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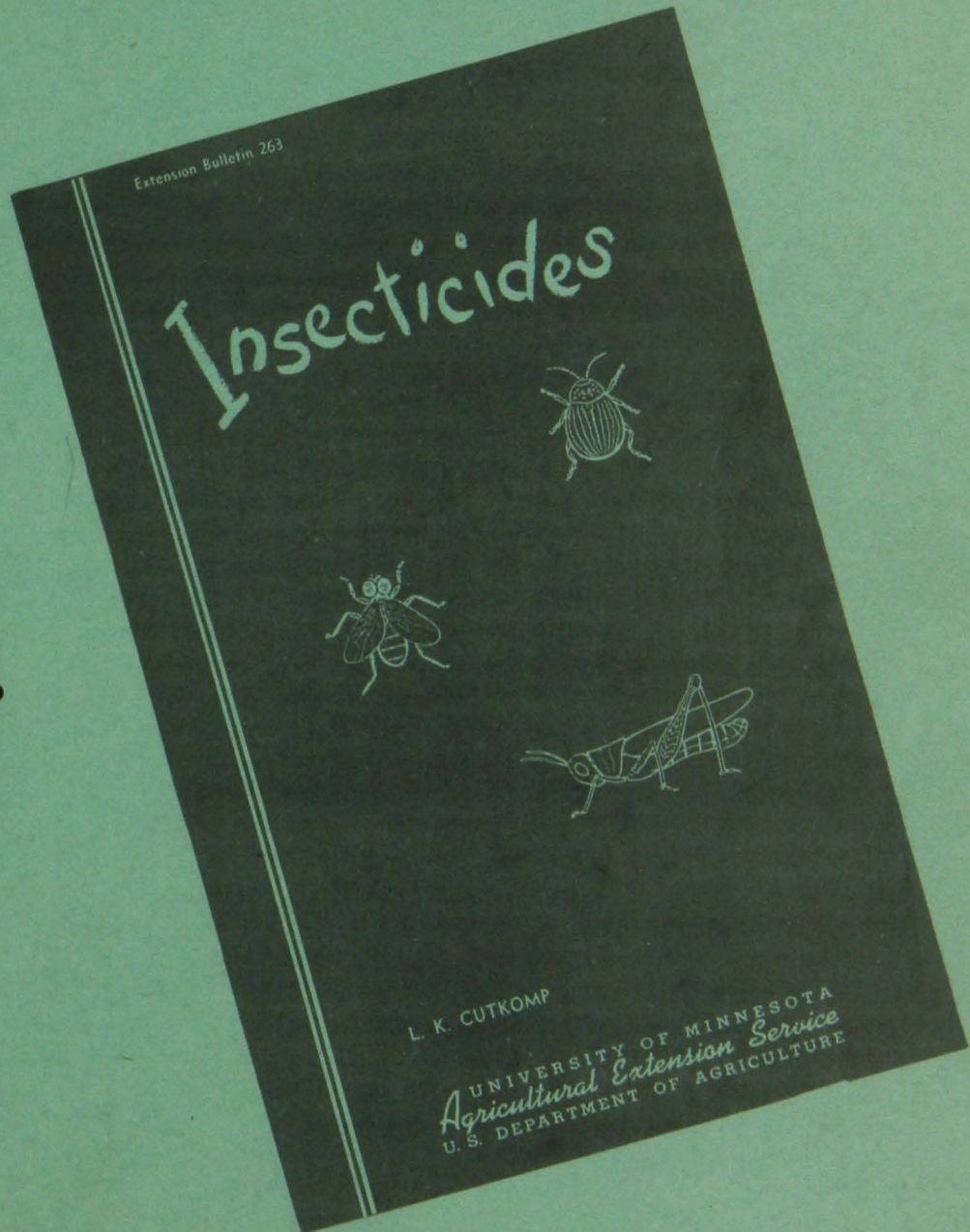
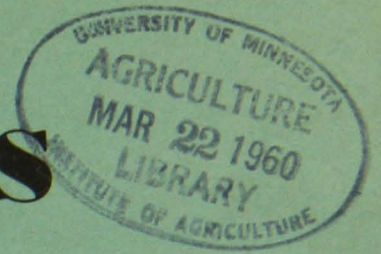
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# INSECTICIDES

## and Their Uses in Minnesota



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**UNIVERSITY OF MINNESOTA**

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## C O N T E N T S

	Page
Regulations on sale and use of insecticides .....	1
Forms of insecticides .....	1
Calculating dosage and rates of application .....	3
Dilution tables .....	5
Descriptions of insecticides .....	8
List of insecticides and principal uses .....	18
Precautions when using toxic phosphates .....	25
First-aid treatment .....	25
Poison information centers .....	26
Insecticide recommendations .....	29
Field crop insects .....	29
Truck crop and vegetable insects .....	35
Fruit insects .....	44
Household insects .....	47
Livestock and poultry insects .....	53
Tree, shrub, and lawn insects .....	59
Stored-grain insects .....	65
Greenhouse and floricultural pests .....	67



# INSECTICIDES AND THEIR USES IN MINNESOTA

J. A. Lofgren and L. K. Cutkomp\*

New insecticides and accompanying recommendations continue to be an important part of effective insect control. The organic phosphate insecticides are being prominently mentioned for control problems which were formerly handled by DDT and other chlorinated hydrocarbons. The development of insect resistance to DDT and its relatives has been influential in this respect. The regulated control of pesticides and label requirements has also played a prominent role in new recommendations. Because of continuing changes, however, you must keep informed through your county and state agencies.

## REGULATIONS ON SALE AND USE OF INSECTICIDES

The sale and use of insecticides are regulated by two federal acts and by corresponding state laws. The federal regulations cover the interstate phases of insecticide labeling and sales and the interstate movement of treated foods or agricultural products. The state laws cover these phases within the state.

The federal acts are the Federal Insecticide, Fungicide, and Rodenticide Act, with amendments, and the Food, Drug, and Cosmetic Act as amended by the Miller Bill.

The Insecticide, Fungicide, and Rodenticide Act, administered by the USDA, provides that all pesticides sold in interstate commerce be approved and labeled according to the provisions of the act.

The Food, Drug, and Cosmetic Act, with amendments, is administered by the Food and Drug Administration, and provides for the establishment of tolerances for pesticides in or on agricultural commodities. This means that the applications of chemicals to crops and livestock must be done in such a way that the residues of those chemicals remaining in or on the commodities are within the established tolerances. This can be done by following to the letter recommendations as to dosage, time of application, crops or livestock to be treated, waiting periods between treatment and harvest, and other limitations stated in current recommendations and on current labels.

## FORMS OF INSECTICIDES

1. Dusts are dry powders ready for immediate use. They may contain  $\frac{1}{2}$ , 1, 2, 3, 5, 10, or 20 percent of the actual chemical. The rest of the dust is a carrier, such as talc or pyrophyllite. Combination dusts with two or more insecticides or with fungicides are available. Dusts should not be used in sprayers because they will not mix properly with water or oil.

2. Wettable powders are dry powders which may be mixed with water to make sprays. Formulations containing 15, 25, 40, 50, and 75 percent of the

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actual ingredient may be obtained. These powders contain a carrier plus a wetting agent which permits them to be mixed with water to form suspensions. This formulation is useful on vegetation because it does not injure foliage as readily as do the emulsions or oil solutions. High-volume hydraulic sprayers with mechanical agitators are best suited for handling wettable powders.

3. Soluble powders. Almost all organic insecticides will not dissolve in water. However, a few of the newer materials are exceptions, and will dissolve in water; powders of these chemicals are called soluble powders. They may be mixed with water in the same way as the wettable powders are mixed, and may be used in the same type of sprayers which will handle solutions or emulsions.

4. Emulsifiable concentrates are liquids containing the insecticide dissolved in a suitable solvent and an emulsifier. This permits the concentrate to mix with water to form an emulsion. These concentrates may contain many different amounts of the active ingredient, but the information on the label will give this concentration plus the weight of active chemical per gallon. For example, 25 percent DDT emulsifiable concentrate contains 2 pounds actual DDT per gallon; 18.5 percent dieldrin emulsifiable concentrate contains  $1\frac{1}{2}$  pounds actual dieldrin per gallon; 57 percent malathion emulsifiable concentrate contains 5 pounds actual malathion per gallon, etc. Emulsions may be used in low-pressure, low-volume sprayers without mechanical agitation. Emulsions damage some types of foliage, so be sure the use on plants is specifically recommended or included on the label.

5. Oil solutions are solutions, usually ready to use, of the insecticide in a suitable solvent and an oil carrier. Ready-to-use solutions usually contain from  $\frac{1}{2}$  to 10 percent active ingredients. Some solution concentrates are available for further dilution with oil or to form oil sprays such as those used by aerial spray equipment, foggers, and mist blowers. Oil solutions should not be used on plants or animals except for special uses with special formulations, such as pyrethrum fly sprays on cattle.

6. Granulated material is a ready-to-use preparation of the insecticide in or on particles of an insect carrier such as attaclay or bentonite. The particles are usually from 25- to 60-mesh in size, or from the consistency of granulated sugar to that of coffee grounds. Granules are particularly useful for controlling soil insects because they sift down through foliage and tend to last longer than other formulations. The granules are also effective for corn-borer control because they roll down into the whorl of the plants. They may be applied with fertilizer spreaders, seeders, or special granule applicators, ground or aerial.

7. Aerosol and spray bombs contain one or more insecticides, an oil solvent, and a propellant gas. These bombs produce a very fine mist (an "aerosol") or a coarse spray, depending on the purpose of the bomb. The fine-mist aerosols are for the control of flying insects, such as flies and mosquitoes, in a closed room. The coarser-spray bombs may be used to apply a residual deposit of insecticide. You may use some spray bombs on certain plants, but check the labels carefully before such use.

Large aerosol cylinders are available for use in greenhouses, warehouses, etc.

8. Miscellaneous. In addition to the main insecticides there are a number of special types. Baits, insecticide-fertilizer mixtures, insecticide - herbicide mixtures, moth-proofing agents, and other special insecticides should be used according to recommendations.

### CALCULATING DOSAGE AND RATES OF APPLICATION

Most recommendations are given in terms of amount of actual insecticide per acre, or as percent active ingredient in the finished spray, or as recipes using a given formulation in 1 or 5 or 25 or 100 gallons of water.

The following formulas and tables will help you in calculating proper dosages. This is extremely important in order to avoid waste, excessive residues, or injury to treated plants or animals.

1. To figure amount of emulsifiable concentrate needed for a required amount of actual chemical to be mixed in a spray tank.

$$\frac{\text{Number of acres to be sprayed per tank} \times \text{pounds actual needed per acre}}{\text{Pounds actual per gallon in concentrate used}}$$

Example:

How many gallons of 25 percent DDT emulsifiable concentrate (2 pounds per gallon) are needed to give 3/4 pound actual DDT per acre, using a sprayer with a 50-gallon tank applying 10 gallons per acre (5 acres per tank)?

$$\frac{5 \times 0.75}{2} = 1.87 \text{ gallons}$$

2. To figure amount of wettable powder needed for a certain amount of actual chemical per acre.

$$\frac{\text{Number of acres per tank} \times \text{pounds actual needed per acre}}{\text{Pounds actual chemical per pound of powder used}}$$

Example:

How many pounds of 50 percent DDT wettable powder are needed to apply 3/4 pound actual DDT per acre, using a sprayer with a 50-gallon tank applying 10 gallons per acre (5 acres per tank)?

$$\frac{5 \times 0.75}{0.5} = 7.5 \text{ pounds of 50 percent DDT in 50 gallons of water}$$

3. To figure amount of wettable powder needed to mix a spray containing a given percent of actual toxicant.

$$\frac{\text{Gallons of spray wanted} \times \text{percent actual toxicant wanted} \times 8}{\text{Percent active ingredient in powder used}}$$

Example:

How many pounds of 25 percent malathion wettable powder are needed to make 100 gallons of a 1 percent malathion spray?

$$\frac{100 \times 1 \times 8}{25} = 32 \text{ pounds}$$

4. To figure the percent actual toxicant in a spray mixture.

$$\frac{\text{Pounds of insecticide used} \times \text{percent active ingredient in insecticide used}}{\text{Gallons of spray} \times 8}$$

Example:

What percent DDT is in a spray in which 8 pounds of 50 percent DDT powder were used in 100 gallons of water?

$$\frac{8 \times 50}{100 \times 8} = 0.5 \text{ percent}$$

5. To figure the gallons of emulsifiable concentrate needed to mix a spray containing a given percent of active ingredient.

$$\frac{\text{Gallons of spray wanted} \times \text{percent active ingredient wanted} \times 8}{\text{Pounds active ingredient per gallon in insecticide used} \times 100}$$

Example:

How much 25 percent DDT emulsion concentrate (2 pounds per gallon) is needed to make 50 gallons of an 0.25 percent DDT spray?

$$\frac{50 \times 0.25 \times 8}{2 \times 100} = 0.5 \text{ gallon}$$

#### RULE-OF-THUMB REDUCING TO ONE GALLON OF SPRAY

It is often necessary, for small jobs, to figure out how much insecticide to use for one gallon of spray. If the recommendation is given in terms of 100 gallons, use the following formulas for one gallon.

With wettable powder:

1 level tablespoon per gallon of water = approximately 1 pound per 100 gallons of water

With an emulsion:

1 teaspoon per gallon of water = approximately 1 pint per 100 gallons of water



DILUTION TABLE - EMULSIFIABLE CONCENTRATES

Pounds of actual chemical per gallon of concentrate used	Desired pounds per acre of actual chemical						
	0.125 lb. (2 oz.)	0.25 lb. (4 oz.)	0.50 lb. (8 oz.)	0.75 lb. (12 oz.)	1 lb.	2 lbs.	3 lbs.
	pints of emulsion concentrate to apply per acre						
1	1.0	2.0	4.0	6.0	8.0	16.0	24.0
1½	0.67	1.3	2.6	4.0	5.3	10.6	16.0
2	0.50	1.0	2.0	3.0	4.0	8.0	12.0
3	0.34	0.67	1.3	2.0	2.7	5.4	8.0
4	0.25	0.50	1.0	1.5	2.0	4.0	6.0
5	0.20	0.40	0.80	1.2	1.6	3.2	4.8
6	0.17	0.34	0.67	1.0	1.3	2.6	4.0
7	0.14	0.30	0.60	0.90	1.1	2.3	3.4
8	0.125	0.25	0.50	0.75	1.0	2.0	3.0

DILUTION TABLE - WETTABLE POWDERS (FOR SPRAYS)

Percent wetable powder used	Desired pounds per acre of actual chemical							
	0.125 lb. (2 oz.)	0.25 lb. (4 oz.)	0.50 lb. (8 oz.)	0.75 lb. (12 oz.)	1 lb.	2 lbs.	3 lbs.	4 lbs.
	amount of wettable powder to use per acre							
15	13 oz.	1 lb., 12 oz.	3 lbs., 5 oz.	5 lbs.	6½ lbs.	13 lbs.	20 lbs.	26½ lbs.
25	8 oz.	1 lb.	2 lbs.	3 lbs.	4 lbs.	8 lbs.	12 lbs.	16 lbs.
40	5 oz.	10 oz.	1 lb., 4 oz.	1 3/4 lbs.	2½ lbs.	5 lbs.	7½ lbs.	10 lbs.
50	4 oz.	8 oz.	1 lb.	1½ lbs.	2 lbs.	4 lbs.	6 lbs.	8 lbs.
75	3 oz.	6 oz.	12 oz.	1 lb.	1 lb., 5 oz.	2 lbs., 11 oz.	4 lbs.	5 lbs., 3 oz.

DILUTION TABLE --

to Obtain a Finished Spray Containing a Desired  
Concentration of Actual Chemical

Formulation to be used in 100 gallons of water	Desired concentration of finished spray in percent									
	0.01	0.03	0.06	0.1	0.25	0.5	1.0	2.5	5.0	
<b>Wettable powders (percent)</b>										
15	½ lb.	1½ lbs.	3 lbs.	5 1/3 lbs.	13½ lbs.	27 lbs.	54 lbs.			
25	1/3 lb.	1 lb.	2 lbs.	3 lbs.	8 lbs.	16 lbs.	32 lbs.			
40	1/5 lb.	3/4 lb.	1½ lbs.	2 lbs.	5 lbs.	10 lbs.	20 lbs.			
50	1/6 lb. (2½ oz.)	½ lb.	1 lb.	1½ lbs.	4 lbs.	8 lbs.	16 lbs.	40 lbs.		
75	1/10 lb. (1½ oz.)	1/3 lb.	2/3 lb.	1 lb.	2½ lbs.	5 lbs.	10 lbs.	25 lbs.	52 lbs.	
<b>Emulsifiable concentrate (in pounds per gallon)</b>										
1	1 1/3 c.	1 qt.	½ gal.	3 qts.	2 gals.	4 gals.	8 gals.	20 gals.	40 gals.	
1½	3/4 pt.	1/3 gal.	1/3 gal.	½ gal.	1 1/3 gals.	2 2/3 gals.	5 gals.	13½ gals.	27 gals.	
2	2/3 c.	1 pt.	1 qt.	3 pts.	1 gal.	2 gals.	4 gals.	10 gals.	20 gals.	
4	1/3 c.	½ pt.	1 pt.	1½ pts.	½ gal.	1 gal.	2 gals.	5 gals.	10 gals.	
5	2 fluid oz.	6 fluid oz.	3/4 pt.	2 2/3 c.	3 pts.	3 qts.	1 3/4 gals.	4 gals.	8 gals.	
6	1 3/4 fluid oz.	2/3 c.	1½ c.	1 pt.	2 2/3 pts.	5 pts.	1½ gals.	3 1/3 gals.	6 2/3 gals.	
8	1 fluid oz.	¼ pt.	½ pt.	3/4 pt.	1 qt.	½ gal.	1 gal.	2½ gals.	5 gals.	

## TABLE OF EQUIVALENTS

1 level tablespoon = 3 level teaspoons  
1 fluid ounce = 2 tablespoons  
1 cup = 8 fluid ounces  
1 pint = 2 cups  
1 quart = 2 pints, or 32 fluid ounces  
1 gallon = 4 quarts, or 128 fluid ounces  
1 gallon (United States) = 0.83 (approximately 4/5) gallon (British or Imperial)  
1 gallon (British or Imperial) = 1.2 gallon (United States)  
1 gallon water (United States) weighs 8.345 pounds  
1 pound = 16 ounces, or 453.59 grams  
1 gram = 0.0353 ounces  
1 ounce = 28.3 grams  
1 kilogram = 35.27 ounces, or 2.2 pounds  
1 milligram per kilogram = 1 part per million

## DESCRIPTIONS OF INSECTICIDES

The following materials are generally available in Minnesota. Some are relatively new and may not be obtained readily, but your dealer or supplier should be able to find a source.

### CHLORINATED INSECTICIDES

#### Aldrin

Aldrin is a chlorinated naphthalene compound available in the same formulations as heptachlor and chlordane. It controls soil-infesting insects and grasshoppers at dosages comparable to heptachlor. Aldrin has a shorter residual action than dieldrin, but a small percentage of the chemical converts to dieldrin on foliage and in soils containing numbers of micro-organisms. Consult recommendations for day-interval information on specific insects and crops.

#### Chlordane

Chlordane (a chlorinated cyclic hydrocarbon) is available in all the formulations, although commercial fertilizer-insecticide mixtures may have to be specially requested.

Chlordane is effective against such field pests as grasshoppers, cutworms, ants, and many soil insects. Solutions of chlordane may be used for spot treatment against household pests, such as roaches, silverfish, carpet beetles, and clothes moths. Restrict household applications of chlordane to such places as baseboards, closets, or similar areas where there might be crawling insects. To minimize hazards to human beings, do not apply chlordane as a vapor, mist, or fog within the household.

This insecticide is not recommended for use in dairy barns or on milk-producing animals. It should not be applied directly to the foliage of sensitive plants such as the cucurbits (squash, melons, cucumbers, etc.), tomatoes, and some delicate flowering garden species.

### DDT

Although DDT is widely used, it does not control grasshoppers and crickets, most plant- and animal-feeding mites, certain aphids, such as the cabbage aphid, most ants, the plum curculio, the German and Oriental cockroaches, resistant houseflies, and Colorado potato beetles.

DDT is available in all of the previously mentioned forms except the fertilizer-insecticide mixture. It is available as a dust, a 50 percent or 75 percent wettable powder, an emulsion concentrate, and an oil solution, and also in an aerosol bomb form, usually combined with pyrethrum or the synthetic counterpart, allethrin.

With ordinary handling precautions DDT is not hazardous during preparation and application.

DDT does concentrate and accumulate in fatty animal tissues and in butterfat of milk. This makes it inadvisable to apply DDT in any form on dairy cattle or in dairy barns. DDT can also get in milk if cows eat crops such as corn and alfalfa which have been sprayed with DDT. This chemical decomposes much more rapidly outdoors than indoors, but under certain conditions it may last over 30 days outdoors.

Recommended concentrations of DDT wettable powders and dusts may be used safely on any plants except most cucurbits (squash, melons, and cucumbers). Here DDT may be used only with careful uniform dusting or with low concentration of sprays or dusts. Tomatoes are also somewhat sensitive. Methoxychlor is safer on these crops.

### Dieldrin

This insecticide is very similar to aldrin, differing chemically in having an epoxy (oxygen-containing portion) group and in being more stable. Dieldrin is available in all forms mentioned with heptachlor and aldrin. It is effective against soil-infesting insects, grasshoppers, plum curculios, thrips, and other insect pests. The persistence of dieldrin makes it quite valuable for long-lasting insect control but requires that rather long waiting periods between time of treatment and harvest be observed on foliage applications. Dieldrin is approved for control of many household insect pests.

### Endrin

Endrin is a chemical isomer of dieldrin. It is very effective against a wide range of insects. Primarily available in emulsion and dust forms, endrin is especially good against sugar-beet webworms, cabbage loopers, armyworms, and cutworms. It is, however, also useful against some leafhoppers and plant bugs, and is better than most chlorinated hydrocarbons against aphids. Endrin must be handled cautiously because it is more toxic than dieldrin and is hazardous unless used carefully at the time of mixing and applying. Take care also that runoff from a treated field does not endanger fish or animals that might drink from the contaminated water.

### Heptachlor

Heptachlor is a close chemical relative of chlordane. It is available in all forms. Heptachlor is outstanding against most soil-infesting insects, grasshoppers, mosquitoes, and other insects, at doses lower than chlordane. Heptachlor has a comparatively short residual toxicity for a chlorinated hydrocarbon. Consult recommendations for each insect and crop to determine the proper day interval between application time and harvest date.

### Lindane and Benzene Hexachloride

For most purposes, lindane is preferable to benzene hexachloride. Lindane contains at least 99 percent of the gamma isomer of benzene hexachloride which is the part of benzene hexachloride that is most toxic to insects and certain mites. In addition, lindane does not have the taste or odor problem characteristic of benzene hexachloride that is readily picked up by dairy products.

Both lindane and benzene hexachloride are more poisonous to warm-blooded animals in a single dose than is DDT. Lindane does not accumulate and persist in body tissues for a long time, however.

### Methoxychlor

Methoxychlor is a good replacement for DDT to control many insects where using DDT would be hazardous to animals, humans, or susceptible plants. It is one of the safest materials to use on livestock, but sprays are not recommended on milking cows. Wettable powders can be rubbed into the hair of dairy cows for fly control. Methoxychlor is safer to use on cucurbits and tomatoes than are DDT and new synthetic insecticides. It is ineffective against Minnesota insects that are difficult to control with DDT, except for the plum curculio. Methoxychlor should replace DDT on the parts of vegetables that are to be eaten, but as with all insecticides you need to observe the day interval indicated for each insect problem.

At present methoxychlor is available as a 50 percent wettable powder, as a dust, and as a 25 percent emulsion.

Methoxychlor has fairly long-lasting qualities which, under certain conditions, approach those of DDT. It is somewhat less stable than DDT.

### Perthane

Perthane is a close chemical relative of TDE, methoxychlor, and DDT. Emulsions and wettable powders are used in agriculture, although approved uses are rather limited. Oil solutions and preparations in aerosol bombs are useful in the clothes moth-carpet beetle problem and in control of other household insects. Perthane and methoxychlor are relatively safe insecticides.

### TDE or DDD

This insecticide, a close chemical relative of DDT, is lower in toxicity to warm-blooded animals. Emulsions and wettable powders are available. TDE is useful against the red-banded leaf roller in apple sprays and is effective against tomato hornworms and fruitworms on tomatoes. Other usages are rather limited in the Midwest.

### Thiodan

Thiodan is a sulfur-containing chlorinated hydrocarbon. Prepared formulations include a miscible formulation, a wettable powder, dusts, and granular dusts. It has received approved use for some potato insects, including aphids. It is effective on plant bugs present on vegetables and forage crops. Its potential hazard to warm-blooded animals is not high, being close to DDT in acute toxicity. Further work is necessary to determine where it will be most useful.

### Toxaphene

Toxaphene is a mixture of chlorinated camphene products. It is most commonly used in the emulsion form; 6 and 8 pound per gallon concentrates are available, as are dusts. Toxaphene is effective against grasshoppers, plant bugs, cutworms, armyworms, and other insects. It has a fairly long residual effect, but the day interval period should be carefully checked, as it can be used close to harvest on certain vegetables but requires a longer waiting period on forage crops.

## CARBAMATE COMPOUND

### Sevin

Sevin is chemically different from the organic phosphates and the chlorinated hydrocarbons. It is formulated as a 50 percent wettable powder, an 85 percent sevin sprayable, a 5 percent dust, and a 5 percent granular material. A liquid concentrate (36 percent) is also available. Sevin has been approved for use on the major fruit insects. In addition, it looks very promising against a number of vegetable and ornamental insects, with the exception of aphids. The insecticide has a comparatively low toxicity to warm-blooded animals, particularly low by skin absorption, and does not present any serious hazard under conditions of pest-control use.

## ORGANIC PHOSPHATES -- Nonsystemic (not translocated or moved within plants)

### DDVP

A highly active compound, DDVP, or dimethyl dichlorovinyl phosphate, gives rapid knockdown and kill of flies. It is principally available as a liquid bait formulation for housefly control. The compound is not very stable and is short-lived in its effect. DDVP is quite toxic to warm-blooded animals, appearing to be a little less toxic than EPN and methyl parathion.

### Delnav

Delnav is an organic dithiophosphate with good persistent properties. It is a mixture of two chemical isomers. Delnav is of intermediate toxicity to warm-blooded animals, the toxicity being in the same general range as for Diazinon and lindane. It is an insecticide and miticide which has considerable value on fruit pests. Delnav is available as a 25 percent wettable powder and a 4 pound per gallon emulsion concentrate. It does not have many approved recommendations at present. The biological activity is primarily as a contact or stomach poison.

### Diazinon

This organic thiophosphate can be considered intermediate in toxicity to warm-blooded animals. It is available in a 2 pound per gallon emulsion, a 20 percent solution for dilution as used in the household, and 25 percent wettable powder formulations; also, 1 percent granules have been prepared particularly for use in fly control in barns. Diazinon is one of the more persistent phosphates showing rather broad application possibilities. It is valuable against a number of fruit pests, including mites, useful against a number of vegetable pests, and rather widely used in housefly control where DDT-resistance is a problem.

### Dibrom

Dibrom is a bromine, chlorine-containing organic phosphate with a rapid effect as a contact insecticide and miticide, with some vapor toxicity. It has a short residual activity, being less stable than several other phosphates. The compound is relatively low in toxicity to warm-blooded animals; it is similar in toxicity to Dipterex, or about one-half as toxic as DDT. Dibrom has a number of approved uses where a short residual is desirable, as on vegetable crops and for flies around processing plants. Dibrom is chiefly available as an 8 pound per gallon emulsion concentrate.

### Dicapthon

Dicapthon is the common name of a chlorinated nitrophenyl thiophosphate which has appeared valuable for control of DDT-resistant houseflies and German roaches resistant to chlordane. It has been prepared in emulsion concentrates and wettable powders. It appears to have a good potential use for many household pests. Its uses on crop insects are still being studied. The toxicity of the compound is moderately low, acute toxicity being in the same range as chlordane.

### Dipterex or Dylox

This chlorinated water-soluble phosphate is available under the name Dipterex for applications in barns for housefly control. The granular form is commonly available. This product is also effective on resistant German roaches. The name Dylox is used for formulations such as 50 percent soluble powder, 5 percent and 10 percent dusts, and 2½ percent and 5 percent in the spray form for some agricultural pests. This chemical is about one-half as toxic as DDT to warm-blooded animals, with no indication of accumulation or storage in tissues.

### EPN

EPN, or ethyl p-nitrophenyl thionobenzenephosphonate, is very effective in controlling most plant-feeding mites, except the clover mite. A wettable powder containing 25 percent of EPN may be used for mite control at  $\frac{1}{4}$  to  $\frac{1}{2}$  pound per 100 gallons of water. A 50 percent emulsion concentrate is also available. EPN is also effective on certain insects, such as the plum curculio. It is about one-eighth as toxic to warm-blooded animals as a parathion.



### Ethion

Ethion is the common name of an organic thiophosphate (tetraethyl S, S'-methylene bisphosphorodithioate) which appears particularly promising for control of several fruit pests. It has been used on rosy apple aphids, bud moths, several mites, and scale insects. It is also effective against onion maggots. Some effective uses have included combinations with dormant oils on fruit trees and woody ornamentals. Ethion is prepared as a 25 percent wettable powder and in two types of 4 pound per gallon emulsifiables, one for usual use, the other for use in combination with spray oils. A 4 percent dust is also available. Ethion has a rather long residual effect for a phosphate without any marked systemic activity. The compound can be considered as having moderate toxicity to warm-blooded animals, being in the toxic range close to that of Diazinon and lindane.

### Guthion

Guthion is an organic dithiophosphate with a rather persistent insecticidal effect. It is sold as a 2 pound per gallon emulsion, a  $12\frac{1}{2}$  percent wettable powder, and in dust and granular forms. Guthion must be handled with considerable care during mixing and spraying, as its toxicity to warm-blooded animals appears to be in about the same range as EPN. It has been approved for use on a number of fruit-infesting pests.

### Malathion

Malathion, an organic thiophosphate, is a type of phosphate that is a comparatively safe insecticide. It is chiefly available as a 4 or 5 pound per gallon emulsion concentrate, a 25 percent wettable powder, or a 4 percent dust. Granules are not common, but can be obtained. Malathion is very useful on most aphid, mite, and scale problems on plants. Previously parathion could have been used routinely for these pests, except for the hazard involved. Malathion is useful for small gardeners, and is available for use in ground sprayers and dusters where more hazardous phosphates could not ordinarily be used.

Malathion shows a fast and effective kill on DDT-resistant strains of houseflies, although there are areas in the southern United States that report some resistance of houseflies to malathion. The lasting period of effectiveness varies from about a week up to three weeks, depending on the mixture used and the environmental influences on the insecticide after it has been sprayed. It is also approved for use as a bin spray and grain protectant to prevent stored-grain insect infestations.

### Methyl Parathion

This compound is the methyl homologue of parathion. It is sold chiefly as a 25 percent emulsion concentrate. It is somewhat less hazardous to use than parathion but still must be handled cautiously. It is approved for use against the spotted alfalfa aphids and some other aphids.

### Parathion

Parathion is an organic thiophosphate which is highly effective against insects and mites. Parathion is available as a 25 percent (2 pound) or 8 pound

per gallon emulsion concentrate, or as a 15 percent or 25 percent wettable powder. One or 2 percent dusts may also be obtained. It is very hazardous to human beings, particularly during mixing and spraying operations or when the chemical has recently been applied to a crop. The lasting effect against insects is generally a matter of a few days, usually shorter than with most of the chlorinated hydrocarbon insecticides. To minimize the hazard from parathion, most applications should be made by qualified aerial-spray operators.

THE HAZARDS IN USING PARATHION CAN SCARCELY BE OVER-EMPHASIZED. Read carefully the symptoms which can result from phosphate poisoning and the precautions which need to be taken to prevent such a situation from occurring. Parathion should not be used by home gardeners!

#### Phosdrin

(described under Systemic Insecticides, page 15)

#### Ronnel (Korlan)

Korlan is a chlorinated organic thiophosphate of very low mammalian toxicity (about 1/10 as toxic as DDT). It is available in emulsion and wettable powder forms. For the present it is recommended as a residual spray for application in dairy barns, for roach control, and for use on some livestock. Korlan is the technical grade of Trolene, the cattle-grub systemic. The common name for the active ingredient in Trolene and Korlan is ronnel.

#### TEPP

Tetraethyl pyrophosphate (TEPP) is sold for direct dilution in water. A wetting agent is necessary, but most products have this in the solution to be diluted. Most of the products contain 20 percent or 40 percent of TEPP.

TEPP decomposes rapidly in the presence of moisture or when mixed as a water spray. It must be used promptly after mixing, for most of its effectiveness is lost in four to six hours. Thus it becomes harmless on the plant within a period of a day or two. Large aerosol bombs containing TEPP are available for insect and mite control in greenhouses.

Tetraethyl dithiopyrophosphate is closely related to TEPP but is more stable and a little safer on plants. It is also slightly less hazardous but requires the same precautions. It is prepared in bomb form for greenhouse use only.

#### Trithion

Trithion is a new monochlorinated thiophosphate compound which has shown great effectiveness against aphids and most plant-feeding mites. It has been most extensively used on the West Coast, but its effectiveness on a number of other insects makes it likely that it will be used more widely throughout the United States. Formulations include a 25 percent wettable powder, a 4 pound per gallon emulsifiable (flowable) concentrate, a 2 percent or 3 percent dust, and a 4 pound per gallon formulation for use only in oil sprays especially for scale insects or aphids. Trithion is not systemic in activity, but has a long residual for a phosphate compound. Trithion must be handled with caution but does not appear to have high toxicity, particularly by skin absorption.

## SYSTEMIC INSECTICIDES

The term "systemic" is used for chemicals which are taken up and translocated by a growing plant in quantities great enough to destroy insects or mites that may feed on that plant. Quite a number of chemicals have been found which have this activity, but only a few are recommended.

### Demeton or Systox

Demeton contains two thiophosphate isomers which are extremely active as contact, fumigant, and stomach poisons and have a pronounced systemic action within a plant. Most sucking insects can be controlled with demeton. It is a highly toxic phosphate and must be handled with great care. Most applications are made by foliage treatment.

### Dimethoate

Dimethoate is a nitrogen-containing thiophosphate which has shown promise on a number of insects and mites. Generally its residual effect is fairly short. It has moderate toxicity to warm-blooded animals. Applications to the foliage seem most useful. Formulations include a liquid concentrate, wettable powder, and granule.

### Di-Syston

A close chemical relative of phorate (Thimet), Di-Syston appears to be competitive with Thimet for many applications, but further testing is necessary. Both Di-Syston and Thimet are quite toxic and must be handled with considerable care.

### Phorate (Thimet)

This organic thiophosphate is closely related to demeton and Di-Syston. It has been effectively used as a seed treatment for cotton, alfalfa, sugar beets, and potatoes. Such treatments protect growing seedlings against all early insect attack. Emulsions, charcoal, and granular preparations have been used. Soil treatments appear promising for some crops. Foliage treatments have not been as satisfactory. Phorate is approved for use as a soil treatment at planting time for potatoes.

### Phosdrin

Phosdrin is a very toxic phosphate containing two chemical isomers. It is a strong contact toxin but is translocated in growing plants. It gives quick initial kill of sucking insects and several larvae, including cabbage loopers and red-banded leaf rollers. It is usually applied as a foliage spray. Phosdrin deteriorates quickly enough so that comparatively short waiting periods are required between application and harvest. It must be handled with care because of its high toxicity.

### Schradan

Schradan, sometimes referred to as OMPA, is another relatively toxic phosphate which is systemic in action. Unlike demeton, it has no effective

fumigant action but must be converted into an active material within the plant and by the sucking insect. A similar conversion to a toxic material appears to occur in the liver of warm-blooded animals. In general, schradan has not become widely used. It is best on aphids.

Schradan is available in bomb form for greenhouse insect control.

## ANIMAL SYSTEMICS

### Co-Ral

Co-Ral is an animal systemic which can protect against cattle grubs. It is a thiophosphate with a coumarin ring structure. Wettable-powder formulations are sprayed directly on the animals. Approval for use on nonmilking cattle has been given. September or October would appear to be the most effective period for spraying the animals. Co-Ral may also be used to control several other livestock pests on nonmilking animals.

### Ronnel (Trolene)

Trolene is a purified grade of the insecticide described under Ronnel (Korlan). The code number ET-57 has been widely used. The compound is sold in large capsules for use in nonmilking cattle to free the animals from cattle-grub infestations. These capsules may be given after all eggs of the heel fly or warble fly have been laid (usually September through October), to kill all larvae of the cattle grubs.

## CHLORINATED MITICIDES

Certain chemicals are more effective on mites than on insects; some are effective on both. Most of those listed here have their greatest potential uses as mite killers and are much less hazardous than the phosphates are.

### Aramite

Aramite (beta chloroethyl-beta-(p-tertiary butylphenoxy)-alpha methyl-ethyl sulfite) is effective on several different plant-feeding mites. A 15 percent wettable powder may be used at the rate of  $1\frac{1}{2}$  pounds per 100 gallons of water. Aramite has little effect on mite eggs at the rate used, but in some cases it will persist and kill active mites for about a week.

### Chlorbenside (Mitox)

A chemical relative of ovex, p-chlorobenzyl p-chlorophenyl sulfide, chlorbenside is a slow-acting material specifically affecting mites but not insects. A 40 percent wettable powder has been used effectively at 1 pound per 100 gallons of water, especially for European red mites and two-spotted mites.

### Chlorobenzilate

Chlorobenzilate is a 4, 4-dichlorobenzilic acid ethyl ester. It has been found effective on many species of plant-feeding mites. Chlorobenzilate is a

comparatively safe material which is compatible with nearly all pesticides except those in which alkaline reactions may take place.

#### Genite EM-923

This miticide is made up of 2, 4-dichlorophenyl ester of benzene sulfonic acid. A 50 percent emulsifiable form has been registered for certain mite-control problems, particularly against the European red mite on apples. The rate of use is 1 pint per 100 gallons of water for light to moderate infestations, and 1 quart per 100 gallons of water for severe infestations.

#### Kelthane

Kelthane is a chlorinated miticide that is very effective on a wide range of mites. It is available as an 18½ percent wettable powder or an 18½ percent emulsion concentrate. Kelthane is effective on cyclamen mites and other plant-feeding mites.

#### Ovex

Ovex, or p-chlorophenyl p-chlorobenzenesulfonate, is a mite killer which is effective against the egg stage as well as the active stages. Under some outdoor conditions Ovex remains effective for two weeks or longer. The 50 percent wettable powder form may be used at rates of 1 to 2 pounds per 100 gallons of water. It has been tested in the greenhouse and on mites infesting fruit.

#### Tedion

Tedion is a miticide described as a chlorinated diphenyl sulfone. It is proving to be effective on orchard mites and greenhouse mites and is not harmful to beneficial insects. Tedion is sold as a 25 percent wettable powder for spraying or using as a slurry (suspension of the highly concentrated wettable powder in water) on steampipes in greenhouses. It is one of the safest materials as far as mammalian toxicity is concerned.

### PLANT DERIVATIVES

#### Pyrethrum

Pyrethrum is prepared from the flowers of imported chrysanthemum plants. The active ingredients, pyrethrins, are nonpoisonous to humans but fast acting against insects. Pyrethrum is effective only for a day or so when used outdoors. The effectiveness is enhanced by using one of the so-called synergists with it (a synergist is an added chemical which increases the effectiveness of the main chemical).

A new synthetic chemical, allethrin, is very similar chemically and is used in place of pyrethrum for some control problems.

Rotenone

Rotenone, one of the oldest insecticides, is prepared from a tropical plant called cube. A comparatively safe material, it is useful for controlling several vegetable insects. It lasts longer than pyrethrum but not as long as the chlorinated hydrocarbon insecticides.

Ryania

Ryania is a product of the stems of a plant obtained from northern South America. It is not prepared synthetically. Ryania gives nearly the same control of the European corn borer as does DDT. The advantage over DDT is that it does not accumulate in body tissues of cattle and other livestock.

The 100 percent product can be used as a wettable powder in water, although the resulting suspension is much poorer than with the synthetic insecticides. A 50 percent wettable powder is now available. It appears to be close to the 100 percent product in toxicity.

The 37 percent to 40 percent dust can be used directly on plants. Dusts of lower concentrations are also available now.

LIST OF INSECTICIDES AND PRINCIPAL USES

<u>Chemical</u>	<u>For Use On</u>	<u>To Control</u>
Aldrin	Alfalfa	Grasshoppers
	Beans	Seed corn maggots, wireworms
	Corn	Grasshoppers, rootworms, white grubs, wireworms, billbugs
	Crucifers (cabbages, broccoli, cauliflower, etc.)	Cabbage maggots
	Cucurbits (squash, melons, cucumbers)	Cucumber beetles
	Pasture, turf	White grubs, sod webworms
	Potatoes	Wireworms
	Radishes, rutabagas	Root maggots
	Spinach	Leaf miners
	Small grains	Grasshoppers, wireworms
	Strawberries	White grubs
	Sugar beets	Root maggots
Sweet clover	Sweetclover weevils	
Allethrin	Cattle, and in buildings	In fly sprays in combination with synergists, with or without repellents
Aramite	Ornamentals, nonbearing fruit trees, and shrubs	Mites

<u>Chemical</u>	<u>For Use On</u>	<u>To Control</u>
Benzene hexachloride	See lindane	
Chlorbenside (Mitox)	Apples, ornamentals	Mites
Chlordane	Carrots Corn  Crucifers Home structures, furnishings, and food  Onions Pasture, lawn, turf  Radishes, rutabagas Strawberries Tomatoes	Cutworms, carrot beetles Cutworms, grasshoppers, rootworms, seed corn maggots, white grubs Cabbage maggots Termites, powder-post beetles, ants, clothes moths, cockroaches, carpet beetles, crickets, stored-food pests Onion maggots, thrips White grubs, sod web- worms, ants, chiggers Root maggots White grubs, weevils Cutworms
Chlorobenzilate	Fruits and ornamentals	Mites
Co-Ral	Livestock, except milk cows	Cattle grubs, hornflies, lice
DDD	See TDE	
DDT	Alfalfa (for seed) Apples  Asparagus Beans Carrots Cattle (beef)  Celery Corn  Crucifers Dogs Home structures, furnishings, and food  Lettuce Onions Potatoes	Leafhoppers, plant bugs Codling moths, canker- worms, tussock moth larvae, oyster-shell scales, leafhoppers, plant bugs Asparagus beetles Bean beetles, leafhoppers Leafhoppers Hornflies (as 5 percent in oil on back-rubbers) Leafhoppers, plant bugs European corn borers, earworms Cabbage worms, loopers Fleas Various pests, including clothes moths, stored- food pests, fleas, bed- bugs, silverfish Leafhoppers Thrips, maggot flies Colorado potato beetles, flea beetles, leafhoppers

<u>Chemical</u>	<u>For Use On</u>	<u>To Control</u>
	Raspberries Strawberries Tomatoes Trees, shrubs	"Slugs" or sawfly larvae Weevils, plant bugs Flea beetles, fruit worms Wide variety of leaf-chewing insects, leafhoppers, and plant bugs
	Vine crops, cucumbers, squash, pumpkins, etc.	Cucumber beetles, squash vine borers
DDVP	Buildings	Flies
Delnav	Apples Beans, ornamentals	Mites Mites
Demeton (Systox)	Alfalfa Apples Ornamentals (greenhouse) Potatoes	Aphids, plant bugs Aphids, mites Aphids, mites, mealy bugs Aphids, leafhoppers
Diazinon	Apples  Buildings, homes Cabbages, broccoli, etc. Household equipment and furnishings  Onions	Apple maggots, codling moths, curculios Flies Cabbage worms, loopers Ants, carpet beetles, clothes moths, cockroaches, fleas, silverfish, ticks Onion maggots
Dibrom	Barns Beans Crucifers  Lettuce, spinach Ornamentals Potatoes	Houseflies Aphids, mites, loopers Aphids, cabbage worms, loopers Loopers, aphids Aphids, mites, leaf miner Flea beetles, Colorado potato beetles
Dicaphon	Household equipment and furnishings	Roaches, flies
Dieldrin	Alfalfa (for seed)  Apples, plums Beans  Beets Household equipment and furnishings  Onions Pastures, lawn, turf Potatoes	Grasshoppers, plant bugs, webworms Plum curculios Seed maggots, wireworms cutworms Soil insects, webworms Ants, roaches, clothes moths, carpet beetles, crickets, spiders Onion maggots, thrips White grubs, webworms Colorado potato beetles, flea beetles, wireworms



<u>Chemical</u>	<u>For Use On</u>	<u>To Control</u>
	Radishes, rutabagas Sheep Small grains Strawberries Sugar beets Tomatoes	Root maggots Keds White grubs, wireworms White grubs Maggots, wireworms Cutworms, flea beetles
Dimethoate	Uses pending	
Dipterex	Barns, buildings	Flies
Dithiono (Sulfotepp)	Greenhouse pests	
D N 289	Apples (dormant) Shade trees (dormant)	Aphids Mites, scales, leafrollers
Di-Syston	Potatoes (experimental or trial use)	Aphids, leafhoppers
Dylox	Alfalfa  Crucifers  Sugar beets	Alfalfa caterpillars, plant bugs Cabbage worms, loopers, webworms Webworms
Elgetol 318	Apples (dormant)	Aphids, mites, oyster- shell scales, leafrollers
Endrin	Crucifers Corn  Potatoes  Small grains Sugar beets Tomatoes	Cabbage worms, loopers Cutworms, European corn borers Flea beetles, Colorado potato beetles, aphids Aphids, cutworms Beet webworms Flea beetles, hornworms
EPN	Beets, spinach Corn	Leaf miners European corn borers
Ethion	Onions Ornamentals	Onion maggots Mites, aphids
Guthion	Apples  Potatoes	Plum curculios, codling moths, leafrollers, apple maggots, aphids, mites Aphids, leafhoppers, flea beetles
Heptachlor	Alfalfa, clover(for seed)	Grasshoppers, cutworms, plant bugs

<u>Chemical</u>	<u>For Use On</u>	<u>To Control</u>
	Corn (soil treatment)	Rootworms, wireworms, white grubs
	Lawn, turf, ornamentals	White grubs, grasshoppers, webworms, ants
Kelthane	Fruit trees and shade trees	Mites
	House (outside walls and lawn)	Clover mites
	Strawberries	Cyclamen mites
Korlan	See Ronnel	
Lead arsenate	Apples	Apple maggots, codling moths, plum curculios
	Trees and shrubs	Variety of leaf-chewing insects
Lethane	Buildings	In space sprays for flies, mosquitoes
Lime-sulfur	Trees and shrubs (dormant)	Scales, aphids
Lindane	Beans	Seed maggots, wireworms
	Beef cattle	Lice, scab mites, hornflies
	Corn (seed treatment)	Seed maggots, wireworms
	Cucurbits	Cucumber beetles
	Household equipment and furnishings	Ants, carpet beetles, clothes moths, roaches, silverfish, bedbugs, ticks, fleas
	Poultry	Lice, mites
	Sheep	Ked, lice, "scab"
	Small grains	Wireworms
	Swine	Mange, lice
Malathion	Alfalfa	Aphids
	Apples	Aphids, codling moths, mites
	Barns, buildings	Flies, mosquitoes
	Beef cattle	Lice, hornflies
	Grain bins (bin spray)	Stored-grain insects
	Household equipment and furnishings	Ants, roaches, flies, mosquitoes
	Most vegetables and garden crops	Aphids, mites
	Poultry	Lice, mites
	Small grains	Aphids
	Stored grain (as grain protectant or surface spray)	Stored-grain insects

<u>Chemical</u>	<u>For Use On</u>	<u>To Control</u>
	Trees and shrubs	Aphids, mites, scale insects
	Also used in "all-purpose" mixtures for fruits, vegetables, and ornamentals	
Methoxychlor	Alfalfa	Leafhoppers, plant bugs, alfalfa caterpillars
	Apples	Apple maggots, codling moths, plum curculios
	Cattle	Hornflies, lice
	Grain bins (bin spray)	Stored-grain insects
	Most vegetables and ornamentals	Leaf-chewing insects
	Sheep	Keds
	Strawberries	Weevils
	Vine crops	Cucumber beetles
	Also used in "all-purpose" mixtures for fruits, vegetables, and ornamentals	
Nicotine sulfate	Trees, shrubs, fruits, vegetables	Aphids
Ovex	Fruits, ornamentals	Mites
Parathion	Alfalfa	Aphids
	Apples	Aphids, mites, codling moths, leafrollers
	Beans	Aphids, mites, bean beetles
	Beets	Aphids, webworms
	Corn	European corn borers
	Crucifers	Aphids, cabbage worms
	Onions	Maggots, thrips
	Peas	Aphids
	Potatoes	Aphids, leafhoppers
	Small grains	Aphids
	Strawberries	Mites, leafrollers
	Tomatoes	Aphids
	Vine crops	Aphids, squash bugs
Perthane	Household furnishings and clothing	Clothes moths
	Lettuce	Leafhoppers
Petroleum oils, dormant miscible oils	Trees, shrubs	Scale insects
Phorate (Thimet)	Potatoes	Aphids, leafhoppers, flea beetles, Colorado potato beetles
	Sugar beets	Root maggots, aphids

<u>Chemical</u>	<u>For Use On</u>	<u>To Control</u>
Phosdrin	Crucifers Peas Sorghum	Aphids, cabbage worms, loopers Aphids Earworms, aphids
Pyrethrins ("Pyrethrum") usually combined with syn- ergists	Buildings Cattle Grain bins (bin spray) Home interiors Stored grain (in grain protectants or surface spray)	Flies, mosquitoes Flies, mosquitoes Stored-grain insects Fleas, flies, mosquitoes Stored-grain insects
Ronnel (Korlan, Trolene)	Barns, buildings Cattle (except milk cows) Household equipment Poultry Sheep Swine	Flies Grubs, hornflies, lice Roaches Mites, lice Keds Lice
Rotenone	Asparagus Cats, dogs Cattle Crucifers  Cucurbits Raspberries  Sheep Tomatoes	Asparagus beetles Fleas Grubs, lice Cabbage worms, flea beetles Cucumber beetles Cane borers, fruit worms, sawfly larvae Keds Flea beetles
Ryania	Corn	European corn borers
Sabadilla	Cucurbits	Squash bugs
Sevin	Apples	Codling moths, plum curculios, apple maggots
Sulfotepp	See Dithiono	
Systox	See Demeton	
TDE (DDD)	Apples Strawberries Tomatoes Vine crops	Leafrollers Leafrollers Fruit worms, horn worms Squash vine borers
Tedion	Ornamentals and non- bearing fruit trees, or postharvest on fruit trees	Mites

<u>Chemical</u>	<u>For Use On</u>	<u>To Control</u>
TEPP	Alfalfa Beans, beets, crucifers, potatoes	Aphids Aphids
Thanite--component of fly sprays		
Thimet	See Phorate	
Thiodan	Potatoes	Aphids, leafhoppers, plant bugs
Toxaphene	Alfalfa, clover Apples Beef cattle Corn  Crucifers Onions Potatoes  Sheep Tomatoes	Grasshoppers, plant bugs Mites, aphids Hornflies, lice Armyworms, cutworms, grasshoppers, European corn borers Cabbage worms Thrips Flea beetles, Colorado potato beetles Keds ("ticks") Flea beetles
Trithion	Onions Ornamentals	Onion maggots Mites, aphids

### PRECAUTIONS WHEN USING TOXIC PHOSPHATES

Use natural rubber gloves to prevent absorption through the skin. Remove and wash contaminated absorbent clothing.

Avoid breathing any wettable powder dust or contacting an emulsion. If this is unavoidable, use a respirator specifically made for phosphates. A list of respirators can be obtained by writing to the Department of Entomology, University of Minnesota, Institute of Agriculture, St. Paul 1, Minnesota.

### FIRST-AID TREATMENT

#### Phosphate-Poisoning Symptoms and Antidote

Many organic phosphate insecticides (TEPP, parathion, methyl parathion, tetraethyl dithiopyrophosphate, EPN, demeton, Guthion, Phosdrin, Thimet, Di-Syston, and schradan) are quite hazardous to man during mixing operations and application. Contact with recently treated plants or surfaces may also be hazardous. Certain organic phosphates have been found which are considerably less toxic, Malathion, Korlan, Dicapthon, Trolene, and Co-Ral being much less toxic and Diazinon, Dylox, and Delnav being intermediate.

All of the organic phosphates discussed, including the least toxic, produce similar symptoms in human beings. All require the same antidote. The

symptoms may be produced by absorption through the skin, inhalation, or swallowing. Signs of poisoning include blurred vision (pinpoint pupils), abdominal cramps, tightness of the chest, digestive upsets, sweating and excessive salivation, restlessness, giddiness, headache, and twitching of the facial and eye muscles.

If any of these symptoms occur:

1. Call physician immediately.
2. Remove contaminated clothing and wash skin thoroughly with soap and water.
3. If chemical has been swallowed, induce vomiting.
4. Keep patient quiet and warm.
5. Physician may administer atropine as an antidote.

If you have had these symptoms from organic phosphorous compounds, do not handle them again until your physician determines by a blood analysis that your condition is satisfactory. Persons often using these compounds should have analyses of the blood made at regular intervals.

Chlorinated-Hydrocarbon First-Aid

For Chlorinated Hydrocarbons (such as aldrin, BHC, chlordane, dieldrin, DDT, endrin, heptachlor, lindane, methoxychlor, toxaphene, thiodan):

1. If chemical has been swallowed, call physician immediately. If patient is conscious, induce vomiting with warm, salty water. Continue until vomit fluid is clear.
2. If chemical has been spilled on the skin or clothing, remove clothing and wash skin thoroughly with soap and water. Do not use kerosene, gasoline, or other solvents.
3. Keep patient quiet and warm.
4. Physician may administer sedatives such as phenobarbital or other barbiturates to keep patient calm or to control convulsions.

POISON INFORMATION CENTERS

A number of Poison Information Centers have been established in Minnesota to give physicians information about different poisons and their antidotes and treatments. These centers operate on a 24-hour basis.

<u>City</u>	<u>Name and Address</u>	<u>Telephone</u>
Duluth	Poison Information Office St. Luke's Hospital 915 E. 1st Street	Randolph 7-6636
Fergus Falls	Poison Information Office Lake Region Hospital 108 Vasa Avenue	Fergus Falls 523

<u>City</u>	<u>Name and Address</u>	<u>Telephone</u>
Mankato	Poison Information Office Medical Record Dept. Immanuel Hospital 413 N. 4th Street	8-1606
Minneapolis	Poison Information Center Division of Special Health Services Minnesota State Dept. of Health Minneapolis 14, Minnesota	FEderal 9-7751
	Poison Information Center Fairview Hospital 2312 S. 6th Street	FEderal 6-6691
	Poison Information Office Minneapolis General Hospital 619 S. 5th Street	FEderal 3-1178
	Poison Information Office North Memorial Hospital 3220 Lowry Ave. N.	JUniper 8-9451
	Poison Information Office Northwestern Hospital 810 E. 27th Street	FEderal 2-7266
St. Cloud	Poison Information Office St. Cloud Hospital Clinical Laboratory 1406 6th Ave. N.	BLackburn 1-2700
St. Paul	Poison Information Office Ancker Hospital 495 Jefferson Ave.	CApital 2-7341
	Poison Information Office Bethesda Hospital 559 Capitol Blvd.	CApital 4-7561
	Poison Information Office St. John's Hospital 403 Maria Ave.	PRospect 1-5521
	Poison Information Office St. Joseph's Hospital 69 W. Exchange	CApital 2-6321

<u>City</u>	<u>Name and Address</u>	<u>Telephone</u>
	Poison Information Office St. Luke's Hospital 287 N. Smith Ave.	CApital 2-6644
	Poison Information Office The Children's Hospital 311 Pleasant Ave.	CApital 7-6521
Worthington	Poison Information Office Worthington Municipal Hospital 1018 6th Ave.	Worthington 2-5601



INSECTICIDE RECOMMENDATIONS

Field Crop Insects

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
Aphids (green- bugs, corn leaf aphids, English grain aphids)	Small grains	Parathion	$\frac{1}{4}$ lb.	Chemical control is seldom justified. An average of 50 or more aphids per foot of row on young grain may warrant control measures if predators and parasites are not prevalent and the weather is cool.
		Malathion	1 lb.	Parathion and Phosdrin are highly toxic and should be applied only by aerial operators. Only malathion should be used with ground equipment. Use parathion at least 15 days, malathion 3 days, and Phosdrin 1 day before harvest.
		Phosdrin	2 oz.	
Armyworms	Small grains	Aldrin	$\frac{1}{2}$ lb.	7 days before harvest.
		Dieldrin	$\frac{1}{4}$ lb.	7 days before harvest.
		Endrin	3 to 4 oz.	45 days before harvest.
		Toxaphene	2 lbs.	7 days before harvest (14 days for barley).
Beet webworms	Sugar beets	Endrin	6 oz.	
		Dylox	1 to $1\frac{1}{2}$ lbs.	
		Toxaphene	2 to 3 lbs.	

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
Corn leaf aphids	Corn	Chemical control on field corn is not justified.		
Corn rootworms	Corn	Aldrin	$\frac{1}{2}$ to 1 lb.	} $\frac{1}{2}$ lb. rate for row treatment; 1 lb. rate for broadcast. To control other soil insects use 1 lb. in the row or $1\frac{1}{2}$ lbs. broadcast.
		Heptachlor	$\frac{1}{2}$ to 1 lb.	
Crickets	Alfalfa, clover for seed	Dieldrin	4 to 8 oz.	Do not feed treated crop residues.
	Flax	Dieldrin	4 to 8 oz.	Apply before swathing to prevent damage to bolls.
Cutworms	Corn, soybeans	Aldrin	$\frac{1}{2}$ to 1 lb.	Soil treatment with aldrin as described for corn rootworms will control many species of cutworms. At first signs of damage, spray over the rows with at least 15 gallons of total spray per acre.
		DDT	2 lbs.	
		Dieldrin	$\frac{1}{2}$ lb.	
		Endrin	3 oz.	
		Toxaphene	2 lbs.	
Cutworms	Small grains	Dieldrin	$\frac{1}{2}$ lb.	Treat at least 7 days before harvest.
		Endrin	3 oz.	Treat at least 45 days before harvest.
		Toxaphene	2 lbs.	Treat at least 7 days before harvest on wheat, oats; 14 days on barley.

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
European corn borers	Corn	DDT (spray)	1½ lbs. per acre	For first brood (June-July) treat when 75 percent of plants show recent larval feeding in the whorls. For second brood (August) apply to the ear zone when the average egg mass count reaches 100 per 100 plants.
		DDT (granular)	1 lb. per acre	
		Endrin (spray or granular)	0.2 lb.	
		EPN (spray or granular)	0.2-0.25 lb.	
		Toxaphene (granular)	2 lbs.	

Note: Do not feed or ensile DDT- or toxaphene-treated stalks, leaves, or husks. Use endrin at least 45 days before feeding as stover. Do not ensile corn treated for second brood. EPN-treated corn plants may be fed 14 days after treatment.

Grasshoppers  
Alfalfa, clover  
forage, and hay  
Pastures

There are zero tolerances for most of the effective grasshopper control chemicals on forage crops. If pastures are grazed by milk cows or if hay is to be fed to milk cows or is to be sold, it should not be treated with aldrin, dieldrin, heptachlor, or toxaphene. Meat animals may be fed or allowed to graze toxaphene-treated pasture, hay, or forage but they should be removed from such feed at least 6 weeks before slaughter.

If economic infestations of grasshoppers develop in hay fields before harvest, the best practice would be to cut the hay and leave a few uncut "trap strips" in the field. After the grasshoppers move into the trap strips, the strips may be treated with aldrin, dieldrin, heptachlor, or toxaphene. Such treated trap strips should not be cut for hay or grazed.

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
				Malathion at 1 to 1½ lbs. per acre will give fairly good grasshopper control, and treated hay or forage may be cut or fed 7 days after treatment. Parathion at 4 to 8 ounces per acre, applied by commercial aerial operators, will also control grasshoppers and the treated crop may be harvested or fed 15 days after treatment.
	Corn, small grains	Aldrin	2 to 4 oz.	5 days before harvest.
		Dieldrin	2 oz.	7 days before harvest.
		Toxaphene	1 to 1½ lbs.	7 days before harvest on wheat, oats; 14 days on barley.
Leafhoppers	Alfalfa hay	Methoxychlor	1½ lbs.	7 days before cutting.
Pea aphids	Alfalfa, clover	Demeton (Systox)	¼ lb.	At least 21 days before cutting.
		Malathion	1 lb.	At least 7 days before cutting.
		Parathion	¼ lb.	At least 15 days before cutting.
			Note:	Demeton and parathion for aerial application. With ground equipment and farm sprayers use malathion only.
Plant bugs (Lygus, rapid and alfalfa)	Alfalfa, clover <u>for seed</u>	DDT	1½ to 2 lbs.	Do not treat when crop is in bloom. Control when plant bugs average one per sweep with a net and when crop is in bud stage. If an emergency demands treatment after blossoms appear, use only tox-
		Dieldrin	4 oz.	
		Endrin	3 oz.	

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
		Toxaphene	2 lbs.	aphene late in evening or early in morning when bees are not active. Do not feed treated crop residues.
		Heptachlor	2 to 4 oz.	
Sweet clover weevils	Sweet clover, alfalfa seedlings	Aldrin	$\frac{1}{2}$ lb.	Apply when clover is in two-leaf stage or at first sign of injury. Do not pasture or feed.
		Dieldrin	$\frac{1}{2}$ lb.	
		Heptachlor	$\frac{1}{2}$ lb.	
Thrips	Barley	Parathion	6 oz.	Aerial application at least 15 days before harvest. Treat just as crop begins to head. Economic value of treatment is questionable.
Webworms (garden, beet, alfalfa)	Alfalfa, clover	Endrin	6 oz.	45 days.
		Toxaphene	2 to 3 lbs.	Do not feed to milk cows or to meat animals later than 6 weeks before slaughter.
Note: For hay crop cut early to expose worms. Spray usually not required.				
Wheat midge		No chemical control recommended.		
Wheat-stem maggot		No chemical control recommended.		
White grubs	Corn, soybeans	Aldrin	3 lbs.	Soil treatment as described under rootworms will reduce damage from white grubs. Heavy infestation will require this higher dosage.
		Dieldrin	3 lbs.	
		Heptachlor	3 lbs.	

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
Wireworms	Corn, small grains	Aldrin	Seed treatment or planter-box treatment using 1 to 2 oz. actual chemical per bushel of seed.	
		Dieldrin		
		Lindane		
Corn	Aldrin	1 to 1½ lbs.	Row or broadcast treatment before or at planting time.	
		Heptachlor		1 to 1½ lbs.

Truck Crop and Vegetable Insects

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
<p>Note: For the home or backyard garden, insect control may be simplified by the use of an all-purpose mixture of malathion plus methoxychlor. This will control most of the leaf-chewing and sap-sucking insects. For special problems such as soil insects, corn earworms, and corn borers, the following methods should be used.</p> <p>Commercial vegetable growers should obtain the current revision of "Commercial Vegetable Pest Control Guide," available through county agents or from the Bulletin Room, University of Minnesota, St. Paul 1.</p>				
Aphids	Cabbages, brocoli, cauliflower, etc.	Malathion	3/4 to 1 lb.	At least 3 days before harvest.
		Parathion	1/4 to 1/2 lb.	Commercial only. At least 21 days before harvest.
		Diazinon	1/2 lb.	At least 7 days before harvest.
		Dibrom	1 to 2 lbs.	4 days.
		Demeton (Systox)	1/2 lb.	Commercial only. At least 21 days before harvest.
		Phosdrin	1/4 lb.	Commercial only. At least 1 day before harvest.
	Cucumbers, squash, melons, pumpkins	Malathion	3/4 lb.	At least 1 day before harvest.
		Parathion	1/4 to 1/2 lb.	Commercial only. At least 15 days before harvest.

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
		Nicotine sulfate	1 pt. 40 percent concentrate per 100 gals. (1 tsp. per gal.)	
	Peas, beans	Dibrom	1 to 2 lbs.	At least 4 days before harvest.
		Malathion	3/4 to 1 lb.	At least 3 days before harvest.
		Parathion	1/4 to 1/2 lb.	Commercial only. At least 10 days before harvest.
		Phosdrin	0.2 lb.	Commercial only. Up to 1 day before harvest.
	Potatoes	Demeton (Systox)	1/4 lb.	Commercial only. At least 21 days before harvest.
		Endrin	1/4 lb.	
		Malathion	3/4 to 1 lb.	
		Parathion	1/4 lb.	Commercial only.
		Phorate (Thimet)	2 to 3 lbs.	Commercial only. Furrow treatment at planting time. Do not use on peat or muck soils. 2 lbs. for light soils, 3 lbs. for clay soils.
		Phosdrin	1/4 lb.	Commercial only.
		Thiodan	1/2 to 1 lb.	
	Tomatoes	Malathion	1/2 to 3/4 lb.	At least 3 days before harvest.



Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
		Parathion	$\frac{1}{4}$ to $\frac{1}{2}$ lb.	Commercial only. At least 10 days before harvest.
Asparagus beetles	Asparagus	DDT	1 to 2 lbs.	After cutting season.
		Methoxychlor	1 to 2 lbs.	At least 5 days before harvest.
		Rotenone	1 percent dust or 4 tbsps. per gal. of water.	
Bean leaf beetles	Beans	DDT	1 to $1\frac{1}{2}$ lbs.	At least 7 days before harvest for green beans, 1 day for dry beans.
		Rotenone	1 percent dust or 4 tbsps. per gal.	
Cabbage maggots	Cabbages, broccoli, cauliflower, radishes, rutabagas, turnips	Aldrin	3 lbs.	Soil treatment to upper 3-4 inches before or at planting time, broadcast or in furrow. (Use one-half listed rate for furrow treatment.)
		Chlordane	5 lbs.	
		Dieldrin	3 lbs.	
Cabbage worms, loopers, Plutella	Cabbages, broccoli, cauliflower, etc.	BEFORE HEADING DDT	1 lb.	May be used up to 7 days before harvest on cabbages if outer leaves are stripped.

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
		Endrin AFTER HEADING	0.3 lb.	Commercial only.
		Diazinon	$\frac{1}{2}$ lb.	7 days before harvest on cabbage, 5 days for broccoli.
		Dibrom	1 to 2 lbs.	4 days.
		Dylox	1 to $1\frac{1}{2}$ lbs.	14 days before harvest.
		Methoxychlor	$1\frac{1}{2}$ lbs.	At least 5 days before harvest.
		Perthane	1 lb.	At least 3 days before harvest.
		Phosdrin	$\frac{1}{2}$ lb.	Commercial only. Up to 1 day before harvest.
		Rotenone	1 percent dust or 4 tbsps. 5 percent powder per gal. of water.	
		Toxaphene	$1\frac{1}{2}$ to 2 lbs.	At least 5 days before harvest.
Colorado potato beetles, flea beetles	Potatoes	DDT	1 lb.	See "Commercial Guide" for tim- ing, combinations, and resistance problems.
		Dieldrin	$\frac{1}{4}$ to $\frac{1}{2}$ lb.	
		Endrin	$\frac{1}{4}$ lb.	At least 21 days before harvest.
		Phorate (Thimet)	2 to 3 lbs.	Furrow treatment at planting time (see aphids).
		Thiodan	$\frac{1}{2}$ to 1 lb.	
		Toxaphene	$1\frac{1}{2}$ to 2 lbs.	

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
Corn earworms	Sweet corn	DDT plus mineral oil	Use 3 qts. 25 percent DDT emulsion concentrate plus 2½ gals. mineral oil plus water to make 25 gals. of spray. Minimum of 3 applications - 10 percent silked, 50 percent silked, and 70 to 90 percent silked. Additional treatments may be needed during severe infestations.	
		DDT	5 to 10 percent dust (for home garden)	Keep silks dusted.
Cucumber beetles	Cucumbers, squash, melons, pumpkins	DDT	3 percent purified grade dust or wettable spray at 1 lb. per acre.	At least 5 days before harvest.
		Methoxychlor	1 to 2 lbs.	At least 7 days before harvest.
		Rotenone	1 percent dust or 4 tbsps. 5 percent powder per gal.	
Cutworms	General	Chlordane	1½ lbs.	Preplanting soil treatment or treat soil around base of plants.
		DDT	1½ to 2 lbs.	
		Dieldrin	½ lb.	
		Toxaphene	1½ to 2 lbs.	
European corn borers	Sweet corn	DDT	1 to 1½ lbs. (spray or granular)	Do not feed treated plant residues.
		Endrin	0.2 lb. (spray or granular)	Treated forage may be fed or ensiled 45 days after treatment.

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
		EPN (spray or granular)	0.2 to 0.25 lb.	Treated forage may be fed or ensiled 14 days after treatment. For detailed information on corn borer control in sweet corn see "Commercial Vegetable Pest Control Guide."
Flea beetles	Beans, cabbages, beets, radishes, tomatoes(see also under Colorado potato beetles)	DDT	1 to 1½ lbs.	Before heading on cabbage.
		Methoxychlor	1½ lbs.	7 days before harvest on cabbage.
		Rotenone	1 percent dust or 4 tbsps. 5 percent powder per gal.	
Grasshoppers	General	Aldrin	2 to 4 oz.	Apply to grassy and weedy margins of field or garden while grasshoppers are small to prevent damage to crop.
		Chlordane	1 to 1½ lbs. or 5-6 percent dust	
		Dieldrin	2 oz.	
		Malathion	1 lb.	
		Toxaphene	1 to 1½ lbs.	
Leafhoppers	Beans, carrots, lettuce	DDT	1½ to 2 lbs.	Carrots only.
		Methoxychlor	1½ to 2 lbs.	At least 5 days before harvest of green beans; do not use on lettuce within 14 days of harvest.
		Malathion	1 to 1½ lbs.	At least 10 days before harvest of lettuce.

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
	Celery	DDT	1 lb.	Before bunch forms or stalks are one-half grown.
		Malathion	1 to 1½ lbs.	Not within 7 days of harvest.
	Potatoes	DDT	1 lb.	
		Demeton (Systox)	¼ lb.	Not within 21 days of harvest.
		Endrin	¼ lb.	21 days.
		Phorate (Thimet)	2 to 3 lbs.	Furrow treatment at planting time (see under aphids).
Onion maggots	Onions	Aldrin	3 to 4 lbs.	Soil treatment before or at planting time.
		Diazinon	1 lb.	Apply in furrow at planting time. May also be used as surface spray to control flies.
		Note: For green onions use only Diazinon at least 10 days before harvest.		
		Dieldrin	3 to 4 lbs.	} Apply in furrow at planting time.
		Ethion	3 to 4 lbs.	
		Parathion(granular)	½ lb.	
		Trithion	1 to 2 lbs.	
		V-C 13(granular)	1 to 2 lbs.	

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
		Aldrin or dieldrin, as seed treatment	1 oz actual per 2 lbs. seed	
				Note: For the home garden apply aldrin, chlordane, or dieldrin, dust or granular, in the furrow at planting time or use in transplant water as for cabbage maggots.
Onion thrips	Onions	DDT	1½ lbs. (spray) to 3 lbs. (dust)	Not for green onions.
		Diazinon	2 lbs.	At least 10 days before harvest.
		Dieldrin	½ lb.	Not for green onions.
		Malathion	1 lb.	At least 3 days before harvest.
Seed corn maggots	Corn, beans	Aldrin	Seed treatment as slurry with sticker such as methyl cellulose at 1 oz. actual chemical per 100 lbs. of seed.	
		Dieldrin		
		Lindane		
Spider mites ("red spiders")	General	Aramite	15 percent wettable powder, 2 lbs. per 100 gals.	Do not treat edible parts of vegetables.
		Kelthane	18½ percent wettable powder, 2 lbs. per 100 gals.	
		Malathion	25 percent wettable powder, 2 lbs. per 100 gals. or 4 percent dust	

Insect	Crop	Insecticide	Dosage (actual toxicant per acre)	Remarks
				Note: Observe the following waiting periods before harvest: Kelthane - beans, 7 days, vine crops and tomatoes, 2 days; malathion - beans and peas, 3 days, vine crops, 1 day.
White grubs	General	Aldrin	3 to 4 lbs.	Soil treatment before planting-- work into upper 4 to 6 inches of soil.
		Chlordane	8 to 10 lbs.	
		Dieldrin	3 to 4 lbs.	
Wireworms	General	Aldrin	2 to 3 lbs.	Soil treatment before planting-- work into upper 2 to 4 inches of soil. Use higher ratios for clay or heavy soils.
		Chlordane	4 to 8 lbs.	
		Dieldrin	2 to 3 lbs.	
	Corn, beans	Aldrin	Seed treatment as for seed corn maggot.	
		Dieldrin		
		Heptachlor		
		Lindane		

### Fruit Insects

For the small farm or home orchard, insect control may be simplified by using an all-purpose mixture containing malathion and methoxychlor plus a fungicide. See current home fruit spray guides.

Commercial fruit growers should obtain the current "Commercial Fruit Spray Guide" available from county agents or from the Bulletin Room, University of Minnesota, St. Paul 1.

The following is a summary of approved insecticides, their tolerances on fruit, the recommended waiting periods between application and harvest, and other limitations.

<u>Material</u>	<u>Use</u>	<u>Tolerance (in parts per million)</u>	<u>Limitations (minimum days before harvest)</u>
<u>Chlorinated hydrocarbons</u>			
Chlorobenzilate	Apples	5.0	14 days.
DDT	Apples	7.0	30 days (do not make more than 5 applications in any case).
DDT	Raspberries, strawberries	7.0	30 days.
Dieldrin	Apples	0.25	35 days.
Methoxychlor*	Apples	14.0	7 days.
Methoxychlor*	Raspberries, strawberries	14.0	3 days.
TDE (DDD)	Apples	7.0	30 days.
TDE	Strawberries	7.0	Dust, 5 days.
TDE	Raspberries, strawberries	7.0	Spray, not after berries begin to form.



Material	Use	Tolerance (in parts per million)	Limitations (minimum days before harvest)
TDE	Raspberries	7.0	Dust, 14 days.
Kelthane	Apples	5.0	7 days.
Kelthane	Raspberries, strawberries	5.0	2 days.
Genite 923	Apples	0.0	Apply only before bloom.
Chlorbenside (Mitox)	Apples	3.0	Apply only before bloom.
Ovex	Apples	3.0	30 days.
Ovex	Strawberries	3.0	Postharvest use only.
<u>Organic phosphates</u>			
Diazinon	Apples	0.75	14 days.
Diazinon	Strawberries	0.75	5 days.
Guthion	Apples	2.0	15 days (not over 8 applications).
Malathion	Apples, strawberries	8.0	3 days.
Malathion	Raspberries	8.0	1 day.
Parathion	Apples, strawberries	1.0	14 days.
Parathion	Raspberries	1.0	Apply only before bloom.
Phosdrin	Apples, strawberries	0.5	1 day.
Trithion	Apples	0.8	30 days before harvest.

Material	Use	Tolerance (in parts per million)	Limitations (minimum days before harvest)
Trithion	Apples	0.8	30 days between applications.
Trithion	Strawberries	0.8	3 days.
<u>Other</u>			
Lead arsenate	Apples	7.0	30 days.
Lead arsenate	Strawberries	7.0	Not after edible parts form.
Sevin	Apples	10.0	7 days.

\* Methoxychlor may be used up to 7 days before harvest if used throughout the season. If other chlorinated materials such as DDT, TDE, or dieldrin are used after the first cover spray, then methoxychlor may not be used within 30 days of harvest. This is necessary to stay within the tolerances for total chlorinated compounds.

Household Insects

Insect	Insecticide	Dosage	Remarks
Ants (indoors). (See also under pests of trees, shrubs, turf.)	Chlordane	2 to 5 percent solution or emulsion, 5 to 6 percent dust	Apply to runways. Do not contaminate food or utensils.
	Diazinon	0.5 percent solution or emulsion	
	Dieldrin	0.5 percent solution or emulsion	
	Lindane	0.5 percent solution, 1 percent dust	
	Malathion	3 percent solution or emulsion	
		Note: A treatment with chlordane or dieldrin on the outside walls and foundation, as described under box-elder bugs, may help keep ants from entering the house.	
Bedbugs	Chlordane	2 to 3 percent solution or emulsion	Apply to springs and frame of bed, and to cracks, crevices around door, window casings, baseboards, etc.
	DDT	5 percent solution	
	Lindane	0.5 percent solution	
Box-elder bugs	Chlordane	2 pts. 45 percent emulsion concentrate per 50 gals. water	Spray infested box-elder trees during late summer when bugs are small.
	Dieldrin		

Insect	Insecticide	Dosage	Remarks
	Dieldrin	2 pts. 15 percent emulsion concentrate per 8 gals. water	Apply <u>outside</u> to foundations, walls, and tree trunks where bugs congregate.
		Note: Household insecticides are not effective against hibernating bugs in the home. The best treatment is a broom and dustpan. Thoroughly caulk cracks around windows and doors; see that doors and windows fit tightly.	
Carpenter ants	Chlordane	2 to 3 percent solution or emulsion	Paint or spray infested wood and runways.
	Dieldrin	0.5 percent solution or emulsion	
Carpenter ants	Chlordane	2 to 3 percent solution	Apply to backs of carpets, rugs, and pads. Spray or paint along baseboards.
	Dieldrin	0.5 percent solution	
Carpenter ants	Lindane	0.5 percent to 1 percent solution	Pressurized spray cans may be used for treating clothing. The dust formulations may be applied to the floor before laying carpeting.
	Diazinon	0.5 percent solution	
	Malathion	3 percent solution	
Clothes moths	Chlordane	2 to 3 percent solution	Apply lightly to clothing.
	DDT	5 percent solution or in EQ-53 for washable woolens	Apply lightly to clothing.
	Dieldrin	0.5 percent solution	Apply lightly to clothing (dry-clean before using treated clothing).

Insect	Insecticide	Dosage	Remarks
	Lindane	0.5 percent or 1 percent solution	Apply lightly to clothing.
	Malathion	3 percent solution	Apply lightly to clothing.
	Perthane	5 percent solution	
	Naphthalene or PDB flakes, crystals		Apply uniformly throughout clothing as it is packed for storage in tight chests or boxes.
Clover mites	For use <u>outside</u> the home to <u>prevent</u> mites from entering		
	Chlorobenzilate	2 tsps. 25 percent emulsion concentrate per gal. water	Apply thoroughly to foundations and walls and to the lawn for at least 20 feet out from the house and all around the house. Use a drenching spray.
	Kelthane	3 tbsps. 18½ percent wettable powder per gal. water	
	Malathion	3 tsps. 50 percent emulsion concentrate per gal. water	A sod-free band 18-24 inches immediately next to the house will help reduce the problem.
		Note: A mixture of malathion with either Kelthane or chlorobenzilate at the above rates is reported to be more effective than either chemical used alone. For mites inside the home - wipe them up with an oily dustcloth or use a vacuum cleaner.	
Cockroaches (roaches, "water bugs")	Chlordane	2 or 3 percent solution or spray, 5 or 6 percent dust	Apply with paintbrush or as "spot treatment" with sprayer or duster. Treat cracks, crevices, and other

Insect		Insecticide	Dosage	Remarks
		Diazinon	0.5 percent solution or spray	hiding places or runways. Do not contaminate food or utensils.
		Dieldrin	0.5 percent solution or spray	
		Ronnel (Korlan)	4 percent spray	
		Lindane	0.5 to 1 percent solution or spray	
		Malathion	2 or 3 percent solution or spray	
Crickets		Chlordane	2 to 3 percent spray or 5 to 6 percent dust	Apply as spot treatment to corners, baseboards, under cabinets, in closets, etc.
		Diazinon	0.5 percent spray	
		Dieldrin	0.5 percent spray	
		Malathion	2 to 3 percent spray	
			Note: A treatment with chlordane or dieldrin on the outside walls and foundation, as described under box-elder bugs, will help prevent crickets from entering the house.	
Fleas	Dogs	DDT or as for cats	5 or 10 percent dust or in washes, shampoos	
	Cats	Rotenone	1 percent dust	<u>Do not use DDT on cats.</u>
		Methoxychlor	1 percent dust	
		Malathion	4 percent dust	

Insect	Insecticide	Dosage	Remarks
Infested kennels, beds, or other areas	DDT	5 percent spray	
	Malathion	2 or 3 percent spray	
Houseflies (Indoors)	Pyrethrins	Space sprays or aerosol "bombs"	
Residual treatment of outbuildings or outside of the home	Diazinon	1 percent spray or bait	Apply to resting places of flies - around windows, doors, frames, under eaves, etc., or as a window-screen paint.
	Dipterex	1 percent bait	
	DDVP	$\frac{1}{2}$ to 1 percent bait	
	Malathion	1 percent spray or bait	
	Ronnel (Korlan)	1 percent spray or bait	
		Note: Fly control depends on good sanitation. Keep garbage in tightly closed cans; dispose of garbage twice a week. Clean up decaying organic matter, haul out manure twice weekly, treat compost piles if flies are breeding in them. Use well-fitting screens on doors and windows.	
Mosquitoes (Indoors)	DDT	In combination with synergized pyrethrum space sprays or in aerosol "bombs."	
(Outdoors)	DDT	1 lb. 50 percent wettable powder per 5 gals. water, or 0.5 percent emulsion spray plus 1 percent malathion spray	Apply to mosquito resting places, such as shrubbery, hedges, and under eaves. May also be painted on screens.

Insect	Insecticide	Dosage	Remarks
	Dieldrin	1 pt. 15 percent emulsion concentrate per 5 gals. water	
		Note: Mosquito control in towns and cities should be an organized community program based on treatment of breeding areas.	
Powder-post beetles	DDT	5 percent oil solution	Paint, spray, or dip to saturate wood.
	Pentachlorophenol	4-5 percent solution	
Silverfish, firebrats	DDT	5 percent solution, 5-10 percent dust	Apply to infested areas, corners in closets, behind radiators, around pipes.
	Chlordane	2-3 percent solution, 5-6 percent dust	
	Diazinon	1 percent spray	
	Dieldrin	0.5 percent spray	
	Lindane	0.5 percent spray, 1 percent dust	
Stored-food pests-- flour beetles, meal moths, larder beetles, etc.	Chlordane	2-3 percent solution	Find and destroy or heat-treat infested foods. Paint or spray insecticides on shelves, cracks, corners. Do not contaminate food or utensils. Keep susceptible food stored in tight glass, metal, or plastic containers. Clean storage area thoroughly.
	DDT	5 percent solution	
	Lindane	0.5 percent solution	
Termites	Chlordane	Termite infestations usually require the services of an experienced pest-control operator. Consult Entomology Fact Sheet No. 6 on termites.	
	Dieldrin		



Livestock and Poultry Insects

Pest	Host	Insecticide	Dosage	Remarks
Cattle grubs	Milk cows or beef cattle	Rotenone	1 percent dust	Treat when grubs first appear in backs, repeat every 30 to 40 days until grubs no longer appear.
			7½ lbs. 5 percent powder per 100 gals. water as spray.	
	12 oz. 5 percent powder per 1 gal. water plus soap as a wash			
	Beef cattle or nonmilking dairy cattle	Co-Ral	16 lbs. 25 percent wettable powder per 100 gals. water	One treatment in early fall after fly season. Use adequate pressure and suitable nozzles to wet the skin thoroughly.
				Do not use within 60 days of slaughter. Follow precautions on label.
		Ronnel (Trolene)	1 bolus per 300 lbs. of body weight	One treatment in early fall. Administer with standard balling gun, preferably done by a veterinarian. Do not treat within 60 days of slaughter. Follow safety precautions on label.
Cattle lice	Milk cows or beef cattle	Synergized pyrethrins		Dust or spray; repeat in 15 to 20 days.
		Rotenone	1 percent dust or 2 lbs. 5 percent powder per 100 gals. water	Rub dust into hair; repeat in 15 to 20 days.

Pest	Host	Insecticide	Dosage	Remarks
	Beef cattle or nonmilking dairy cattle	Co-Ral	16 lbs. 25 percent wettable powder per 100 gals. water	Spray with 1 to 4 qts. per head. Do not use within 60 days of slaughter.
		Lindane	2 lbs. 25 percent wettable powder per 100 gals. water	Do not treat within 30 days of slaughter.
			1 qt. 20 percent emulsion concentrate per 100 gals. water	Do not treat within 30 days of slaughter.
		Malathion	16 lbs. 25 percent wettable powder per 100 gals. water	
			1 gal. 50-57 percent emulsion concentrate per 100 gals. water	
		Methoxychlor	8 lbs. 50 percent wettable powder per 100 gals. water	
		Ronnel (Korlan)	16 lbs. 25 percent wettable powder per 100 gals. water	
	Toxaphene	8 lbs. 50 percent wettable powder per 100 gals. water	Do not treat within 28 days of slaughter.	

Note: A 5 percent solution of DDT, malathion, methoxychlor, or toxaphene in fuel oil applied to cable-type back-rubbers will also help reduce lice on beef cattle. All cattle should be treated for lice in the fall so that they go into winter free of lice.

Pest	Host	Insecticide	Dosage	Remarks
Cattle scab		Notify veterinarian or official of the Minnesota Livestock Sanitary Board.		
Flies, biting (horn, stable, deer, horse, mosquitoes)	(See Extension Folder 192, "Fly Control for Livestock") Milk cows or beef cattle	Malathion	4 percent dust	2 to 4 tbsps. per head. Apply <u>dry</u> .
		Methoxychlor	50 percent wettable powder	Apply 1 tbsp. <u>dry</u> per head. Rub into hair on <u>top</u> line.
		Synergized pyrethrum (with repellents such as R-11 or Tabatrex)		Spray daily or as needed with hand sprayer, treadle sprayer, barn fogger, or aerosol.
	Beef cattle	(The following insecticides are effective mainly against hornflies. Deerflies and horseflies can be controlled best with the synergized pyrethrum sprays as for milk cows.)		
		Co-Ral	16 lbs. 25 percent wettable powder per 100 gals.	Not within 60 days of slaughter.
		DDT	5 percent in fuel oil on back-rubbers <u>only</u> .	
		Malathion	16 lbs. 25 percent wettable powder per 100 gals.	
		Methoxychlor	8 lbs. 50 percent wettable powder per 100 gals. or 5 percent in fuel oil on back-rubbers	
		Toxaphene	8 lbs. 50 percent wettable powder per 100 gals. or 5 percent in fuel oil on back-rubbers	Not within 28 days of slaughter.

Pest	Host	Insecticide	Dosage	Remarks
		Ronnel (Korlan)	1.3 percent on back-rubbers	
Poultry lice, mites	Chickens	Lindane	1 percent spray	Treat roosts.
		Malathion	0.5 percent spray	Treat roosts and birds. 1 gal. of mixed spray will treat 100 birds.
			4 percent dust	1 lb. per 40 sq. ft. of litter as litter dust.
	Turkeys on range	Malathion	3 percent solution	Paint roosts.
			2 qts. 50-57 percent emulsion concentrate in 24 gals. water	Will treat approximately 3-4,000 birds. Use at least 7 days before slaughter.
Screwworms	Cattle, swine, sheep, horses	Screwworm smears	62 1038 EQ 335	Treat wounds, wire cuts, scars.
		Co-Ral	16 lbs. 25 percent wettable powder per 100 gals. water (spray)	At least 60 days before slaughter.
Sheep keds ("ticks")	Sheep	Co-Ral	8 lbs. 25 percent wettable powder per 100 gals. water	Spray only at least 60 days before slaughter.
		DDT	8 lbs. 50 percent wettable powder per 100 gals. water (spray)	At least 30 days before slaughter.
			4 lbs. 50 percent wettable powder per 100 gals. water (dip)	At least 30 days before slaughter.

Pest	Host	Insecticide	Dosage	Remarks
		Lindane	2 lbs. 25 percent wetable powder per 100 gals. water (spray)	At least 30 days before slaughter.
			1 lb. 25 percent wetable powder per 100 gals. water (dip)	At least 30 days before slaughter.
		Malathion	16 lbs. 25 percent wetable powder per 100 gals. water (spray only)	
		Methoxychlor	8 lbs. 50 percent wet- table powder per 100 gals. water (spray or dip)	
	Sheep	Ronnel (Korlan)	16 lbs. 25 percent wetable powder per 100 gals. water (spray only)	6 weeks before slaughter.
		Toxaphene	8 lbs. 50 percent wetable powder per 100 gals. water (spray)	At least 28 days before slaughter.
		Dieldrin	1½ percent dust	1 to 2 oz. per head with duster.
			Note: Sheep should be treated shortly after shearing. Treat both ewes and lambs.	
Sheep scabies ("scab")	Sheep	Notify veterinarian or official of the Minnesota Livestock Sanitary Board.		

Pest	Host	Insecticide	Dosage	Remarks
Swine mange	Swine	Lindane	5 lbs. 25 percent wetable powder per 100 gals. water	Spray or dip. Treat sows at least 40 days before farrowing. Do not treat suckling pigs.
Wool maggots (fleece worms)	Sheep	Screwworm smears	62 1038 EQ 335	Shear wool from infested area and treat wound and surrounding skin.
		Lindane	2 lbs. 25 percent wetable powder per 100 gals. water	Spray to prevent strike.

Tree, Shrub, and Lawn Insects

Pest	Where found	Insecticide	Dosage	Remarks
				Note: The all-purpose garden and fruit mixture of methoxychlor plus malathion will control most of the leaf-feeding and sap-sucking insects on trees and shrubs. Another good mixture may be made by substituting DDT for the methoxychlor. For special problems follow the recommendations given below.
Ants	Lawn	Chlordane	5 to 10 percent dust or granular	$\frac{1}{4}$ lb. per 100 sq. ft.
			50 percent wettable powder, 3 tbsps. per gal. water	Apply as spray to 100 sq. ft.
			45 percent emulsion concentrate, 5 tsps. per gal. water	Apply as spray to 100 sq. ft.
		Dieldrin	5 percent dust or granular	$\frac{1}{2}$ lb. per 100 sq. ft.
		Heptachlor	2 $\frac{1}{2}$ percent dust or granular	$\frac{1}{4}$ lb. per 100 sq. ft.
25 percent emulsion concentrate	3 tsps. per gal. on 100 sq. ft.			
				Note: The liquid sprays may be used as a drench on individual ant nests. Water broadcast treatments thoroughly.
Aphids	Trees, shrubs	Malathion	50 percent emulsion concentrate, 2 pts. per 100 gals. or 2 tsps. per gal. water	Apply thoroughly to all foliage.

Pest	Where found	Insecticide	Dosage	Remarks
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Note: Some aphids, such as elm cockscomb gall, elm leaf, woolly apple, woolly elm, and woolly elm bark, may be controlled with dormant sprays, as described under scale insects.

Borers  
 Borers usually attack trees which are low in vigor, damaged, or suffering from drought, lack of nutrients, or winter injury. To prevent borer attack, trees should be well watered and fertilized, if needed; the dead or dying branches should be pruned out and all wounds properly dressed.

Active borer tunnels or burrows may be treated by injecting carbon disulfide into them with an oil can. After treating, plug the burrows with clay or putty. Carbon disulfide is extremely explosive so avoid smoking or any flame when using it.

A strong DDT-emulsion spray or wash containing 2½ percent DDT applied to the trunks and lower branches will control some borers. Avoid treating the foliage with the concentrated spray.

The proper time to apply DDT is about the time the adult borers are laying eggs. This usually occurs at the following times of the year:

Bronze-birch borers	Late June, early July
Poplar borers	August
Apple-tree borers	Late May, early June
Lilac borers	Late May and early June
Locust borers	August

Canker worms, spring and fall	Elm, apple, box-elder, and other trees	DDT	50 percent wettable powder, 2 lbs. per 100 gals. or 2 tbsps. per gal.	Apply at first sign of injury, usually early in May.
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Pest	Where found	Insecticide	Dosage	Remarks
Caterpillars and sawflies	Various trees and shrubs	Most leaf-chewing caterpillars and sawflies may be controlled by spraying the foliage with 2 lbs. 50 percent DDT per 100 gals. of water (2 tbsps. per gal. ). The time when these different worms appear varies. Some of the common defoliators are listed along with the time they are usually present on the trees.		
		<u>Time to Control</u>		
Eastern tent caterpillars	Wild cherry, apple, mountain ash, other	Early to mid-May, when tents are noticed		
White-marked tussock moths	Elm, basswood, poplars, apple	Middle to late May; occasionally again in August		
Fall webworms	Most deciduous trees	July and early August		
Spiny elm caterpillars	Elm	Late May, early June		
Brown-headed ash sawflies	Ash	Late May, early June		
Red-headed pine sawflies	Jack pine	Late June, early July		
Jack-pine sawflies	Jack pine	Late May, early June		
Introduced pine sawflies	White pine	Early feeding in June, again in August		
Spruce budworms	Fir, spruce	As buds break and again 10 days later		

Pest	Where found	Insecticide	Dosage	Remarks
Galls	Most deciduous trees, especially oak, hackberry, maple, linden, elm		<u>Control</u> Control of the insects or mites which cause galls with chemicals is not very satisfactory. Most galls do not seem to cause much injury. Pruning out and burning infested twigs or leaves sometimes reduce the problem.	
Leaf beetles	Many deciduous trees, especially willow, elm, cottonwood, aspen	DDT	50 percent wettable powder, 2 lbs. per 100 gals. water or 2 tbsps. per gal.	Apply when adult beetles appear; repeat when larvae appear.
Leafhoppers	Many trees and shrubs, especially caragana	DDT	2 to 4 lbs. 50 percent wettable powder per 100 gals. or 2 to 4 tbsps. per gal. water	
Mites ("red spider", spider mites)	Many trees and shrubs, especially evergreens and ornamentals	Aramite	2 lbs. 15 percent wettable powder per 100 gals. or 2 tbsps. per gal. water	
		Chlorobenzilate	1 qt. 25 percent emulsion concentrate per 100 gals. or 2 tsps. per gal. water	
		Kelthane	2 lbs. 18½ percent wettable powder per 100 gals. or 2 tbsps. per gal. water	
		Ovex	1½ lbs. 50 percent wettable powder per 100 gals. or 2 tbsps. per gal. water	

Pest	Where found	Insecticide	Dosage	Remarks
		Malathion	2 pts. 50 percent emulsion concentrate per 100 gals. or 2 tsps. per gal. water	
Night crawlers, earthworms	Lawn, turf	Dieldrin	When used as recommended for white grubs, will help reduce numbers of night crawlers.	
		Lead arsenate	10 lbs. per 1,000 sq. ft. Soak thoroughly.	

Scale insects

Dormant Sprays

Oyster-shell European elm Scurfy Cottony maple European fruit lecanium	}	DN-289	1 gal. per 100 gals. water	Apply in spring before buds open but when temperature is above freezing.
		Elgetol	1 gal. per 100 gals. water	
		Dormant oils	2 to 3 gals. per 100 gals. water	
Pine-needle		Liquid lime sulfur	1 part to 9 parts water	Apply in spring before buds open but when temperature is above freezing.

Crawler Sprays

(2 pts. 50 percent emulsion concentrate of malathion per 100 gals. water)

When to Control

European fruit lecanium	Elm, fruit trees	Late June, early July (about when catalpas bloom)	Thorough coverage of foliage, twigs, and branches.
Oyster-shell	Many shade, fruit, ornamental trees, shrubs	When apple petals have fallen (early June)	Thorough coverage of foliage, twigs, and branches.
Cottony maple		Late June, July	

Pest	Where found	Insecticide	Dosage	Remarks
Scurfy	Elm, maple, hackberry	June and July		
Pine-needle	Pines, spruce	Late May (when lilacs bloom)		Repeat in 10-15 days.
White grubs, sod webworms, billbugs	Lawn, turf	Aldrin	4 lbs. actual per acre 1½ lbs. 5 percent dust or granular per 1,000 sq. ft. 5 fl. oz. 2 lbs. emulsion concentrate per 1,000 sq. ft.	
		Chlordane	2½ lbs. 10 percent dust or granular per 1,000 sq. ft. 8 fl. oz. 45 percent emulsion concentrate per 1,000 sq. ft.	
		Dieldrin	4 lbs. 2½ percent dust or granular per 1,000 sq. ft. 6 fl. oz. 15 percent emulsion concentrate per 1,000 sq. ft.	
		Heptachlor	¼ lb. 25 percent granular per 1,000 sq. ft.  4 fl. oz. 2 lbs. per gal. emulsion concentrate	
			Note:	Apply to seedbed before seeding or sodding or apply to the surface of established turf and soak thoroughly. May be combined with lawn fertilizer.

## Stored-Grain Insects

Note: Market or food grains should not be stored in barns, in buildings where livestock feed is stored, or in other situations where they are near to sources of infestation. Excessive moisture content, dirty or damaged grain, and dirty bins all encourage insect infestation.

### Bin sprays

Thoroughly clean bins as soon as they are emptied; spray walls, ceilings, and floors of the empty bin with:

Malathion	1 gal. 57 percent <u>premium-grade</u> emulsion concentrate in 25 gals. water (1 pt. in 2 to 5 gals. water).
or	
Methoxychlor	2 gals. 25 percent emulsion concentrate for 25 gals. of spray or ready-to-use methoxychlor bin spray.
or	
Synergized pyrethrins	bin spray, ready to use.

### Grain protectants (applied directly to grain as it comes from combine or as it is binned)

Malathion	1 pt. <u>premium-grade</u> emulsion concentrate per 2 to 5 gals. water per 1,000 bu.
Malathion	1 percent <u>premium-grade</u> wheat flour dust, 60 lbs. per 1,000 bu.

Synergized pyrethrins Ready-to-use protectant sprays or dusts, as labeled.

### Surface treatments (applied to surface of grain after it is in the bin)

Malathion	$\frac{1}{2}$ to 1 pint <u>premium-grade</u> emulsion concentrate in 2 gals. water per 1,000 sq. ft. of grain surface area.
Malathion	1 percent <u>premium-grade</u> wheat flour dust, 30 lbs. per 1,000 sq. ft.

Synergized pyrethrins Ready to use, 1 gal. per 1,000 sq. ft.

### Fumigation (applied to binned grain to stop insect infestation. Does not give a residual preventive treatment.)

There are many commercial fumigants available. Some of the common ones are listed below. Grain to be fumigated should be in a tight bin and leveled to a height no more than within 6 or 8 inches from the top of the side walls of the bin. Fumigate on a calm day when the grain temperature is at least 60°F. Persons applying or handling the fumigant should protect themselves from vapors by using suitable gas masks and protective clothes. More than one person should be present at the job in case of accident. Read and follow all precautions listed on the labels for each different fumigant.

Fumigant	Dosage (gal. per 1,000 bu.)			
	Small grain		Shelled corn	
	Wooden bins	Metal bins	Wooden bins	Metal bins
Carbon tetrachloride - carbon disulfide, 80-20	4	2	6	5
Carbon tetrachloride - ethylene dibromide, 95-5	4	2	6	5
Carbon tetrachloride - ethylene dichloride, 3-1	6	3	8	6
Carbon tetrachloride - ethylene dichloride- ethylene dibromide, 60-35-5	4	2	6	5
Chloroform - carbon bisulfide, chloroform - ethylene dibromide mixtures as labeled.				
Use other liquid fumigant mixtures as labeled.				
Aluminum phosphide (Phostoxin)	Add 180 tablets per 1,000 bu. as grain is binned, or probe tablets into binned grain.			

Greenhouse and Floricultural Pests

Pest	Insecticide, miticide	Dosage	Remarks
Ants	Chlordane	5-6 percent dust, 2 percent spray	Apply to soil and along walks. Do not apply to foliage.
	Diazinon	1 percent spray	
	Dieldrin	2 percent dust, $\frac{1}{2}$ percent spray	
Aphids	Malathion	1- $1\frac{1}{2}$ pts. of 5 lbs. e. c. * per 100 gals. water	Apply when needed.
		$2\frac{1}{2}$ lbs. of 25 percent w. p. * per 100 gals. water	
	Parathion	1 lb. of 25 percent w. p. per 100 gals. water	
		Aerosol	
	Sulfotepp (Dithio)	Smoke or aerosol	
	Demeton (Systox)		
Chrysanthemum gall midges	Lindane	1 lb. of 25 percent w. p. per 100 gals. water	For adult control.
	DDT	2 lbs. of 50 percent w. p. per 100 gals. water	
	Parathion	1 lb. of 25 percent w. p. per 100 gals. water	
Cutworms	Dieldrin	2 percent dust, 1 lb. of 50 percent w. p. or 1 qt. of $1\frac{1}{2}$ lbs.e. c. per 100 gals. water	Soil treatment.

Pest	Insecticide, miticide	Dosage	Remarks
	DDT	10 percent dust, 2 lbs. of 50 percent w. p. per 100 gals. water	
	Toxaphene	10-20 percent dust, 2½ lbs. of 50 percent w. p. per 100 gals. water	
Cyclamen mites	Endrin	1 qt. of 1.6 percent lbs. e. c. per 100 gals. water	Make 2 or 3 applications at 2-week intervals.
	Kelthane	1½ lbs. of 18½ percent w. p. per 100 gals. water	Sanitation and isolation important.
		1½ pts. of 18½ percent e. c. per 100 gals. water	Sanitation and isolation important.
Fungus gnats	Chlordane	1 qt. of 4 lbs. e. c. per 100 gals. spray	Treat soil weekly until infestation is controlled.
	Dieldrin	½ lb. of 50 percent w. p. per 100 gals. spray	
		1 pt. 1½ lbs. e. c. per 100 gals. spray	
	Malathion	4 percent dust, 1½-2 pts. e. c. of 5 lbs. e. c. per 100 gals. spray	
	Nicotine sulfate	1 pt. of 40 percent (5 lbs.) e. c. per 100 gals. spray	
Centipedes, symphylids	Lindane	6 oz. of 25 percent w. p. per 1,000 sq. ft.	Work into soil. Steam sterilization is also advised.
Leaf miners	Parathion	½ lb. of 25 percent w. p. per 100 gals. spray	Avoid excessive treatment of asters especially.



Pest	Insecticide, miticide	Dosage	Remarks
Leaf rollers	DDD (TDE)	2 lbs. of 50 percent w. p. per 100 gals. spray	Dusts and sprays more effective than aerosols.
	Parathion	3/4 lb. of 25 percent w. p. per 100 gals. spray	
Mealy bugs	Parathion	1 lb. of 25 percent w. p. per 100 gals. spray	Repeat in 3 to 4 weeks.
	Sulfotepp (Dithio)	Smoke or aerosol	
	Malathion	3 lbs. of 25 percent w. p. per 100 gals. spray	
Spider mites		1½ pts. of 5 lbs. e. c. per 100 gals. spray	Avoid using parathion on ferns. Use aerosols at 3- to 4-day intervals. Use sprays very thoroughly, 2 applications at 7- to 10-day intervals.
	Parathion	1 lb. of 25 percent w. p. per 100 gals. spray	
	Sulfotepp (Dithio)	Smoke or aerosol	
	Demeton (Systox)	1½ pts. of 25 percent e. c. per 100 gals. spray	
	Malathion	1½ pts. of 5 lbs. e. c. per 100 gals.	
Spider mites (aramite resistant)	Kelthane	1½ lbs. of 18½ w. p. per 100 gals.	See Note on page 70.
	or chlorobenzilate	3/4 lb. of 25 percent w. p. per 100 gals.	
	plus azobenzene	1½ lbs. of 70 percent w. p. per 100 gals.	
	Tedion	1 lb. of 25 percent w. p. per 100 gals.	

Pest	Insecticide, miticide	Dosage	Remarks
Note: Make very thorough applications and follow a sequence of chemically unrelated materials to avoid or postpone resistance.			
Spider mites (phosphate resistant)	Aramite	1½ lbs. of 15 percent w. p. per 100 gals.	Avoid emulsions, especially aramite, ovex, and chlorobenzilate. Avoid ovex on roses and other tender foliage.
	Chlorobenzilate	1½ lbs. of 25 percent w. p. per 100 gals.	
	Kelthane	1½ lbs. of 18½ percent w. p. per 100 gals.	
	Ovex	1½ lbs. of 50 percent w. p. per 100 gals.	
	Azobenzene (combined with aramite or chlorobenzilate)	1½ lbs. of 70 percent w. p. per 100 gals.	
	Tedion	1 lb. of 25 percent w. p. per 100 gals.	Tedion is slow acting against adult mites but has fairly long residual activity. Tedion is also very effective when used on steampipes.
Roaches	Chlordane		
	Dieldrin	Same as for ants	
	Diazinon		
Scale insects	Malathion		
	Parathion	Same rate as for mealy bugs	3 or 4 applications.
	Sulfotepp		

Pest	Insecticide, miticide	Dosage	Remarks
Slugs and snails	Metaldehyde, or proprietary baits containing metaldehyde	2 oz. of 15 percent dust per 100 sq. ft.	Apply once every 2 weeks to soil.
Sowbugs(pillbugs)	Lindane	1 lb. of 25 percent w. p. per 100 gals. spray	
Spittle bugs	Dieldrin	1 lb. of 50 percent w. p. per 100 gals. spray	
	Lindane	1 lb. of 25 percent w. p. per 100 gals. spray	
Springtails	Malathion	1½ pts. of 5 lbs. e. c. per 100 gals. spray	
Tarnished plant bugs (and other plant bugs)	Dieldrin	½ lb. of 50 percent w. p. per 100 gals. spray	
	DDT	2 lbs. of 50 percent w. p. per 100 gals. spray	
	Heptachlor	1 lb. of 25 percent w. p. per 100 gals. spray	
Thrips	DDT	2 lbs. of 50 percent w. p. per 100 gals. spray	
	Dieldrin	½ lb. of 50 percent w. p. per 100 gals. spray	
		1 pt. of 1½ lbs. e. c. per 100 gals. spray	
	Heptachlor	1 lb. 25 percent w. p. per 100 gals. spray	

Pest	Insecticide, miticide	Dosage	Remarks
		1 pt. of 2 lbs. e. c. per 100 gals. spray	
White flies	Parathion	1 lb. of 25 percent w. p. per 100 gals. spray	
	Sulfotepp (Dithio)	Smoke or aerosol	
	Malathion plus DDT	3 lbs. of 25 percent w. p. per 100 gals. spray	
		2 lbs. of 50 percent w. p. per 100 gals. spray	

\* Abbreviations: e. c. --emulsion concentrate; w. p. --wetable powder.

#### USE INSECTICIDES CAREFULLY!

Wear protective clothing and respirators or gas masks for highly toxic materials such as parathion, TEPP, Sulfotepp, and demeton. Wash thoroughly after spraying and change to clean clothes. Do not smoke or eat while spraying. Read and follow the precautions given on the labels.