four counties along the northern Illinois border. Three different fly control programs were compared in each of the three counties, so each program was replicated three times. The three programs were (1) residual spraying plus use of a repellent spray on half the herd and a standard stock spray on the other half; (2) barn fogging with either a portable or a permanent system, plus use of a repellent spray on half the herd and a standard stock spray on the other half; and (3) no barn treatment, but use of a repellent spray on half the herd and a standard stock spray on the other half.

The materials consisted of 25 percent diazinon (1.0%) and ronnel (1.0%) emulsion concentrates, fogging concentrate containing 0.1 percent pyrethrin plus 1.0 percent piperonyl butoxide, a 0.4 percent R-326 synergized repellent spray, and an 0.5 percent tabatrex synergized repellent spray. Face fly baits containing 0.2 percent DDVP in corn sirup were applied to the foreheads of all cattle in each herd as needed.

Farms on which residual sprays were used had the fewest flies. Control was rated good to excellent. Farms on which a fogger was used had noticeably more flies, and control was rated fair with a range of good to poor. Farms on which no chemical control was used had high fly populations.

The fly control results for the counties in the southwestern section this year indicate that the greatest benefits from the repellent-treated groups came in herds where residual spraying or fogging was used (Table 1). Just the reverse was true in 1960 in the northern counties, where the greatest benefit from repellent-treated groups came in herds where little or no fly control was conducted. The fly intensity increases from year to year in the southwestern section, and this is probably the reason for the lower performance of the repellent sprays, especially on farms where little or no fly control was conducted.

Table 2 gives the cost-performance values for the various programs. The total cost per cow for one season for a sound fly control program ranged between \$2.50 and \$4.00 per cow, with an average of about \$3.00 per cow for the two years. The average profit per repellent-treated cow over the stock-spray-treated cow for all programs during the two years was \$9.86.

Table 1.--Percent of Average Daily Production per Cow From July to October, With June as the 100 Percent Base Month, Illinois, 1960 and 1961

Type of program	No. of herds	Repellent-treated cows	Stock-spray-treated cows	Percent increase for repellent-treated cows
Residual barn spraying and repellent				
Northern section	3	71.66	71.96	- .30
Southwestern section	3	81.34	71.59	+9.75
Average	3	76.50	71.78	+4.73
Daily barn fogging and repellent				
Northern section	2	72.21	70.00	+2.21
Southwestern section	2	71.33	62.17	+9.16
Average	2	71.77	66.09	+5.69
Repellent only				
Northern section	3	82.98	75.53	+7.45
Southwestern section	3	77.14	73.55	+3.59
Average	3	80.06	74.52	+5.52
Over-all average				
Northern section		75.62	72.50	+3.12
Southwestern section		76.60	69.10	+7.50
Both sections		76.11	70.80	+5.31

Table 2.--Cost-Performance Values for Dairy Farm Fly Control Programs, Four Northern and Three Southwestern Illinois Counties, 1960 and 1961

Type of program	Cost per cow: Residual or fogger	Cost per cow: Repellent	Cost per cow: Total	Cost of stock spray per cow	Increased cost of repellent per cow	Inc. milk, repellent-treated cow over stock-spray-treated cow (lb., 4 mo.)	Value of increased milk per repellent-treated cow	Profit per repellent-treated cow over stock-spray-treated cow
Residual and repellent								
Northern section	1.22	1.31	2.53	.94	.37	0	0	0
Southwestern section	2.28	1.90	4.18	1.36	.54	482	19.28	18.74
Average	1.75	1.61	3.36	1.15	.46	241	9.64	9.18
Fogger and repellent								
Northern section	1.57	1.57	3.14	1.12	.45	117	4.39	3.94
Southwestern section	2.08	1.35	3.43	.97	.38	422	16.88	16.50
Average	1.83	1.46	3.29	1.05	.41	270	10.80	10.39
Repellent only								
Northern section		1.86	1.86	1.33	.53	393	14.74	14.21
Southwestern section		1.57	1.57	1.20	.37	162	6.48	6.11
Average		1.72	1.72	1.27	.45	278	11.12	10.67
Over-all average								
Northern section	1.40	1.58	2.98	1.13	.45	170	6.38	5.93
Southwestern section	2.18	1.61	3.79	1.18	.43	356	14.21	13.78
Both sections	1.79	1.60	3.39	1.16	.44	263	10.30	9.86

RECENT DEVELOPMENTS IN SOIL INSECTICIDE USAGE

J. H. Bigger

During the past five years we have had 93 tests in which a soil insecticide was applied during the winter and spring months. We have arbitrarily divided the periods as follows: "winter," December 1 to March 15; "spring," March 16 to April 15; and "planting time," the period after April 15, which includes the preparation of the soil up to and through planting.

Previous reports have rather thoroughly covered the results of treatments during the planting-time period. The following data cover the performance of treatments during the winter and spring periods. Yield data are not yet all in, but additions will make only minor changes in the final results.

Performance of the treatments is shown for winter and spring applications and for those made with ground equipment and by airplane. The effect of "prompt" and "delayed" disking is shown. The interval between treatment and disking is apparently the most important of these variables.

Prompt disking of winter treatments is arbitrarily set as having occurred within one week of the end of the "winter" period (March 22) or within one week of insecticide application during the "spring" period. Prompt disking of winter application averaged 5.5 days after March 15; delayed treatment averaged 59 days after March 15. For the spring treatments, prompt disking averaged less than two days after treatment, while delayed treatment averaged 16 days.

Of the winter treatments, 86 percent were in the delayed category; 91 percent of the airplane treatments were also delayed (possibly the reason for lower control with aerial applications). Spring treatments showed that 52 percent were delayed disking, and ground treatments 44 percent delayed. Nineteen percent of the fields were not disked before plowing. Prompt disking is shown to be important in all categories.

Some insecticide is lost even with almost immediate disking, as shown by the chemical analyses in the last table. This information also shows that there is a much greater loss when the insecticide is applied as a spray than in granular formulation.

Our recommendations for soil applications, particularly those during the winter months, follow the tabular material.

Table 1.--Control of Insects Found by Digging Following Winter and Spring Soil Treatments. 1957-1961

Method of treatment	Wireworm		White grub		Root aphid		Rootworm	
	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control
Winter	33	75.6	6	90.0	22	12.9	17	72.5
Spring	9	100.0	5	100.0	9	30.8	18	89.7
Ground equipment	12	89.7	4	66.7	9	22.2	12	90.8
Airplane	30	75.8	7	100.0	22	20.5	23	75.5

Table 2.--Effect of Timely Disking of Winter and Spring Soil Treatments on Insect Control. 1957-1961

Method of treatment	Wireworm		White grub		Root aphid		Rootworm	
	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control
Prompt--ground	7	82.4	2	50.0	6	16.7	8	88.6
Prompt--air	1	100.0	0	--	2	25.0	3	79.5
Delayed--ground	3	100.0	0	--	3	42.9	2	94.6
Delayed--air	15	64.3	7	100.0	16	8.0	14	64.3
All prompt	8	84.2	2	0.0	8	20.0	11	86.2
All delayed	18	70.6	7	100.0	19	15.6	16	68.7

Table 3.--Effect of Ground Cover on Control of Insects by Winter and Spring Soil Treatments. 1957-1961

Type of cover	Wireworm		White grub		Root aphid		Rootworm	
	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control
Stubble (corn, soybean, grain)	16	60.7	10	81.5	23	34.0	27	80.6
Sod (grass or legume)	7	100.0	1	100.0	4	0.0	3	2.4
Plowed ground	10	79.3	1	100.0	0	--	5	97.7

Table 4.--Plant Population Increases Following Winter and Spring Soil Treatments. 1957-1961

Method of treatment	No. of tests	Increases for treatment	
		Plants per acre	Percent
Winter treatment	58	846	6.5
Spring treatment	27	524	3.9
Ground equipment	30	747	5.5
Airplane	55	739	5.7

Table 5.--Effect of Timely Disking of Winter and Spring Soil Treatments on Plant Population Increases. 1957-1961

Method of treatment	No. of tests	Increases for treatment	
		Plants per acre	Percent
Prompt--ground equipment	13	977	6.5
Prompt--airplane	4	655	5.1
Delayed--ground equipment	8	616	4.7
Delayed--airplane	28	631	5.0
All prompt	17	901	6.2
All delayed	36	631	4.9

Table 6.--Effect of Ground Cover on Increased Plant Populations With Winter and Spring Soil Treatments. 1957-1961

Ground cover when treated	No. of tests	Increases for treatment	
		Plants per acre	Percent
Stubble (corn, soybean, grain)	51	739	5.5
Sod (grass or legume)	13	328	2.7
Plowed ground	18	1,017	7.8

Table 7.--Yield Increases Following Winter and Spring Soil Treatments. 1957-1961

Method of treatment	No. of tests	Increases for treatment: Bushels per acre	Percent
Winter treatment	16	7.7	7.9
Spring treatment	10	10.4	11.1
Ground equipment	11	11.9	12.2
Airplane	15	6.4	6.7

Table 8.--Effect of Timely Disking of Winter and Spring Soil Treatments on Increases in Yield. 1957-1961

Method of treatment	No. of tests	Increases for treatment: Bushels per acre	Percent
Prompt disking	8	14.7	16.2
Delayed disking	13	6.2	6.0
Not disked	5	6.0	5.6
Fall plowed	4	14.7	17.4

Table 9.--Insecticide Residues Remaining in Soil in Late June, 1961--Aldrin Plus Dieldrin

Pounds applied per acre	Date treated	Date disked	Elapsed days	Residue in soil (pounds per acre) Granule treated	Spray treated
1.5	February 17	March 4	15	0.876	0.190
1.5	March 4	March 4	0	0.966	0.540
1.5	May 9	May 9	0	1.584	0.544

Table 10.--Effect of Planting-Time Soil Treatments. 1957-1961

	Control of insects found by digging										Increase in:			
	Wireworm		White grub		Root aphids		Rootworm		Colaspis		Plant populations		Yield	
Method of treatment	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control	No. tests	Percent control	No. tests	Percent increase	No. tests	Percent increase
Broadcast	43	78.9	18	81.8	27	85.7	15	95.6	18	77.4	108	7.0	33	10.7
Row	28	78.1	6	81.8	12	70.8	19	76.2	9	41.5	54	4.8	11	9.5
All tests	71	78.6	24	81.8	39	79.7	34	87.7	27	62.2	162	6.2	44	10.4

APPLICATION OF SOIL INSECTICIDES IN ILLINOIS DURING THE WINTER

Two insecticides are commonly recommended to control insects in Illinois cornfields. They are aldrin and heptachlor, broadcast at some time prior to planting, at 1 1/2 pounds of actual insecticide per acre or banded in the row at planting at 1 pound per acre. This year these insecticides were applied to more than 2 1/2 million acres of corn ground. Slightly over half of this land was treated at planting time with row applicators on the planters. This latter method has given good results in Illinois and is still being recommended. However, it does not provide such consistent control of the soil insect complex or give the same yield benefits as the broadcast method. For these reasons, we prefer broadcast applications, in which the insecticide is most commonly broadcast and disked in during seed-bed preparation.

However, research from 1957 to 1961 by J. H. Bigger, entomologist for the Illinois Natural History Survey, indicated that these insecticides in dry form could be applied from the first of December to March 15, the slack season for most farmers. Corn root aphids and cornfield ants were not controlled by winter applications, but they were controlled when the insecticide was broadcast just before planting.

Therefore, we made a limited recommendation for winter applications in December 1960. Slightly more than 86,000 acres were treated this past winter. Farmers who tried this practice were, in general, well satisfied and intend to continue it. We personally saw many examples of good results in fields where untreated sections were left for comparison. However, in five or possibly six fields black cutworms were not controlled where insecticides had been applied in the winter. It may have been that control in many fields was satisfactory and that these five or six failures were exceptions. But it is possible that winter applications may not control black cutworms. We do know that row treatment does not control black cutworms, cornfield ants, and corn root aphids satisfactorily.

On the basis of this past year's experience, farmers who apply soil insecticides this winter should probably be prepared, if necessary, to control black cutworms with surface sprays during the late spring or early summer, just as they do if they use a row applicator at planting.

Applying an insecticide during the winter saves time and labor during the peak load at planting. This is an advantage. However, some insect control is sacrificed. The farmer has to decide which best fits his needs: somewhat lower but still effective insect control with less work during the planting season or more effective control and more work during planting.

We are modifying our recommendations on winter applications of soil insecticides as follows:

1. Apply only in the dry form--as granules or in dry fertilizer.
2. If applied to fall-plowed fields, disk earlier than normally in the spring.
3. On other fields, disk as soon as possible after application. Do not wait for spring plowing or seed-bed preparation.
4. Apply only to reasonably level fields where water erosion will not be a problem.

Sods are usually not disked before plowing; thus winter applications may not be feasible on sod fields. Disking soybean stubble in February or early March may increase both wind and water erosion, so on these fields winter applications may be questionable. The most logical places to apply insecticides during the winter are fall-plowed fields and corn-stalk ground.

Thus soil insecticides can be applied at various times, provided certain cultural practices are followed. Present research points to the following methods, in order of preference, based on efficiency of control:

1. Broadcast 1 1/2 pounds of a soil insecticide after plowing and just before planting during seed-bed preparation. Disk it in immediately. Use sprays or granules. In the past this timing has controlled black cutworms.

2. Broadcast 1 1/2 pounds in early spring (March 15 to April 15) and disk in immediately. If on unplowed ground, use in granules, sprays, or fertilizers. We have not had any experience with black cutworms in fields treated during this time.

3. Broadcast 1 1/2 to 2 pounds in granules or dry fertilizer from December 1 to March 15 to fall-plowed ground or to corn-stalk ground. Disk the fall-plowed fields earlier than normally in the spring, but disk the corn-stalk ground as soon as a disk can be pulled through the field. It might even be better not to apply the material to corn stalks until a disk can be used immediately.

   Winter applications are equal to row applications.

4. Apply 1 pound of soil insecticide per acre as a row treatment at planting. Use sprays, granules, or started fertilizer. When used in a started fertilizer, apply only with a split-boot applicator.

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Prepared by entomologists of the University of Illinois
College of Agriculture and the Illinois Natural History Survey

(Not for Publication)

BIOLOGY AND CONTROL OF THE PICNIC BEETLE, GLISCHROCHILUS QUADRISIGNATUS (SAY)

W. H. Luckmann, Illinois Natural History Survey, Urbana

Glischrochilus quadrisignatus (Say) has no approved common name, but it has been called picnic beetle, four-spotted fungus beetle, sap beetle, ips beetle, and corn sap beetle. It is probably best known as the picnic beetle. Records show that it has been invading fruits, vegetables, and corn, as well as homes, for the past 100 years, but it seems to be more abundant now than ever before.

The picnic beetle is both friend and foe. McCoy and Brindley (1961) showed that the beetle is helpful in reducing European corn borer populations. They reported that the adult beetles moved to cornfields and congregated in borer tunnels as soon as the corn borer larvae invaded the stalks. It is believed that they reduced borer numbers by mechanically injuring them and then killing the weakened larvae.

The picnic beetle is both a nuisance and a pest. It invades homes, backyards, and picnic areas in large numbers during July and August, often making it impossible to enjoy a meal out of doors. It congregates around commercial vegetable stands, hiding under tomatoes or melons on display. It is a serious pest of raspberries. It invades sweet corn ears damaged by birds or insects. In the past few years the beetle has occasionally invaded undamaged ears of silking corn, chewing and feeding in the silk channel and providing a favorable location for invasion by the dusky sap beetle, smut, and mold.

The picnic beetle overwinters as an adult in debris, clumps of grass, logs, and rotting vegetable materials. It becomes active in late winter and early spring. In Illinois, egg laying begins in late April and continues during May, June, and into early July. Most of the eggs are laid in the soil on decomposing corn ears or spilled grain and feeds around storage bins and grain elevators. Larvae from the first eggs complete their development in late June, but heavy flights of new adults usually do not appear until after July 1. The new adults feed on damaged fruits, vegetables, and field crops until cold weather. There appears to be only one generation of this insect a year.

The invasion of silking corn ears by the picnic beetle creates a serious problem in canning sweet corn. In Illinois, the dusky sap beetle readily invades and lays eggs in ears that have been damaged by the picnic beetle, other insects, or birds. Larvae of the dusky sap beetle feed extensively on the ear and are difficult to remove because of their small size. The picnic beetle and the dusky sap beetle are frequently found together in early-planted sweet corn, but the picnic beetle does not lay eggs in the ears of sweet corn.

I have not conducted any field experiments for controlling the picnic beetle, but I have observed cornfields that were treated commercially for control of the beetle and other insects. From these observations it appeared that sevin at a dosage of 1.7 pounds active per acre gave good control. DDT at 1.5 pounds per acre did not seem to be effective. On several occasions I have sprayed my lawn, shrubs, garbage cans, and screen doors with malathion several hours before a backyard picnic party. This treatment provided good temporary relief.

This year we conducted laboratory tests with DDT, sevin, malathion, parathion, diazinon, and aldrin. These tests were preliminary and not extensive, but they provided some good information. Exposure of field-collected adults to filter paper treated with DDT showed this material to be ineffective. All of the other insecticides tested were effective. Aldrin and parathion appeared to be the most toxic. The data indicate that all of the materials tested except DDT, when used at dosages currently employed for other insects and within the limits of regulations for their use, should give good control of the picnic beetle in crops, processing plants, and around the home or picnic area.

McCoy, C. E. and T. A. Brindley. 1961. Biology of the four-spotted fungus beetle, Glischrochilus q. quadrisignatus, and its effect on European corn borer populations. Jour. Econ. Ent. 54(4):713-717.

(Not for Publication)

ROOT AND STEM ROTS OF SOYBEAN

D. W. Chamberlain

Brown stem rot and Phytophthora rot are two of the more important diseases of soybeans in Illinois. Both are caused by fungi that live in the soil for long periods and invade the plants readily through the roots. The brown stem rot fungus (Cephalosporium gregatum) and the Phytophthora rot organism (Phytophthora megasperma var. sojae) are specific for soybeans and do not infect other common crop plants in Illinois.

Brown stem rot is a disease that may go unrecognized because it does not kill the plants. It causes an internal browning in the pith and vessels of the lower stem that can be seen when the stem is split longitudinally with a knife. Leaf symptoms, involving a browning and drying of the leaf tissues between the veins, sometimes appear in late August, but they occur infrequently. All of our common soybean varieties are susceptible to brown stem rot. The losses caused by the disease are in the form of reduced yield; like the symptoms of the disease, these losses are not usually recognized by the grower.

Phytophthora rot, unlike brown stem rot, is destructive to soybeans at all stages of plant development. The seedlings may be killed before they emerge from the soil, or they may wilt and die soon after emergence. Scattered groups of dead plants may be found in the rows throughout the season. In older plants, an elongated brown lesion appears on the stem before the plant wilts. Infected plants usually die regardless of the time of infection. Although Phytophthora rot is most destructive in heavy clay soils, it may appear in other types of soil in wet seasons and is very damaging in low, poorly drained areas of a field. All of the common soybean varieties grown in Illinois, except Blackhawk, are susceptible.

Like most field crops, soybeans have certain limitations in the application of disease control measures. Spray programs are too expensive for the margin of profit involved in soybean production. Seed treatment does not control these diseases. Breeding for disease resistance is the most feasible approach to the control problem, since resistant varieties offer the grower the most economical method of control.

An intensive search for resistance to brown stem rot has been under way in Illinois for about 15 years. A type of resistance has been found in one of the introductions originating in Korea. Breeders are now attempting to incorporate this resistance into some of our commercial varieties. Until resistant varieties become available, we must rely on other methods of control, such as a rotation wherein soybeans are planted on the same field only once in three or four years. Continuous growing of soybeans on a field where the disease has occurred increases the severity of brown stem rot.

The search for resistance to Phytophthora rot showed a high degree of resistance in Blackhawk. This variety, however, is adapted only to the latitude of northern Illinois; it is too early for use over the entire state. The plant breeders found that the Blackhawk resistance was controlled by a single genetic factor and could be readily transferred by the backcrossing technique. By this method, they have incorporated resistance into several of our later varieties. It now seems likely that the first of these resistant varieties should be available to growers within the next two years. A new variety must have not only disease resistance, but also the good agronomic and chemical qualities of the susceptible variety it replaces. For this reason no estimate of a release date can be "firm" until a strain has been found that combines all of the important chemical and agronomic qualities with Phytophthora resistance.

ROTARY HOEING AND CULTIVATING PRE-EMERGENCE TREATMENTS

E. L. Knake

Rotary Hoeing

Farmers often ask, "Should I rotary hoe after using pre-emergence herbicides?"

There are two main reasons for rotary hoeing: to break a crust and to kill weeds. Regardless of whether or not a chemical has been used, a crust should be broken if it is preventing crop emergence. If weeds begin to grow, apparently the chemical has not been effective and a good rotary hoeing is suggested to kill the weeds before they get too large.

What effect does rotary hoeing have on the effectiveness of herbicides? In 1961 we set up an experiment at the Agronomy South Farm to try to find out.

Corn and soybeans were planted on May 18, and pre-emergence herbicides were applied as band treatments the next day. Atrazine and Randox were used on corn. Alanap and Amiben were used on soybeans. Both granular and spray applications of each herbicide were included in the experiment. Each treatment was replicated four times. Half of the plots were rotary hoed with the row on June 2, two weeks after the herbicides had been applied. At the time of rotary hoeing, weeds were one-half inch high and corn and soybeans were two to three inches high. One-half inch of rain fell at the end of the first week after the chemicals had been applied, and four and one-fourth inches fell at the end of the third week. An evaluation of the effectiveness of the herbicides was made on the corn plots on June 10 and on the soybean plots on June 14 and September 21. Results are presented in Table 1.

The following herbicide effectiveness rating scale was used: 1--Good, 2--Fair, 3--Poor.

Table 1.--Effect of Rotary Hoeing on Performance of Pre-Emergence Herbicides

Herbicide	Herbicide effectiveness rating	
	Not rotary hoed	Rotary hoed
Corn--observations made June 10		
Randox--spray	1.00	1.25
Randox--granules	1.25	1.50
Atrazine--spray	2.50	1.25
Atrazine--granules	2.50	2.75
Soybeans--observations made June 14		
Alanap--spray	2.00	2.50
Alanap--granules	3.00	2.75
Amiben--spray	1.50	1.00
Amiben--granules	1.50	1.50
Soybeans--observations made September 21		
Alanap--spray	2.25	2.00
Alanap--granules	2.50	3.00
Amiben--spray	1.25	1.25
Amiben--granules	1.25	1.25
Average	1.9	1.8

In summary, rotary hoeing had little or no influence on the effectiveness of pre-emergence herbicides under the conditions of this experiment.

Using the Shovel Cultivator

In some sections of Illinois rainfall in 1961 was not adequate for good performance of some pre-emergence herbicides. When the herbicide is not effective and weeds begin to grow, farmers ask, "Should I cultivate or should I wait for the chemical to work?"

If weeds begin to grow after application of a pre-emergence herbicide, such as 2,4-D ester, with little residual action, the herbicide evidently was not effective and will probably not give any benefit in the future.

If rainfall is not sufficient for a herbicide like atrazine to be effective and weeds begin to grow, they are likely to keep on growing if the root systems become well established below the zone where the chemical is present. If sufficient rain falls to move the chemical down before the crown roots of grasses become established, some kill may result even after weeds have emerged. This effect has been noted with both amiben and atrazine.

Waiting for the chemical to take effect after the weeds have emerged is quite risky, however, and it is usually advisable to cultivate to destroy the first crop of weeds. This does not mean that the investment in a herbicide like atrazine, with relatively good residual action, will be lost entirely. After the first crop of weeds is destroyed by cultivation, there may still be enough chemical in the soil to give some control of weeds that begin to grow later.

Even though soil with weed seeds is thrown into the row on top of the treated area, when these weed seeds germinate there is a good chance that the roots will be killed by a chemical that has fairly good residual action.

WEED CONTROL IN IDLE ACRES

W. O. Scott

We would define idle acres as any acreage or area that was not being used to produce a crop. It could be land diverted from wheat or corn production to comply with government programs or land temporarily or permanently out of production for conservation purposes. Regardless of the reasons for its being idle, we assume that a crop is not to be harvested for forage or grain.

Following are our recommendations for different kinds of cover for idle acres:

Kind of Cover	Recommendations
Temporary cover of small grain with no legume underseeding.	One-fourth to one-half pound of 2,4-D ester or amine per acre after grain tillers but before boot stage. Use 5 to 10 gallons of water per acre to control broad-leaved weeds.
Alfalfa, red, alsike, ladino clovers with small grain companion crop and with or without grass seeding.	One-fourth pound of MCP amine or 2,4-D amine applied after grain tillers and before boot stage, but after oats and weeds have formed canopy over legumes. May reduce legume stand. Use 5 to 10 gallons of water per acre.
Perennial grass seedlings with no legume.	Up to 3/4 pound of 2,4-D ester or amine per acre after perennial grass seedlings have reached the 2- to 4-leaf stage.
Alfalfa, birdsfoot trefoil, lespedeza seeded without grain companion crop or grass.	Apply Eptam according to label directions. Work into soil with disk or harrow before planting. Controls early annual grasses.
Established or seedling alfalfa that will not be harvested during the current year and that is not seeded to small grain or grasses.	To control annual grasses, such as foxtail and crabgrass, apply 2 to 4 pounds of dalapon when grass weeds are 2 to 3 inches tall.
Established grass cover.	Amine or ester form of 2,4-D at 1/2 to 2 pounds in 5 to 10 gallons of water per acre applied after grasses are well tillered, but before boot stage.

GRANULAR VS. LIQUID PRE-EMERGENCE CHEMICALS

F. W. Slife

The interest in granular pre-emergence chemicals remains at a high level. In each year since 1959, increasing amounts of granulars have been sold. Most farmers indicate that convenience in handling is the main reason for using granulars over liquid sprays.

In 1961 granular materials seemed to equal their liquid counterparts in performance except for Atrazine 20G. This material in general was erratic and did not control weeds as well as Atrazine 80W. The main reason seems to be that Atrazine has such low solubility. It requires excellent granular distribution to give good results.

The sale of Atrazine 10G in 1962 will be a distinct advantage, and it will be recommended over the 20G, particularly on the heavier soils. It should be pointed out that before the introduction of 10G Atrazine the wettable powder was consistently better than the granular forms. It is hoped that with the introduction of 10G the difference in results between it and 80W will be less than in previous years.

In spite of the appeal of granular forms over liquids, the cheapest method is the liquid. Liquid chemicals not only cost less than the granulars, but the equipment for applying them also usually costs less.

THE GARLIC AND ONION PROBLEM IN ILLINOIS

L. V. Sherwood

A. Losses:

Wild garlic ranges from Massachusetts south to northern Georgia and Mississippi and west into Missouri. The entire Ohio River Valley is infested with wild garlic and also with wild onions. Wild garlic in the southern half of Illinois causes losses of over $1,000,000 annually. These losses occur in the form of:

1. Reduced yields of pasture and grains (5-10%).

2. Aerial bulb contamination of harvested cereal grains.

    a. Cause dockage of 10 to 15 cents per bushel, or $3.00 to $4.50 per acre for 30-bushel yield.

    b. Cause spoilage in storage.

3. Off-flavoring of milk (overcome by vacuum pasturization).

4. Off-flavoring of meat (overcome by feeding non-contaminated feed for several days before slaughtering).

Because most of the problem acreage in Illinois is infested with the more difficult to control wild garlic, rather than wild onions, this presentation will be limited primarily to the description and control of wild garlic.

B. Plant description and growth habits:

1. Wild garlic reproduces by seeds, aerial bulbs, softshell underground bulbs, and hardshell underground bulbs.

2. Practical aspects of wild garlic life cycle:

    a. The plant grows mostly in late fall, winter, and early spring, remaining dormant throughout the summer. Growth of wild garlic coincides in time with fall-seeded cereal and pasture species. For this reason, competition and contamination are greatest among these crops.

    Bulbs in the soil are difficult to destroy when they are dormant during the summer; hence, most eradication procedures involve other times of the year, preferably when bulb germination is at a maximum. This led to a study to determine the date of maximum germination under southern Illinois soil, climate, and garlic species conditions. In the 1959-60 season field germination occurred in February, but varied only slightly from January through mid-April, as shown in Table 1.

Table 1.--Field Germination of Wild Garlic Bulbs, Carbondale, Illinois, 1959-60

Date	Percent bulbs germinated[a/]	
	Oat field[b/]	Alfalfa field[c/]
November 10	84	55
November 25	84	68
December 10	85	78
December 22	96	70
January 11	98	88
January 25	97	90
February 10	99	83
March 25	92	84
April 10	88	83
April 25	89	78
May 10	Plowed	44
May 25		21

a/ Germination based on having leaves above ground. Each reading based on 100 or more bulbs removed to plow depth.
b/ Oats were seeded after corn in fall of 1959.
c/ Continuous alfalfa for at least three years.

High percentages of germination do not apply to all types of bulbs and are therefore somewhat misleading from an eradication point of view. The different bulb types are not all easily eradicated. Therefore one needs to know more about numbers and types of bulbs.

b. Professor J. F. Freeman, University of Kentucky, estimated in 1958 that a heavy stand of wild garlic produced over 18 million bulbs per acre, approximately 5 percent of which were hardshell bulbs, as shown in Table 2.

Table 2.--Number of Wild Garlic Bulbs in One Acre of Soil. (Based on Data From C. F. Freeman, University of Kentucky.)

Bulb type	Percent	Number of bulbs	
		Per acre	Per sq. ft.
Aerial	91.0	16,380,000	3,760.0
Hardshell	4.7	846,000	19.4
Softshell	4.3	774,000	17.8

A very high percentage of total bulbs could germinate and still leave up to 19 hardshell bulbs per square foot of soil, depending on the germination percentage for hardshells.

Those that germinate may be killed easily by cultural or chemical methods, but not the dormant bulbs.

c. Hardshell bulbs germinate poorly compared with other bulb types, leaving the field contaminated with dormant bulbs to germinate later.

d. High percentages of the hardshell bulbs may live in the soil several years before germination and growth. Professor Freeman of Kentucky planted hardshell bulbs in the field and determined that most of them germinated during the first two years but that 11 percent had not germinated at the end of three years, as shown in Table 3.

Table 3.--Field Germination of Hardshell Garlic Bulbs During a Three-Year Period (From C. F. Freeman, University of Kentucky)

Season	Percent germinated
1956-57	40.75
1957-58	42.75
1958-59	4.50
To October 1959	1.00
Total in 3 years	89.00

e. Cultivation practice can influence germination. A higher percentage of bulbs will germinate in infestations that have been disturbed by recent cultivations.

f. Temperature and moisture relationships during the garlic growing season may influence bulb germination.

Under conditions of a Southern Illinois University laboratory experiment outlined in Table 4, moisture had little effect on time or percentage germination of aerial or hardshell bulbs. However, higher temperatures resulted in quicker and higher percentage germination, particularly a higher percentage for aerial bulbs.

Table 4.--Laboratory Germination of Wild Garlic Bulbs Under Different Temperature and Moisture Conditions. (Southern Illinois University, 1959-60.)

	High moisture		Low moisture	
	Aerial	Hardshell	Aerial	Hardshell
35° F. Chamber				
Days to first germination	22	22	21	21
Percent germination in 32 days	83	10	62	10
50° F. Chamber				
Days to first germination	11	12	11	17
Percent germination in 32 days	100	15	100	23

C. Eradication and control of wild garlic:

1. Late-fall plowing followed by clean-cultivated crops.

On non-erodible crop land, late-fall plowing is recommended to smother young plants, expose underground bulbs to climatic adversities, and reduce or prevent the formation of additional underground bulbs.

Seedlings that appear the next spring should be destroyed by seedbed preparation and subsequent clean cultivation of a cultivated crop, such as corn. Repeated cultivations before seedbed preparation may be needed to prevent top growth and underground bulb development.

Because not all of the underground hardshell bulbs and seeds germinate readily, this program must be followed for at least three or four years to exhaust the stockpile in the soil.

Fall plowing should be at a depth just below the underground bulbs to leave them exposed as much as possible to the atmosphere and sun.

2. Chemical eradication:

a. Non-selective permanent soil sterilization:

In non-crop areas where lack of vegetation and consequent erosion are not objectionable, or on very limited crop areas for the protection of larger acreages, the use of soil sterilant chemicals may be justified.

Such materials as sodium chlorate, Atlacide, Ureabor, Telvar, polyborchlorate, and TBA will keep the soil sterile for several years and thereby kill those seedlings that delay emergence.

b. Non-selective temporary soil sterilization:

Temporary soil sterilants, which leave the soil barren for less than a year, can be used with fair success, but some of the dormant underground bulbs and seeds may escape serious injury. High rates of 2,4-D and TCA and maleic hydrazide (somewhat selective on dormant established perennial grasses) may be used.

c. Selective topical treatments:

In pastures where retardation of legumes is not serious, along highways and fence lines and in other places where it is desirable to maintain some type of vegetative cover, the proper use of 2,4-D ester or amine on emerged garlic is highly effective. The use of a low-volatile ester or amine is preferred where volatilized chemical or drift may affect desirable vegetation nearby.

On an acid-equivalent basis, two to three pounds per acre of the ester form, and about one-half pound more of amine, are needed for eradication of emerged garlic plants.

Since not all underground garlic bulbs and seeds will have germinated at any one time, for complete eradication it will be necessary to treat in both late fall (October through November) and early spring (March through early April) for a period of two to three years. All emerged shoots and directly attached bulbs may be destroyed by only one treatment during the early spring of each year, but many additional hardshell bulbs produced during the winter will be missed.

This treatment cannot be used on small grains or legumes.

3. Chemical control (not eradication):

Aerial bulb contamination of harvested wheat can be greatly reduced by applying one-half to three-fourths pound acid equivalent 2,4-D ester to infested wheat between tillering and the boot stage of wheat. The amine form can also be used. Neither form can be used in the fall. These two products, at suggested rates, will seriously damage or kill underseeded legumes.

Application of 2,4-D at these rates will not eradicate garlic and will only partly control it. If the rate is increased, serious wheat yield losses will result. Best results have been obtained where rate recommendations have been carefully followed and the treatments applied as early as possible in the period indicated.

D. Current experimental procedures for eradication (winter treatments with temporary soil sterilants so that no crop is lost).

E. Summary:

1. Wild garlic reproduces by seeds, aerial bulbs, softshell bulbs, and hardshell bulbs.

2. Hardshell bulbs constitute less than 5 percent of the total bulb population, but if undisturbed some of them may remain dormant in the soil for four to six years before germination; therefore, they must be given primary consideration in any eradication program. Disturbed, they may break dormancy earlier.

3. A combination of late-fall plowing followed by a clean-cultivated crop, for two to three years, will greatly reduce or completely eradicate wild garlic.

4. A series of late fall and early spring applications of 2,4-D, for one to three years, will usually eradicate wild garlic from grass pastures, roadsides, and fields. In some cases the spring treatment may not be needed if the fall treatment prevents spring growth.

5. The garlic plant is easiest to kill with chemicals at the young, succulent stage.

6. If 2,4-D is applied to grain, rates must be reduced and applications made after tillering, but before booting, to prevent serious crop injury.

7. The more expensive soil sterilant type of chemical can be used to kill garlic where lack of vegetation and any resultant erosion are not objectionable. If it is used on crop land, nothing can be grown successfully for one to several years, depending upon the chemical and the rate applied.

8. What has been said about the eradication and control of wild garlic also applies to wild onions. However, since the wild onion does not produce hardshell bulbs, complete eradication can be accomplished quicker--usually in one to two years by cultivation or by translocated 2,4-D chemicals.

9. How to distinguish between wild garlic and wild onions:

	Wild garlic	Wild onion
Leaves:		
Form	Cylindrical.	Flat.
Base	Sometimes above ground on stem.	At ground level arising from bulb.
Bulbs (underground):		
Number	Clusters at base of each plant.	One at base of each plant.
Covering	Fibrous.	Netlike.
Kind	Hardshell (brown) and softshell.	All softshell.
Flavor and odor	Strong	Moderate

CULTIVATION VS. PRE-EMERGENCE HERBICIDES FOR WEED CONTROL ON SOUTHERN ILLINOIS SOILS

L. V. Sherwood

A. Introductory remarks:

This presentation applies to the Illinois area south of U. S. Highway 40, or south of the Shelbyville terminal moraine. Soils are low in organic matter and are sometimes rolling and highly erodible. Rainfall is high during spring and early summer. Yields are lower than for areas north of U. S. Highway 40. These facts all influence the choice of weed control method or of herbicide, if one is used.

In southern Illinois there are areas where a high percentage of farmers apply pre-emergence herbicides to corn and less to soybeans. However, in most areas weed control by mechanical cultivation is still popular, chemicals being applied on a limited basis. The purpose of this presentation is to describe conditions under which pre-emergence herbicides should be used and also where cultivation procedures should be used.

B. Herbicidal control of southern Illinois weeds in cultivated crops:

1. Most pre-emergence herbicides perform well in southern Illinois. Major factors influencing usage and choice of herbicide are as follows:

   a. Organic matter: Most pre-emergence materials perform well on soils containing low organic matter, but there are exceptions. In general, Randox materials perform poorly on southern Illinois soils except on those relatively high in organic matter, such as in river bottoms.

   b. Rainfall: Heavy rainfall after planting favors the use of pre-emergence herbicides. Thus, the rows are kept weed free even though the soil remains too wet for mechanical cultivations. Southern Illinois is the most likely part of the state to have heavy rains after planting.

   Amount and distribution of rainfall are almost always adequate for good performance of most pre-emergence herbicides if crops are planted and treated at normal planting dates.

   Since southern Illinois rainfall is the highest in the state, it follows that certain low-solubility pre-emergence herbicides may perform more consistently in this than in any other area in the state. Examples are Simazine and Atrazine for use in corn.

   This high rainfall may also cause problems for the river bottom or other farmer who has open silty or sandy soils. Chemicals may leach down, concentrate in lethal quantities around the germinating crop seed, or become so diluted that the weeds are not killed.

Farmers on open soils, especially in high rainfall areas, should preferably choose the less soluble herbicides, such as Simazine and Atrazine.

c. Erosion: Heavy rains on sloping soils of southern Illinois favor the use of herbicides. Erodible soils should be farmed on the contour. This necessitates drill planting, no cross cultivation, and heavier weed populations in the row unless special weed control precautions are taken.

2. Annual weeds predominate in southern Illinois corn and soybean fields, as is the case elsewhere in the state.

Both broad-leaved and grassy annuals are likely to be prevalent in most fields. Therefore, the grass-specific types of pre-emergence herbicides are generally less well suited than those that will kill both types of weeds.

C. Mechanical cultivations for weed control are still popular on most southern Illinois farms.

1. Not all acreage should be chemically treated.

About 5 to 10 percent of the acreage is so weedy and/or poorly drained that pre-emergence herbicides should be consistently used thereon. Another 8 to 10 percent of the acreage contains weed infestations and produces crop yields that make the use of pre-emergence herbicides a marginal decision. This leaves 80 to 85 percent of the acreage well suited to mechanical weeding, assuming that growers will maintain good cultivation equipment and use it effectively.

2. Yield level affects amount of money that can be spent economically for pre-emergence herbicides.

According to University of Illinois Agronomy Department data, one giant foxtail (southern Illinois has plenty of this weed) in every 4 inches of row lowers corn yields 9 percent. On 100-bushel-per-acre corn land, full control of this weed will save nine bushels, or about $9.00 per acre; on 50-bushel land, about $4.50. From the same University of Illinois data, it appears that one weed in every 12 inches of row would cause a 3 3/4-bushel yield reduction on land that would produce 50 bushels of corn per acre. A farmer would just about break even with the cost of the chemical if he applied pre-emergence herbicides and obtained perfect weed control on 50-bushel-per-acre land. But the farmer needs to make a profit on his investment, not just break even. There are studies which show that he needs a return ratio of $3.00 for $1.00 spent, to cover the years when the products fail or other factors might negate the investment. On this basis, farmers in southern Illinois should treat soils where at least one weed grows in every 6 to 8 inches of row.

Obviously, the farmer can afford to spend more for weed control on land that yields higher. A farmer should also apply suitable fertilizers and limestone on most southern Illinois soils. This coupled with good weed control will offer highest returns.

3. Mechanical cultivations, where effective, are generally cheaper than pre-emergence herbicides, especially where the herbicides are broadcast applied, as shown in Table 1.

Table 1.--Comparative Costs of Weeding Methods

Method of weeding	Per acre costs
Herbicides (broadcast)	$7.50--18.00
2,4-D (broadcast)	3.35-- 5.65
Herbicides (band--1/3)	2.50-- 6.00
2,4-D (band--1/3)	1.12-- 1.88
One-sweep cultivation	0.50-- 1.50
Rotary hoe or weeder	0.50-- 1.00
Cost of operating a sprayer (does not include material costs)	1.00-- 1.50

The cost of operating the sprayer can be greatly reduced if chemicals are applied by an attachment on the planter.

Where herbicides are band-treated, it is almost always necessary to also cultivate between the rows, being careful to avoid throwing weed-seed-contaminated soil back into the weed-free chemically treated row. Many farmers avoid herbicides because they must cultivate anyhow, but they may be overlooking the following advantages of band treatments:

a. Result in weed-free rows even during a wet season.

b. Cultivation between the rows can be done at higher speed.

c. May be able to wait longer before cultivating, possibly saving at least one cultivation.

4. Breaking of soil crust remains a factor in the use of mechanical methods of weed control.

Many southern Illinois soils crust more severely than those farther north. Breaking this crust between rains may to a limited extent help reduce run-off and therefore increase water infiltration. But if good weed control can be obtained without mechanical cultivations, yield data show that cultivations only to break the soil crust are usually not justified.

D. Summary:

1. Most weedy fields in southern Illinois are infested with both broadleaf and grassy annuals. Therefore, if pre-emergence herbicides are used, it is usually best to choose one that will kill both types of weeds.

2. Pre-emergence herbicides should be applied on soils that are habitually wet and weedy during the spring season. The farmer would break even by applying band treatments on land that grows one weed in every foot of row.

3. Southern Illinois rainfall, in amount and seasonal distribution, is well suited for good performance of pre-emergence herbicides.

4. Except for 2,4-D applications that can be used only in corn, but not always safely or successfully, the cost of pre-emergence herbicides prohibits broadcast treatments.

5. Band application of herbicides necessitates mechanical cultivations for the elimination of weeds between the rows.

6. In general, mechanical weeding is cheaper than a combination of band treatment and mechanical weeding.

7. Use of the combination is justified only where weed control is definitely improved over use of mechanical procedures alone.

8. More careful application of mechanical procedures may help to postpone the need for herbicides.

CHEMICAL WEED CONTROL FOR ILLINOIS--1962

F. W. Slife and E. L. Knake

To control weeds, a combination of practices is most effective. Good cultural practices, including clean seed, proper seedbed preparation, timely cultivation, and a good fertility program, are basic for weed control. Herbicides (chemical weed killers) can often be used to control weeds at considerable savings and to control weeds that cannot be controlled with normal cultural practices. Chemical control should be used to supplement, not replace, cultural control.

These suggestions have been prepared to serve as a guide to those wishing to use herbicides for their weed control programs. They are based primarily on results of research and observations in Illinois and other corn-belt states.

Most of the herbicides listed are selective. At the suggested rate of application, they should control weeds without seriously injuring the crop. In many cases the range of selectivity is narrow. Therefore, follow closely the suggested rate of application; otherwise, excessive crop injury may result.

Unless otherwise indicated, rates of application are given as active ingredient (most chemicals) or acid equivalent (2,4-D and 2,4,5-T). Most product labels indicate the amount of material to apply. If for any herbicide the label gives directions for rates, timing, or crop use that are different from those suggested here, follow those on the most recent label.

The following terms are commonly used to describe time of application:

Pre-emergence--applying before the crop comes up. The herbicide is applied to the soil at time of planting or shortly after. To reduce cost, pre-emergence herbicides are usually applied in a 14-inch band over the crop rows.

Post-emergence--applying after the crop is up.

Amount of Water to Use

To apply pre-emergence herbicides in 14-inch bands, 7 to 10 gallons of water per acre are usually sufficient. For broadcast pre-emergence applications, use 20 to 30 gallons of water per acre. The water serves as a carrier to permit uniform distribution of the herbicide. We must rely on rainfall to move the chemical into the soil around the germinating weed seeds.

For post-emergence applications, 5 to 10 gallons of water per acre are usually sufficient unless otherwise specified on the chart. For treating specific weeds, such as Johnsongrass, quackgrass, and Canada thistle, it is preferable to use 30 to 50 gallons of water with some herbicides to get good coverage of the foliage. In general, the larger and the more dense the weed growth, the greater the amount of water.

Granular Herbicides

Most pre-emergence herbicides come in both granular and liquid forms. The two forms are about equally effective when applied properly. Granules cost more than liquids, but some farmers consider them more convenient to handle. The irritation caused by some herbicides may be reduced, but not eliminated, by using granules.

Precautions

Carefully observe label precautions to protect the operator, to prevent crop injury, and to prevent harmful residues in food and feed crops.

1. Use herbicides only on crops for which they are specifically approved and recommended.

2. Use only recommended amounts. More is costly, may damage the crop, and may be unsafe if the crop is to be used for food or feed.

3. Apply herbicides only at times specified on the label. Observe recommended intervals between treatment and pasturing or harvest of crops.

4. Wear goggles, rubber gloves, and other protective clothing as recommended on the label.

5. Guard against possible injury to nearby susceptible plants.

Always read and follow instructions on the label.

Names of Some Herbicides

Common	Trade	Common	Trade
Amiben	Amiben	Fenuron	Dybar
Amitrole	Amino triazole, Weedazol	Fenuron TCA	Urab
Amitrole-T	Cytrol, Amitrol-T	MCP	(Several)
Ammonium sulfamate	Ammate-X	NPA	Alanap-3
Atrazine	Atrazine	Sodium PCP	Weedbeads, Napclor
CDAA	Randox	Simazine	Simazine
CDAA-T	Randox-T	Sodium chlorate	(Several)
CIPC	Chloro IPC	Sodium chlorate plus calcium chloride	Atlacide
Dalapon	Dowpon	2,4-D	(Several)
Dinitro (DNBP)	Premerge, Sinox PE		
EPTC	Eptam	2,4,5-T	(Several)

Use of Trade Names

For the sake of clarity, trade names have been used in some instances. This is not intended to discriminate against similar products not mentioned by trade name.

Use of Chemicals to Control Weeds

(Rates are expressed in pounds of active ingredient or acid equivalent per acre broadcast.)

Crop or weed	Chemical	Rate	Remarks
		Crops	
Corn, pre-emergence (Atrazine or Randox preferred)	Atrazine	2 to 3 lb.	Controls annual grasses and broad-leaved weeds. Use lower rate on light soils. Do not follow with fall-seeded small grain. In some cases injury to spring oats may occur the following year. On sandy soils, use Simazine.
	Randox	4 lb.	Controls annual grasses. Use precautions to prevent irritation to skin and eyes. Do not use on sandy soils.

The following pre-emergence herbicides are also available for corn, but from the standpoint of crop tolerance and degree of weed control they are less preferable than the above chemicals:

Crop or weed	Chemical	Rate	Remarks
	2,4-D ester	1 1/2 lb. liquid or 2 lb. granular	For control of broad-leaved weeds. May give some annual grass control. Some hazard to corn if heavy rains occur soon after treatment. Do not use on sandy soils.
	Randox-T	See label for rate.	Controls annual grasses and broad-leaved weeds. Use precautions to prevent irritation to skin and eyes. Some injury may result with heavy rains. Do not use on sandy soils. Toxicity to soybeans from soil residues not fully determined.
Corn, post-emergence	2,4-D amine or 2,4-D ester	1/2 lb. / 1/4 lb.	Use 5 to 10 gallons of water per acre. Does not control grass. Use nozzle extensions after corn is 8 inches tall. Amines are preferable to help prevent damage to nearby susceptible crops.

Crop or weed	Chemical	Rate	Remarks
Soybeans, pre-emergence (Amiben or Randox preferred)	Amiben	3 lb.	For control of annual grasses and broad-leaved weeds. Received label approval in 1961.
	Randox	4 lb.	Controls annual grasses. Use precautions to prevent irritation to skin and eyes. Do not use on sandy soils.

The following pre-emergence herbicides are also available for soybeans, but from the standpoint of crop tolerance and degree of weed control they are less preferable than the above chemicals:

Crop or weed	Chemical	Rate	Remarks
	Alanap	4 lb.	Controls annual grasses and broad-leaved weeds. May reduce stand somewhat. Does not give good control of smartweeds. Two pounds of Alanap and two pounds of CIPC may be mixed to control smartweed.
	Sodium PCP	See label for rate.	Controls broad-leaved weeds better than grasses. Usually more effective on soils low in organic matter. May cause some injury to soybeans. Dust or spray causes sneezing and is irritating to skin. Received label clearance in 1961.
Sorghums	Randox	4 lb.	As pre-emergence--same as for corn.
	2,4-D amine or 2,4-D ester	1/2 lb. / 1/4 lb.	Apply when sorghum is between 4 and 12 inches high.
Small grains, no legume sown	2,4-D amine	1/4 to 1/2 lb.	Use 5 to 10 gallons of water. Apply after grain tillers but before boot stage, not during milk stage. Do not apply in fall to fall-seeded grain. Oats are more sensitive than wheat and barley. Respray in stubble after harvest for control of some perennials.
Small grain as companion crop with under-seeded legumes	MCP amine or 2,4-D amine	1/4 lb.	Use 5 to 10 gallons of water. Treat in spring only. Apply after grain tillers and before boot stage, but after small grain and weeds have formed canopy over legumes. May reduce stand. Do not use on sweet clover.

Crop or weed	Chemical	Rate	Remarks
Small grain as companion crop with under-seeded legumes (continued)	Dinitro-amine	1 to 2 lb. (1 1/2 to 2 qt.)	Apply in 25 to 40 gallons of water when grain is 3 to 6 inches tall and weeds are small. Temporary leaf burn of small grain likely.
Pasture, permanent grass	2,4-D amine or 2,4-D ester	1/2 to 2 lb.	Amount of 2,4-D depends on weed species to be killed. Retreatment may be required. Will kill or severely injure most legumes.
	Specific Weed Problems		
Canada thistles	Amitrole	4 lb. active in 20 to 30 gal. water	Apply to spring growth or regrowth when thistles are 6 to 8 inches high to bud stage. Cover foliage completely with spray. Plow at least two weeks later, and plant to corn. Do not plow before treating. If used in pastures, do not graze for eight months after treatment. In grain stubble, clip and treat regrowth when 6 to 8 inches high.
	2,4-D amine or 2,4-D ester	1/2 to 1 lb. in 5 to 20 gal. water	Apply before thistles bloom. May require two or three treatments per year. Some strains of thistles not controlled with 2,4-D. Apply on warm, sunshiny day.
Quackgrass	Atrazine	4 lb. in 20 to 30 gal. water	In fall, spray quackgrass any time before freeze. Do not work treated area until spring--the later the better. Plant only to corn. An alternative is to make a spring application, either as a single treatment of 4 pounds atrazine at least three weeks before working the soil or as a split application of 2 pounds atrazine at least three weeks before working the soil and 2 pounds atrazine as broadcast pre-emergence. Land must be planted to corn the following year also.
	Amitrole-T	2 lb. (1 gal.) in 20 to 30 gallon water	Apply in spring when quackgrass is 4 to 6 inches high. Wait 10 to 14 days and plow. Plant corn as soon

Crop or weed	Chemical	Rate	Remarks
Quackgrass (Continued)			as possible, using 2 to 3 pounds rate of Atrazine as pre-emergence. With this treatment small grain may be planted the following year.
	Dalapon	6 to 8 lb. in 30 to 40 gal. water	In spring before planting corn or soybeans, apply to quackgrass when 6 to 10 inches high. Plow 7 to 10 days later. To avoid crop injury, wait three to four weeks before planting corn or soybeans.
Johnsongrass old grass	Dalapon	10 lb. in 30 to 40 gal. water	Apply in spring before planting corn or soybeans when Johnsongrass is about a foot high. Wait 10 days after treatment to plow. Wait two to three weeks after plowdown to plant.
Johnsongrass seedlings	Eptam	3 lb. in 20 to 30 gal. water	Apply as pre-emergence when corn is planted or immediately after. Applying in 14-inch bands will reduce cost. Incorporate into top inch of soil with rotary hoe or harrow. Treat also with dalapon, as indicated above, prior to planting to kill old Johnsongrass.
Johnsongrass in small grain	Dalapon	8 lb. in 30 to 40 gal. water	Harvest grain, clip or chop stubble, and treat regrowth when 12 to 14 inches high. Fall-plow. Plant corn or soybeans the following spring, and cultivate frequently to control Johnsongrass seedlings. If corn is planted, use Eptam as pre-emergence.
Johnsongrass spot treatments	Atlacide	6 lb. per sq. rod	May be mixed with water and used as spray or used dry. Sterilizes the soil for one year or more.
Johnsongrass spot treatments for roadsides and fence rows	Dalapon	1 lb. in 5 gal. water	Apply when grass is 1 to 2 feet high. Re-treat in three weeks.

See Illinois Circular 827 for further details on Johnsongrass.

Crop or weed	Chemical	Rate	Remarks
Wild garlic and onions in cornstalks or soybean stubble	2,4-D ester	2 to 3 lb. in 5 to 10 gal. water	Apply in October or November or in late February, March, or early April for bulblet control. Winter-plow if possible, but delay plowing three to four weeks after treatment. Repeat treatment for two to three years. Treatment can be used for grass pasture without plowing.
Wild garlic and onions in wheat	2,4-D ester or 2,4-D amine	1/2 to 3/4 lb. in 5 to 10 gal.	Apply in spring after grain has tillered, but before boot stage. Will not kill all garlic, but plants not killed will usually be distorted so that combine will miss them if wheat is not lodged. May reduce grain yield. May destroy legume underseeding.
Giant foxtail	Use pre-emergence herbicides when planting corn or soybeans. See Illinois Circular 828 for further details on giant foxtail.		
Fencerows	2,4-D amine or 2,4-D ester	1/2 to 2 lb. in 10 gal. water	For broad-leaved weed control. Apply in late spring or early summer when plants are growing rapidly, but before blooming. Use extreme care to reduce drift onto susceptible crops or trees and shrubs. Do not use ester form in vegetable crop areas.
	Dalapon	5 to 8 lb. in 30 to 40 gal. water	For grass control. Apply in spring before grass heads out. 2,4-D may be added to control broad-leaved weeds. Completely cover foliage.
	Woody Plants (Apply sprays as necessary.)		
Foliage treatment	2,4-D ester or 2,4,5-T ester or Mixture of both	3 lb. in 100 gal. water	Apply when leaves are full size in spring and before slow summer growth. For mixed brush, use mixture of 2,4-D and 2,4,5-T. For brambles, use 2,4,5-T. Avoid spraying near susceptible plants.
	Ammate	60 lb. in 100 gal. water.	Apply when leaves are full size, before slow summer growth. Less hazard to nearby desirable plants than 2,4-D and 2,4,5-T. Kills grasses.

Crop or weed	Chemical	Rate	Remarks
Bark or stump treatment	2,4,5-T ester	16 lb. in 100 gal. fuel oil or kerosene	Apply in winter or summer to base of plant from 1 to 2 feet above groundline. Spray to run-off. For trunks over 5 inches in diameter, apply in frills or girdles.
Soil treatment	Dybar Urab	1 T. pellets on ground to cover 1/2 to 1 sq. ft. at base of each tree or cluster of brush	Readily applied dry any time of year, but late winter or early spring is best. Kills most species of woody plants. Some species do not die until second year following treatment. Do not treat where roots of desirable species grow.
Poison ivy	Amitrole	1/2 lb. active in 25 gal. water	Apply when plants are in full leaf. Spray until they are thoroughly wet.
	2,4-D ester or 2,4-D ester plus 2,4,5-T ester	3 lb. in 100 gal. water	Apply when plants are in full leaf. Avoid spraying near susceptible crops and ornamentals.

CONTROL OF WEEDS IN CHRISTMAS TREE PLANTATIONS

J. J. Jokela and R. W. Lorenz

Weed control in Christmas tree plantings may be warranted throughout most or all of the rotation. Initial survival and early growth can be severely reduced by heavy weed competition. This reduced growth rate not only lengthens the rotation, but also unduly prolongs the period during which trees are subject to injury by mice and rabbits. By interfering with the growth and development of the lower branches, weeds degrade the quality or reduce the marketable length of Christmas trees.

Low-volatile esters of 2,4,5-T or mixtures of 2,4,5-T and 2,4-D are still standard tree and brush killers. They can be applied as basal sprays (8-12 ahg, fuel oil) in any season or as foliage sprays (2-4 ahg, water) in the spring after full leafing. Soil sterilants, such as monuron, fenuron, diuron, and urab, are also very effective on woody species. Monuron applied about the base at the rate of one-half teaspoon per inch of tree diameter has been reported to be effective on hardwoods of all sizes. Planting sites are best cleared of trees and brush one or two years in advance of planting. This will allow free access for treating regrowth and escapes and time for soil sterilants to dissipate.

The control of annual weed growth is still a knotty problem. Because of irregular spacing of trees and rough terrain, machine cultivation and mowing are difficult and often ineffective.

A number of commercially available herbicides are in need of extensive testing under varying soil and climatic conditions in Illinois. In a current test at Urbana, the tolerance and response of eight commonly planted tree species to simazine, diphenatrile, and zytron applied immediately after outplanting on tilled silt loam are being investigated. End-of-the-season results are summarized in Tables 1 and 2.

The simazine treatments gave 90 percent or better control of giant foxtail and broadleaf weeds except velvet weed. Diphenatrile gave fair control of grasses, but no observable control of any broadleaf weeds. Zytron gave good control of grasses, but no control of broadleaf species except annual smartweed. Almost 100 percent control of smartweed was observed at both rates of zytron. In all treatments escapes were extremely vigorous and grew at about twice the rate of weeds in the non-weeded control plots. This explains the discrepancies between the percent of weed control and the percent of weed cover in Table 1. Trees, unlike most agricultural crops, do not effectively shade out weeds until several years after outplanting. Thus, for forestry purposes, a satisfactory herbicide must be extremely effective over a broad spectrum of weed species throughout the growing season.

In general, conifers were more tolerant of the chemical treatments than were the hardwoods. Under the conditions of this test, the commonly planted Christmas tree species, pines and spruce, withstood up to 6 pounds of simazine without appreciable mortality.

In another test the same eight tree species were planted in thick bluegrass sod without the customary scalping. Granular simazine applied at the rates of 3 and 6 pounds per acre immediately after planting on March 30 gave satisfactory kill of the bluegrass without observable injury to any tree species.

Table 1.--Percent of Weed Control and Weed Cover, September 1961

Treatment applied April 4, 1961			Percent weed control: Grasses	Percent weed control: Broad-leaves	Percent weed cover
T-1	Simazine	3 lb./acre	95	90	22
T-2	Simazine	4 1/2 lb./acre	99	99	20
T-3	Simazine	6 lb./acre	99	99	18
T-4	Diphenatrile	30 lb./acre	75	10	64
T-5	Zytron	10 lb./acre	90	10	50
T-6	Zytron	15 lb./acre	95	10	44
T-7	Hand-weeded check		100	100	0
T-8	Non-weeded control		0	0	92

Table 2.--Percent of Survival of Tree Species on October 5, 1961

Treat-ment	Red oak	Tulip-tree	Eastern cotton-wood	American sycamore	Eastern white pine	Norway spruce	Japanese larch	Scotch pine
T-1	97	91	47	74	98	100	78	96
T-2	98	93	13	65	100	93	64	98
T-3	91	86	14	29	93	96	78	93
T-4	96	89	89	78	100	100	93	96
T-5	100	89	96	78	96	100	98	98
T-6	94	91	98	87	98	100	89	93
T-7	98	91	89	78	98	96	79	89
T-8	100	96	96	89	100	100	87	95

INSECTS OF CABBAGE AND RELATED COLE CROPS

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Cabbage maggot	44	Early spring	Aldrin Dieldrin	1/4 1/4	Seed bed	At seeding.
			Aldrin	1		In soil, row or band.
			Aldrin Dieldrin	2 oz. actual per 50 gal. transplant water		6 fluid oz. transplant water per plant.
Aphid	47	Throughout season	Malathion Phosdrin Parathion	1 1/4 0.4	Foliage	When aphids appear, but before leaves begin to curl.
Diamond-back moth larva Imported cabbage worm Cabbage looper		June	Dibrom Endrin	1 1/2	Foliage	When small worms first appear, and about every 10 days thereafter.
			Parathion and Toxaphene	1/2 2		
			Perthane with Diazinon	1 1/2	Foliage	
			Parathion Phosdrin	0.4 1/2		
Thrips	48	At onion harvest	Dieldrin	1/4	Foliage	As needed.
Cutworm		At planting	Aldrin Dieldrin	2 1	Soil	Preplanting, disk in.
			Dieldrin	1/2	Foliage	As needed, when first damage occurs.

(See other side for restrictions.)

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Leafhopper		Throughout season	DDT	1 1/2	Foliage	As needed.
Flea beetle		Throughout season	DDT	1 1/2	Foliage	As needed.

1962 Restrictions on Use of Insecticides Recommended for Cole Crops.
Expressed in Days Between Application and Harvest. Read Labels and Follow Precautions.

Crop	Aldrin	DDT	Diazinon	Dibrom	Dieldrin	Endrin	Mala-thion	Para-thion1/	Perthane	Phos-drin1/	Toxaphene
Broccoli	14,A	B	5	4	30,A	B	3	7	3	1	B
Brussels sprouts	14,A	B	--	4	30,A	B	7	7	3	3	B
Cabbage	21,A	B	7	4	21,A	B	7	7	3	1	7 2/
Cauliflower	21,A	B	5	4	21,A	B	7	7	3	3	B
Horseradish	7,A	C	--	--	21	--	7	--	--	--	--
Radish	7,A	C	10	--	21	--	7	21	--	--	C
Turnip	14,A	C	10	4	30,A	--	3	21	--	3	C

A - No restrictions on preplanting or planting soil treatments.
B - Do not apply after edible portions have begun to form.
C - No time limitations, but if tops are to be used for feed or food, do not apply after seedling stage.
1/ To be used only by commercial gardeners or professional applicators.
2/ If outer leaves are stripped, otherwise B applies.
Follow label precautions on use of crop residues for livestock feed.

WHL and HBP

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INSECTS OF VEGETABLE SALAD CROPS

			Insecticides			
Insects	NHE No.	Approximate time of attack	Name	lb. of active ingredient per acre	Placement	Timing of application
Aphid	47	Throughout season	Diazinon Malathion Parathion Phosdrin	1/2 1 0.4 1/4	Foliage	As needed.
Cutworm		On seedling plants	Aldrin Dieldrin	1/2 1/2	Base of plant and soil	When first damage appears.
Leafhopper		Throughout season	DDT Malathion	1 1/4 1	Foliage	When first leafhoppers appear and as needed.
Caterpillar		Throughout season	Dibrom	1	Foliage	As needed.
			Perthane with Diazinon or Malathion or Parathion or Phosdrin	1 1/2 1 0.4 1/2		
Leaf miner		Throughout season	Parathion	0.4	Foliage	When first miners are observed.
Flea beetle		Throughout season	Rotenone DDT	1/4 1	Foliage	As needed.

(See other side for restrictions.)

1961 Restrictions on Insecticides Recommended for Vegetable and Salad Crops.
Expressed in Days Between Application and Harvest. Read Labels and Follow Precautions.

Crop	Aldrin	DDT	Diazinon	Dibrom	Dieldrin	Malathion	Parathion1/	Perthane	Phosdrin1/	Rotenone
Collards	14	A	10	4	21	7	7	--	3	B
Kale	14	A	10	4	21	7	7	--	3	B
Lettuce	30	A	10	4	21	14 2/	21	4	2	B
Spinach	14	A	10	4	21	7	7	7	4	B
Swiss chard	14	A	12	4	21	7	21	--	--	B

A - Do not apply after edible portions have begun to form.
B - No restrictions.
1/ To be used only by commercial gardeners or professional applicators. 2/ Leaf lettuce; head lettuce 7 days.
Follow label precautions on use of crop residues for livestock feeds.

WHL and HBP

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INSECTS OF TOMATOES AND EGGPLANT

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Cutworm, subterranean	38	May-June	Dieldrin Heptachlor Aldrin	1 1 1/2 2	In soil	Preplanting broadcast treatment, disked in.
Cutworm, climbing	77		Aldrin Dieldrin Toxaphene	1/2 1/4 2	Foliage	As needed.
Flea beetle		May-June	DDT Rotenone Sevin	1 0.2-0.4 2	Foliage	Apply every week as long as needed.
Aphid	47	May-July	Thiodan Malathion Diazinon Parathion	1/2 1 1/4 0.4	Foliage	As needed, but before leaves curl.
Corn earworm		July-Sept. Occasionally even in June	DDT Toxaphene Sevin	1 2 2	Foliage	Weekly applications of fungicide sprays beginning at first fruit set. If spraying is infrequent, use 3 lb. of DDT or 6 lb. of toxaphene.
Hornworm		July-Sept.	Toxaphene Sevin	3 2	Foliage	When first small worms appear.
Mites (several species)		July-Sept.	Kelthane Malathion Parathion Trithion	1/2 1 0.4 1	Foliage	As needed.

(over)

Tomatoes and Eggplant

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Russet mites		July-Sept.	Parathion Sulfur dust Sulfur	0.4 30 lb. of 20-50% 10 lb. as spray	Foliage	As needed.
Blister beetle	72	June-Sept.	Parathion Toxaphene	1/4 2	Foliage	As needed.
Fruit fly		Aug.-Oct.	Aldrin Diazinon Pyrethrin dust	1/2 1/4	Foliage	When flies first appear, apply aldrin or diazinon--usually at 1st harvest. Apply pyrethrin dusts to hamper immediately after it is filled.

1962 Restrictions on Use of Insecticides Recommended for Tomatoes and Eggplant.
Expressed in Days Between Application and Harvest. Read and Follow Label Precautions.

Crop	Aldrin	DDT	Diazinon	Dieldrin	Heptachlor	Kelthane	Malathion	Parathion[1]	Sevin	Sulfur	Trithion	Thiodan	Toxaphene
Eggplant	3	5	--	7	--	2	3	15	B	B	7	1	5
Tomatoes	1	5	1	7	A	2	1	10	B	B	7	1	3

A - For soil treatment at or before planting.
B - No restrictions.
1/ Parathion should be applied only by commercial gardeners or professional applicators.
Follow label precautions on use of crop residues for livestock feeds.

WHL and HBP

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INSECTS ON ONIONS

Insects	NHE No.	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Onion maggot	50	Diazinon Ethion	1/2-1 lb. to 40-50 lb. of seed 1 lb. to 40-50 lb. of seed	Seed	Seed treatment for set onions only. Use lighter dosage of diazinon on sandy, highly mineral soils.
		Diazinon Ethion Trithion	1/2-1 1/2-2 1/2-2	Granules in furrow	Use 1.0 lb. actual per acre for rows 12" apart; 3/4 lb. for rows 18" apart; 1/2 lb. for rows 24" apart. Up to double dosage necessary on muck soils except for diazinon.
		Diazinon	2	Broadcast	Preplanting. Disk into upper 1 to 2 inches of soil.
		DDT Diazinon Malathion Parathion	2 1/3 1 1/3	Foliage spray	Supplemental to soil treatment. Make first application with DDT when first adult flies are seen. Make another 2 weeks later. From then on use any of the insecticides, but only as necessary.
Thrips	48	Parathion DDT Diazinon Dieldrin	1/2 1 1/2 1/2 1/4	Foliage	When injury first appears and every 10 days as necessary.
Cutworm		Dieldrin	1/4	Foliage	As needed.

WHL and HBP

(See other side for restrictions.)

1962 Restrictions on Use of Insecticides Recommended for Insects on Onions.
Read Labels and Follow Precautions.

There are no restrictions on the use of ethion as a furrow treatment at planting.
Trithion can be used as a furrow treatment for dry onions, but not for green bunching onions.
Do not apply dieldrin or DDT to green bunching onions.
Do not apply diazinon to onion foliage within 10 days, parathion within 15 days, malathion within 3 days, or dieldrin within 14 days of harvest of dry onions.
Parathion should be applied by commercial gardeners and professional applicators only.
Follow label precautions on use of crop residues for livestock feeds.

WHL and HBP

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INSECTS ON CUCURBITS AND OTHER VINE CROPS

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Seed maggot	27	Germination	Dieldrin	According to manufacturer's directions	Seed	Protects seed only at planting time.
Striped and spotted cucumber beetles	46	Seedling to mature plants	Dieldrin Sevin	1/4 to 1/2	Foliage spray	When beetles first appear; as often as necessary thereafter.
			Dieldrin	1	Soil treatment	Preplanting broadcast application. Disked in.
Aphid	47	All stages	Diazinon Malathion Phosdrin Parathion	1/2 1 1/4 1/2	Foliage	When aphids become noticeable.
Squash bug	51	All season	Dieldrin Sevin	1/2 1	Foliage	Do not apply until first eggs are found hatching (6/15--7/15).
Leafhopper		July-Aug.	Malathion	1	Foliage	As needed.
Squash vine borer		June-Sept.	Lindane	1/4	Base of stem and runners for 3 ft. from stem	Weekly applications when vines begin to run--5 applications.
Pickle worm		Aug.-Sept.	Lindane Sevin	1/4 1	Foliage	Weekly applications beginning in late August.
Cutworm		May-June	Aldrin Dieldrin	2 1	Soil	Preplanting. Disk in.

(See other side for restrictions.)

1962 Restrictions on Use of Insecticides Recommended for Cucurbits and Other Vine Crops. Expressed in Days Between Treatment and Harvest. Read and Follow Label Precautions.

Crops	Aldrin	Diazinon	Dieldrin	Lindane	Malathion	Parathion 1/	Phosdrin 1/	Sevin
Cucumber	A	7	A, 7	1	1	15	1	C
Melon	A	3	A, B	C	1	7	1	-
Pumpkin	A	-	A, B	C	3	10	14	-
Squash (winter)	A	3	A, B	1	1	15	14	C
Squash (summer)	A	7	A, 7	1	1	15	1	C

A - No restrictions on use as soil treatment prior to or at planting.
B - Do not apply after blossoming.
C - Up to and including day of harvest.
1/ To be applied by commercial gardeners or professional applicators only.
Follow label precautions on use of crop residues for livestock feeds.

WHL and HBP

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INSECTS ON BEANS

Insects	NHE No.	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Seed maggot	27	Lindane Dieldrin Aldrin	Manufacturer's directions	Seed	At seeding. Preplanting soil treatment of 1/8 lb. of aldrin as band over row at planting can be used also.
Bean leaf beetle		DDT Toxaphene Methoxychlor Malathion Sevin	1 1 1/2 1 1/2 1 1	Foliage	When feeding first appears and weekly for 2 or 3 applications as needed.
Leafhopper and plant bug	22 68	Methoxychlor Malathion Sevin DDT	1 1/2 1 1 1	Foliage	When tiny wedge-shaped green leafhoppers appear and before plants become yellow and stunted. Repeat applications at 1-week intervals as necessary.
Mexican bean beetle		Sevin Malathion Thiodan	1/2 1 1/2	Foliage	When occasional leaves show lacework feeding.
Aphid	47	Malathion Thiodan	1 1/2	Foliage	Before leaves begin to curl and deform. Usually applied when a few aphids can be found on each plant.
Blister beetle	72	Toxaphene Parathion	2 1/4	Foliage	As needed.
Corn earworm	33	Sevin	1	Foliage	As needed.
Mites		Malathion Kelthane Trithion	1 0.4 3/4	Foliage	As needed.

(See other side for restrictions.)

1962 Restrictions on Use of Insecticides Recommended for Insects on Beans.
Read Labels and Follow Precautions.

Do not apply DDT within 7 days of harvest; malathion within 1 day of harvest; methoxychlor within 3 days of harvest; parathion within 15 days of harvest; trithion within 7 days of harvest; or kelthane within 7 days of harvest. Sevin may be applied up to and including the day of harvest.
Do not apply thiodan or toxaphene after pods form.
Parathion should be applied only by commercial gardeners or professional applicators.
Follow label precautions on use of crop residues for livestock feed.

WHL and HBP

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INSECTS ON POTATOES

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Insecticides: Lb. of active ingredient per acre	Insecticides: Placement	Insecticides: Timing of application
Flea beetle		May-July	DDT Thiodan	1 1/2 (as spray) 1/2 (as spray) 1 (as dust)	Foliage	When first damage appears on leaves and repeat as needed.
Colorado potato beetle		May-July	DDT Thiodan	1 1/2 (as spray) 1 (as dust)	Foliage	As needed.
Potato leafhopper	22	May-July	DDT Thiodan	1 1/2 (as spray) 1 (as dust)	Foliage	Weekly applications when green leafhoppers first appear.
Aphid	47	Throughout season	Thiodan Malathion Parathion	1/2 (as spray) 1 (as dust) 1 1/4	Foliage	As needed.
Blister beetle	72	Throughout season	Toxaphene Parathion	2 1/4	Foliage	As needed.
Wireworm	43	Throughout season	Aldrin Dieldrin	2 2	Soil	Preplanting, disk in.
White grub	23	Throughout season	Aldrin Dieldrin	3 2	Soil	Preplanting, disk in.
Grasshopper	74	July-Sept.	Aldrin Dieldrin Toxaphene	1/4 1/8 2	Foliage	As needed--control in fence rows, roadsides, ditch banks, etc., before migration occurs.

Phorate (Thimet) can be used as a furrow or band treatment at planting time at the rate of 2 to 3 lb. per acre for the control of aphids, flea beetles, and leafhoppers. Do not use in muck soils.

(See other side for restrictions.)

1962 Restrictions on Use of Insecticides Recommended for Insects on Potatoes.
Expressed in Days Between Application and Harvest. Read Labels and Follow Precautions.

There are no restrictions on the use of DDT, malathion, thiodan, or toxaphene on potato foliage.
Allow 5 days to elapse between application of parathion and harvest, and 23 days when dieldrin is used as a foliage spray.
Parathion should be applied only by commercial gardeners or professional operators.
Follow label precautions on use of crop residues for livestock feed.

WHL and HBP

Those who produce vegetables commercially should record for each crop the names of all chemicals used, the amount used, method and date of application, and date of harvest.

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INSECTS ON SWEET CORN

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Soil insects		April-Aug.	Aldrin	1 1/2--3	In soil	Broadcast prior to planting. Disk in immediately unless applied during winter.
Cutworm	38		Heptachlor	1 1/2--3		
Grub	23		Dieldrin	1		
Grape colaspis	25					
Rootworm	26					
Seed corn maggot	27					
Seed corn beetle	27					
Root aphid	31					
Wireworm	43					
Cutworm	23	April-June	Endrin	1/4	Base of plants	When first damage appears. Use large quantities of water per acre.
Flea beetle	36	April-July	DDT	1 1/2	Foliage	As necessary. (Dieldrin soil treatment recommended.)
Corn borer		June, July, August	DDT	1 (granule) 1 1/2 (spray)	Foliage	If tassel ratio is 20 or more with 20 unhatched egg masses per 100 plants, make first application at T.R. 30-40. Repeat at 4- to 5-day intervals as long as field has 20 or more unhatched egg masses per 100 plants. (For further information on 1st and 2nd generation borer control, see U. of I. Cir. 773.)
Corn earworm	33	June-Sept.	DDT	1 1/2 plus 2 1/2 gal. of mineral-type oil in 25 gal. water per	Ear zone	At 10% silk and every 3-4 days thereafter for 4 applications. (Early tassel spray without oil may be required. See U. of I. Cir. 739.)
			Sevin	1 3/4 - 2		

(See other side for restrictions.)

Sweet Corn

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Sap beetles	10	July-Sept.	Parathion Malathion Diazinon Sevin	1/2 1 1 1 3/4-2	Foliage	When adults first appear in field. Usually between pollen shedding and silk drying.
Corn leaf aphid	29	July-Sept.	Parathion Malathion Phosdrin	1/4 1 1/4	Foliage	As needed to produce attractive ears for fresh market.

1962 Restrictions on Insecticides Recommended for Insects on Sweet Corn.
Read Labels and Follow Precautions.

Allow 12 days to elapse between treatment with parathion and harvest, and 1 day with phosdrin.
Parathion and phosdrin should be applied only by commercial gardeners or professional applicators.
Follow label precautions when using treated crop residues for livestock feed.

WHL and HBP

Those who produce vegetables commercially should record for each crop the names of all chemicals used, the amount used, method and date of application, and date of harvest.

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MEASUREMENTS FOR SMALL QUANTITIES OF SPRAY
For the Home Gardener

For the home gardener who needs a small amount of spray, a table of measurements is given below. This table shows how recommendations can be adjusted for preparing small amounts of spray.

Suppose you want to make a gallon of spray to control an insect pest in your garden. First look up the recommendation for that insect and for the specific crop. Write down the dosage recommended per acre. Then read the label on the container of the insecticide and turn to the table below. If the recommendation was for 1 pound of the active ingredient per acre and you have 25 percent wettable powder, use 2 tablespoons in 1 gallon of water. If you have bought a liquid emulsifiable concentrate containing 2 pounds of the actual insecticide per gallon, use 4 teaspoons of the liquid concentrate in 1 gallon of water.

The dosages listed in the table are for recommendations of 1 pound of active insecticide per 100 gallons of water per acre. Thus, if the recommended dosage is 1/2 pound per acre, use only one-half the amount listed. If the recommended dosage is 2 pounds per acre, double the amount listed.

	Amount of insecticide needed in		
Type of formulation	25 gallons of water	5 gallons of water	1 gallon of water
Wettable powder			
15 percent	1 1/2 lb.	16 1/b Tb.	10 tsp.
25 percent	1 lb.	10 Tb.	2 Tb.
50 percent	1/2 lb.	5 Tb.	1 Tb.
Emulsifiable concentrate, per gallon			
1 1/2 lb.	2 1/2 C.	8 Tb.	5 tsp.
2 lb.	1 pt.	6 Tb.	4 tsp.
5 lb.	3/4 C.	2 1/2 Tb.	1 1/2 tsp.

All measurements standard and level.

No adjustment of dust formulas is necessary for home gardens. However, with dusts, as with sprays, thorough coverage is desirable.

HBP:je

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DILUTION TABLE FOR INSECTICIDES

Insecticide emulsion concentrate or wettable powder	Pounds of insecticide per gallon concentrate	To obtain the indicated amounts of actual insecticide per acre, add the following amounts of emulsion concentrate or wettable powder to enough water to spray one acre.							
		0.1 lb.	0.25 lb.	0.5 lb.	1.0 lb.	1.5 lb.	2 lb.	3 lb.	4 lb.
Aldrin - 23.1%	2		1 pt.	1 qt.	2 qt.	3 qt.	1 gal.		
Aramite - 25%	2		1 pt.	1 qt.	2 qt.	3 qt.	1 gal.		
Chlordane - 45-47%	4		1/2 pt.	1 pt.	1 qt.	1 1/2 qt.	2 qt.	3 qt.	1 gal.
Chlordane - 73-75%	8		1/4 pt.	1/2 pt.	1 pt.	1 1/2 pt.	1 qt.	1 1/2 qt.	2 qt.
DDT - 25%	2		1 pt.	1 qt.	2 qt.	3 qt.	1 gal.		
Dieldrin - 15.83%	1.5	8/15 pt.	1 1/3 pt.	1 1/3 qt.	2 2/3 qt.	1 gal.	1 1/3 gal.	2 gal.	
Dimite - 25%	2		1 pt.	1 qt.	2 qt.	3 qt.	1 gal.		
Endrin - 18.5%	1.6	1/2 pt.	1 1/4 qt.	1 1/4 qt.	2 1/2 qt.	3 3/4 qt.	1 1/4 gal.		
Heptachlor - 23.4%	2	2/5 pt.	1 pt.	1 qt.	2 qt.	3 qt.	1 gal.		
Lindane - 20%	1.6	1/2 pt.	1 1/4 pt.	1 1/4 qt.	2 1/2 qt.	3 3/4 qt.	1 1/4 gal.		
Malathion - 57%	5	4/25 pt.	2/5 pt.	4/5 qt.	4/5 qt.	1 1/5 qt.	1 3/5 qt.		
Methoxychlor - 24%	2		1 pt.	1 qt.	2 qt.	3 qt.	1 gal.	1 1/2 gal.	2 gal.
Parathion - 25%	2		1 pt.	1 qt.	2 qt.	3 qt.	1 gal.		
Parathion - 42%	4		1/2 pt.	1 pt.	1 qt.	1 1/2 qt.	2 qt.		
Rhothane - 25%	2		1 pt.	1 qt.	2 qt.	3 qt.	1 gal.	1 1/2 gal.	2 gal.
Systox - 21.2%	2		1 pt.	1 qt.	2 qt.	3 qt.	1 gal.		
Toxaphene - 60%	6		1/3 pt.	2/3 pt.	1 1/3 pt.	1 qt.	1 1/3 qt.	2 qt.	2 2/3 qt.
Any 25% Wet. Powder	-		1 lb.	2 lb.	4 lb.	6 lb.	8 lb.	12 lb.	
Any 40% Wet. Powder	-		10 oz.	1 1/4 lb.	2 1/2 lb.	3 3/4 lb.	5 lb.	7 1/2 lb.	
Any 50% Wet. Powder	-		1/2 lb.	1 lb.	2 lb.	3 lb.	4 lb.	6 lb.	
Any 75% Wet. Powder	-		1/3 lb.	2/3 lb.	1 1/3 lb.	2 lb.	2 2/3 lb.	4 lb.	

HBP:je
4/1/60

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR

FIELD CORN INSECTS

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per acre		Placement	Timing of application
Seed corn maggot Seed corn beetle	27	At time of germination	Dieldrin Heptachlor	Follow manufacturer's directions.		On seed	Protects the seed only at planting time (prefer soil applications, as for rootworms).
Southern and northern corn rootworm	26	June-August		Broadcast	In row		To control soil insect complex. Preferably two weeks or more before planting. If broadcast, work into soil immediately.
			Aldrin	1 1/2	1	In soil	
			Heptachlor	1 1/2	1	In soil	
Wireworm	43	May-July	As for rootworm, but use 3 lb. on peat soils or for high populations of large worms.				
Grape colaspis	25	May-July	As for rootworm.				
White grub	23	June-October	Aldrin Heptachlor	3 3		In soil	Broadcast and disk in. 1 to 1 1/2 lb. kills only small grubs.
Sod webworm	42	May and June	DDT	1 1/2		At base of plant	At time of initial attack.
Cutworms	38	May and June	Prefer preplant soil treatment, broadcast only, as preventive.				
			Dieldrin Toxaphene Endrin	1/2 3 1/4		At base of plant.	When damage is first noticeable; high gallonage of finished spray needed.
Grasshopper	74	June-September	Dieldrin Toxaphene	1/8 1 1/2		On entire plant	As needed.
Flea beetle	36	May and June	DDT Dieldrin	1 1/2 1/4		Over row	When damage becomes apparent on small corn.
Armyworm	21	May and June	Dieldrin Toxaphene	1/4 1 1/2		Over row	At first migration or when damage first becomes apparent.
Fall armyworm	34	June, August and September	DDT Toxaphene	1 1/2 1 1/2		In whorl as granules.	When plants show leaf ragging. Granules preferred. When silking (see earworm).
Chinch bug	35	June, July August	Dieldrin Endrin	1/2 1/4		At base of plant	At beginning of migration. Also apply strip in adjacent grain.
Thrips	39	June	DDT	1 1/2		As foliage spray	When severe wilting and severe discoloration are noticeable.
Corn leaf aphid	29	July-September	Malathion Parathion Phosdrin	1 1/4 1/4		As foliage spray	Usually at pretassel when aphids are thick on occasional plants.

Field corn insects...continued

Insect	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per acre	Placement	Timing of application
Corn borer, first generation		June-July	DDT	1 1/2 as spray; 3/4 to 1 as granules	On upper 1/3 of plant and into whorl.	Tassel ratio 30 to 50, 75% or more plants show recent borer feeding in whorl
			(Toxaphene as granules, or endrin as spray or granules, may also be used.)			
Corn borer, second generation		Mid-August	DDT Endrin	As for first 1/4	From ear upward	When eggs are first found hatching in late-planted fields.
Corn earworm	33	July, August	DDT	1 1/2 plus 2 gal. of earworm oil	In ear zone seed corn only	2 to 4 applications at 3- to 5-day intervals, starting at 10% silk. 25 gal. of finished spray per acre.

RESTRICTIONS ON USE OF RECOMMENDED INSECTICIDES ON CORN

This table gives the required time interval in days between application and pasturing or harvesting of corn for grain, ensilage, or stover. Further limitations or qualifications are listed in the footnotes. Read labels carefully and follow precautions.

	Aldrin	DDT	Dieldrin	Endrin	Heptachlor	Malathion	Parathion	Phosdrin	Toxaphene
Field corn-seed and soil	B		B		B				
-grain		B	60	45 D		B	12	1	B
-ensilage		C	60	45 D		7	12	1	A
-stover		C	60	45 D		7	12	1	A

A - Do not feed treated forage to dairy animals. Do not feed sprayed forage to animals being finished for slaughter. Do not feed granular-treated forage within 28 days of slaughter. B - No specific restrictions when used as recommended. C - Do not use treated corn for ensilage or stover for dairy cattle. Fattening cattle can be fed granule-treated ensilage or stover (one treatment only), but not within 90 days of market. Fattening cattle should not be fed sprayed ensilage but may be fed stover sprayed once if they are removed from the treated stover 90 days before market. D - One application only.

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NHE-99
Forage
1/1/62

CONDENSED INSECTICIDE RECOMMENDATIONS FOR CLOVER AND ALFALFA INSECTS 1/

Insect	NHE No.	Approximate time of attack	Name	Lb. actual per acre	Placement	Timing of application
Clover leaf weevil	12	March-April	Lindane	1/4	On foliage	When larvae are numerous and damage is noticeable, usually early to mid-April.
Spittlebug	13	Late April, early May	Lindane Methoxychlor	1/4 1	As foliage spray	When bugs begin to hatch and tiny spittle masses are found in crowns of plants.
Aphid	14 19	April-May	Demeton Malathion Parathion Phosdrin	1/4 1 1/4 1/8-1/4	On foliage	When aphids are becoming abundant. Parathion, phosdrin, and demeton should be applied only by professional operators.
Leafhopper	22	Early July	Methoxychlor Sevin	1 1	On foliage	When second-growth alfalfa is 1 to 6 inches high, or as needed.
Garden webworm	42	July-August	DDT Methoxychlor Toxaphene	1 1/2 1 1/2 1 1/2	On foliage	When first damage appears. Use methoxychlor on hay crops and DDT or toxaphene on new seedlings.
Cutworm	77	April-June	Toxaphene	1 1/2	On foliage	Observe residue precautions. Cut, remove hay, and spray immediately.
Armyworm	21	May-June-September	Methoxychlor Sevin	2 1 1/2	On foliage	Will not kill worms, but keeps them from feeding.
Seed crop insects	68 73	July-August	DDT	1 1/2	On foliage	No later than 10 percent bloom.
Grasshopper	74	June-September	Malathion Sevin Toxaphene Aldrin Dieldrin Heptachlor Toxaphene	1 3/ 1 1/2 3/ 1 1/2 4/ 1/4 5/ 1/8 5/ 1/4 5/ 1 1/2 5/	On foliage	When grasshoppers are small and before damage is severe.
Sweet clover weevil	15	April-May	DDT	1 1/2	On foliage	When 50 percent of foliage has been eaten. New seedings only.
			Aldrin granules Dieldrin granules Heptachlor granules	1/2 1/4 1/2	With seed	At planting with seed.

1/ Do not apply insecticides when insects are pollinating these crops. 2/ Observe residue precautions on the labels. 3/ For use on pasture and hay to be fed to dairy animals and livestock fattening for slaughter. 4/ For permanent pasture for beef cattle only. 5/ For fence rows, ditch banks, roadsides, diverted acres, and other unused areas. Do not use on crops to be fed to livestock.

RESTRICTIONS ON USE OF RECOMMENDED INSECTICIDES ON FORAGE CROPS

This table gives the required time interval in days between application and pasturing or harvesting of the crop. Further limitations or qualifications are listed in the footnotes. READ LABELS AND FOLLOW PRECAUTIONS.

	Aldrin	DDT	Demeton	Dieldrin	Endrin	Heptachlor	Lindane	Malathion	Methoxychlor	Parathion	Phosdrin	Sevin	Toxaphene
Alfalfa - hay			21 1/				28	7	7	15	1	B	A
Clovers - hay	2/		21 1/	2/		2/	28	7	7	15	1	B	A
Pastures			21 1/				28	7	7	15	1	B	A
Seed crops	B	B	B	B	B	B	B	B	B	B	B	B	B

A - Do not feed treated forage to dairy animals or livestock being fattened for slaughter.

B - Do not feed treated forage to dairy animals. If you feed treated forage to other than milking cattle, remove from the treated forage six weeks before slaughter.

C - No specific restrictions.

1/ Once per cutting only.

2/ For sweet clover weevil, apply to soil.

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NHE-100
Grasses
1/1/62

CONDENSED INSECTICIDE RECOMMENDATIONS FOR INSECT PESTS OF SMALL GRAINS

Insect	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per acre	Placement	Timing of application
Grasshopper	74	June, July, August	Aldrin Dieldrin Toxaphene	1/4 1/8 1 1/2	On entire plant	Control early while hoppers are small and before they scatter over a wide area. Do not use on forage crops.
Chinch bug	35	June-July	Dieldrin Endrin	1/2 1/4	General, but at ground level is best	When bugs are damaging grains and during migrations. Treat strip in grain to protect corn.
Armyworm	21	May-June	Dieldrin Toxaphene	1/4 1 1/2	On foliage	When worms are still small and before damage is done.
Greenbug		May-June	Parathion	1/4	On foliage	When needed, and by professional operators only.
Hessian fly		October-April-May	Phorate (Thimet)	1/2	At seeding	5 lb. of 10% granulas in drill row with a grass-seeder attachment.

RESTRICTIONS ON USE OF RECOMMENDED INSECTICIDES ON GRAIN CROPS

This table gives the required time interval in days between application and pasturing or harvesting of the crop. Further limitations or qualifications are listed in the footnotes.

		Aldrin	Dieldrin	Endrin	Malathion	Parathion	Phorate	Toxaphene
Barley	- grain	7	7	45A/	7	15	B	14
	- straw	30	30	45A/	7	15	B	C
Oats	- grain	7	7	45A/	7	15	B	7
	- straw	30	30	45A/	7	15	B	C
Rye	- grain	7	7	45A/	7		B	7
	- straw	30	30	45A/	7		B	C
Wheat	- grain	7	7	45A/	7	15	B	7
	- straw	30	30	45A/	7	15	B	C

A - One application only. B - Do not graze treated fields in fall. C - Do not feed treated forage to dairy animals or livestock being fattened for slaughter.

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CONDENSED INSECTICIDE RECOMMENDATIONS

SOYBEAN INSECTS

Name	NHE No.	Approximate time of attack	Insecticide[1/] Name	Lb. actual per acre	Placement	Timing of application
Bean leaf beetle	67	May, June, August	DDT Dieldrin Toxaphene	1 1/2 1/4 1 1/2	On foliage	When leaf feeding becomes severe and plants are being killed, or when pods are attacked.
Grape colaspis	34	May-June	Aldrin Heptachlor	1 1/2 1 1/2	In soil prior to seeding	On second-year beans or beans after clover.
White grub	23	June-September	Aldrin Heptachlor	3 3	As soil treatment	Two weeks before planting; 1 or 1 1/2 lb. will not kill large grubs.
Clover root curculio adult	71	May-June	DDT	1 1/2	On marginal rows	Usually when adjacent clover field is plowed up, this pest migrates to adjoining beans.
Grasshopper	74	June-September	Aldrin Dieldrin Toxaphene	1/4 1/8 1 1/2	On foliage	When migration from adjoining crops begins. For border spray, use 1 1/2 to 2 times as much, and preferably dieldrin or toxaphene.
Flea beetle		May-June	DDT Dieldrin Toxaphene	1 1/2 1/4 1 1/2	On foliage	Plants usually attacked in seedling stages. Treat when needed.
Green clover worm	75	August	DDT Toxaphene	1 1/2 1 1/2	On foliage	When damage appears and small worms are numerous.
Webworm	42	June, July, August	DDT Toxaphene	1 1/2 1 1/2	On foliage	When damage appears and small worms are numerous.

1/ These recommendations apply to beans only as grain and not as forage.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR CATTLE INSECTS1/

Animal	Insect	NHE No.	Insecticide2/	Concentration	Finished spray per animal	Timing of application
Dairy cattle	Lice	18	5% rotenone	2 lb. per 100 gal. of water	1-2 gal.	2 treatments at 14-day interval.
			Rotenone-sulphur	0.5-1.0%	6 oz. of dust	Repeat treatments as needed.
	Horn flies Stable flies Horse flies	61 59 60	Killing and knock-down agents in combination with repellents like tabatrex and R-326 may be used effectively as ready-to-use oil-base sprays at 2 oz. per animal per day or in oil-base forms in an automatic-treadle sprayer. Follow specific directions on label. Do not overdose, particularly in hot weather, or burn may result.			
	Face flies	106	Apply a 0.2% DDVP sirup bait daily in a one-inch-wide, six-inch-long area on the forehead of the animal.			
Beef cattle	Lice and mange	18	20% lindane concentrate	1 pt. per 100 gal. of water	1-2 gal.	2 applications at 14-day intervals.
			55-57% malathion concentrate	3 qt. per 100 gal. of water	1-2 gal.	2 applications at 14-day intervals.
	Stable flies Horn flies	59 61	60% toxaphene concentrate	5 pt. per 100 gal. of water	1-2 qt.	Repeat every 2-3 weeks. Provides only partial control of stable flies.
	(Backrubbers saturated with 5% toxaphene or 1% ronnel in oil give practical control of both horn flies and lice.)					
	Stable flies Horse flies	59 60	Killing and knock-down agents in combination with repellents like tabatrex and R-326 may be used effectively as directed for dairy cattle above.			
	Face flies	106	Use cloth-wrapped backrubbers saturated with 5% toxaphene in a light-grade fuel oil.			
Cattle	Grubs		5% rotenone powder	7 1/2 lb. per 100 gal. of water	2 gal.	Monthly, December through April. Spray at 300-400 p.s.i. or add detergent to spray mix.
			1 1/2% rotenone dust	1 1/2% dust	3 oz. of dust per animal	Monthly, December through April. Rub vigorously over affected areas.
	(Two systemics, co-ral and ruelene, are available as sprays and they are highly effective when properly used. Use only on beef cattle, apply during August, September, or October.)					

1/ Recommendations are purposely simplified on this chart. 2/ Wettable powders may be substituted for emulsion concentrates if the finished spray is agitated.

1960 RESTRICTIONS FOR RECOMMENDED INSECTICIDES APPLIED TO CATTLE

	Allethrin	Co-ral	DDT	DDVP	Lethane	Lindane	Malathion	Methoxychlor	Pyrethrins	R-326	Ronnel	Rotenone	Ruelene	Tabatrex	Thanite	Toxaphene
Dairy cattle	A			G	A				A	A		A		A	A	
Fattening cattle	A	B	C	G	A	D	A	A	A	A	E	A	H	A	A	F
Breeding herd	A	B	C	G	A	D	A	A	A	A	E	A	H	A	A	F

A - No restrictions when used as recommended.
B - Allow 45 days between treatment and slaughter. Do not treat sick animals or calves less than six months old. Do not use with pyrethrin, allethrin, or synergist.
C - 5% in oil in backrubbers only. Allow 30 days between treatment and slaughter.
D - Do not apply within 30 days of slaughter.
E - Allow 56 days between treatment and slaughter.
F - Do not apply within 28 days of slaughter.
G - As a 0.2% bait in corn sirup (1/10 teaspoon) on forehead.
H - Do not apply within 28 days of slaughter. Give animals free access to wafer and feed before and after treatment.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR INSECTS ON SWINE, SHEEP, AND POULTRY[1]

Animal	Insect	NHE No.	Insecticide[2]	Concentration	Finished spray per animal	Timing of treatment
Swine (do not treat pigs until after weaning)	Mange and lice		20% lindane concentrate[3] or	2 1/2 pt. to 100 gal. of water	1-2 qt.	2 applications at 14-day intervals.
			55-57% malathion concentrate[4]	3 qt. to 100 gal. of water	1-2 qt.	2 applications at 14-day intervals.
Sheep	Ticks, lice, and scab	53	25% DDT concentrate (not for scab)[3]	2 gal. per 100 gal. of water	Spray to saturation. Dips use 1/2 strength.	
			20% lindane concentrate[3]	1 pt. per 100 gal. of water	Spray to saturation. Dips use 1/2 strength.	
			60% toxaphene concentrate[5]	3 qt. per 100 gal. of water	Spray to saturation. Dips use 1/2 strength.	
Chickens (gather eggs before treating; do not contaminate feed and water)	Lice	54	55-57% malathion concentrate[4]	10 oz. per 5 gal. of water	Spray roosting areas to run-off. One treatment.	
			4% malathion dust[4]	1 lb. per 40 sq. ft. floor space	Apply to litter and nesting material. One treatment.	
			5% sevin[6]	1 lb. per 40 sq. ft. floor space	Apply to litter. Repeat in 4 weeks, if necessary.	
	Common red mite	54	55-57% malathion concentrate[4]	10 oz. per 5 gal. of water	Spray infested house areas. One treatment.	
			50% sevin wettable[6]	6 oz. per 5 gal. of water	Spray infested house areas. Repeat as needed.	
	Northern fowl mite	54	4% malathion dust[4]	1 lb. per 40 sq. ft. of floor space	Apply to litter, nesting material, and male birds. Use at rate of 1 lb. per 100 male birds.	
			5% sevin[6]	1 lb. per 40 sq. ft. of floor space	Apply to litter and male birds. Use at rate of 1 lb. per 100 male birds.	
			55-57% malathion concentrate[4]	5 oz. per 5 gal. of water	Spray birds, nesting, and roosting areas (1 gal. per 100 birds). One treatment. Use in place of dust when litter is sparse or wet.	

1/ Recommendations are purposely simplified in this chart. 2/ Wettable powders may be substituted for emulsion concentrates if the finished spray is agitated. 3/ Do not apply within 30 days of slaughter. 4/ No restrictions. 5/ Do not apply within 28 days of slaughter. 6/ Do not apply within 7 days of slaughter. Do not treat nesting material.

Prepared by entomologists of the Illinois Agricultural Extension Service and Illinois Natural History Survey.
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Cooperative Extension Work in Agriculture and Home Economics
University of Illinois College of Agriculture and the United States
Department of Agriculture cooperating. Louis B. Howard, Director.

CONDENSED INSECTICIDE RECOMMENDATIONS FOR HOUSE FLY CONTROL

Infested areas	Insect	NHE No.	Insecticide	Amount per 50 gal. water, plus 10-20 lb. sugar	Finished spray per 1000 sq. ft. of surface	Timing of application
In barns	House fly	16	25% diazinon1/ concentrate	1-2 gal.	2 gal., or to runoff	Every 2-6 weeks during fly season.
			25% diazinon1/ wettable powder	8-16 lb.	"	"
			Diazinon bait2/	0.1% in 2 parts corn sirup and 1 part water		Apply to favorite roosting areas as needed as a spray bait.
			12% ronnel1/ concentrate	4 gal.	2 gal., or to runoff	Every 2-6 weeks.
			24% ronnel1/ concentrate	2 gal.	"	"
			25% ronnel1/ wettable powder	16 lb.	"	"
			Ronnel bait2/	2% in 2 parts corn sirup and 1 part water		Apply to favorite roosting areas as needed as a spray bait.
			Dipterex bait2/	0.1% in 2 parts corn sirup and 1 part water		"
			Dibrom2/	0.1%-0.5% in 2 parts corn sirup and 1 part water		"
			DDVP bait2/	0.1%-0.5% in 2 parts corn sirup and 1 part water		"
			Dimethoate will be recommended subject to label approval.			

1/ Remove animals before treatment. Do not contaminate feed and water. Do not use in milkhouse.
2/ Do not apply within reach of animals or in milkhouse. Use only as bait.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR INSECT PESTS OF TURF

			Insecticides				
				Lb. actual per			
Insects	NHE No.	Approximate time of attack	Name	10,000 sq. ft.	acre	Placement	Timing of application
True white grubs	23	May-Oct.	Aldrin	0.75	3.0	On soil surface	Established sod: if used as a spray, water in thoroughly. Apply preferably in early spring or late fall. New seeding: Mix in soil prior to seeding.
Annual " "	23	May, Aug.-Oct.	Chlordane	2.5	10.0		
Japanese beetle larvae	32	" " "	Dieldrin	0.5	2.0		
Green June beetle larvae		" " "	Heptachlor	0.75	3.0		
Ants		May-Oct.					
Cicada killer wasp	79	June-Aug.	......as for grubs......			On soil surface	As for grubs. For individual nests, pour 3% chlordane in nest after dark. Seal in with dirt.
Earthworms		April-July	Chlordane	2.5	10.0	On soil	As for grubs.
Sod webworms	42	July-Oct.	DDT	1.25	5.0	On grass	As a spray. The more water used, the better the control.
			Chlordane	0.6	2.5		
Armyworms and cutworms	21 77	May-June & Sept.-Oct.	Dieldrin	0.125	0.5	On grass	As spray or granules.
			Toxaphene	0.50	2.0		
Chinch bugs	35	June-Aug.	Dieldrin	0.125	0.5	On grass	Sprays or granules. Use plenty of water as a spray.
Leafhoppers	22	July-Aug.	DDT	0.25	1.0	On grass	As a spray.
Mites	58	July-Sept.	Kelthane	0.125	0.5	On grass	Thorough coverage needed. 75 to 100 gal. water per acre.
			Malathion	0.4	1.5		
Chiggers		May-July	Chlordane	0.6	2.5	On grass	Good coverage required. Use minimum 20-25 gal. water per acre.
			Dieldrin	0.2	0.8		
			Lindane	0.125	0.5		
			Toxaphene	0.5	2.0		

Insect Pests of Turf...continued

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per 10,000 sq. ft.	Lb. actual per acre	Placement	Timing of application
Thrips		July-Sept.	DDT	0.5	2.0	On grass	Control rarely needed.
Slugs	84	June-Oct.	......Slug baits......			Scatter in grass	Where slugs are numerous.
Sowbugs		June-Oct.	DDT	0.5	2.0	On grass	As a spray. Lots of water needed. Control rarely required.

PRECAUTIONS: Most insecticides are poisonous. Be sure insecticides are clearly labeled. Keep them away from children and pets. After applying an insecticide, do not allow children and pets on the lawn until the insecticide has been washed into the soil by sprinkling, and the grass has dried completely. To protect fish and wildlife, do not contaminate streams, lakes, or ponds with insecticides.

One gallon of insecticide contains the following amounts of active ingredient: 25% DDT, aldrin, or heptachlor, 2 lb.; 45% chlordane, 4 lb.; 15% dieldrin, 1.5 lb.; 55-57% malathion, 5 lb.; 18 1/2% kelthane, 1.5 lb.; 60% toxaphene, 6 lb.; 20% lindane, 1.6 lb.

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