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Insecticides

FOR THE GARDEN

FOR THE HOME

FOR THE FIELD

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Insecticides

for the Home, Garden, and Field

by L. K. Cutkomp

A FEW YEARS ago DDT was hailed as the solution to many of our insect problems. Today DDT is still being used, and used effectively, but other new insecticides have replaced it for many purposes. This bulletin presents the best information available now on the use of all these new insecticides. Remember though that science—including the study of insecticides—is ever changing. So watch for changes.

Our newer insecticides are prepared in much the same way as DDT. Thus we find that most come in one of these five forms:

1. Dusts or dry powders which are ready for immediate use. The powders may contain ½, 1, 2, 3, 5, or 10 per cent of the active insecticide. The remainder is a carrier dust such as talc. Some dusts are combined with a fungicide or possibly a different insecticide. The dry powder form cannot be mixed successfully with water or oil and so cannot be used in spraying equipment.

2. Wettable powders which may be mixed with water and sprayed. The powders contain the insecticide at such concentrations as 15, 25, 40, 50, and 75 per cent. The powders contain a carrier and a wetting agent, which makes mixing with water possible. This type is particularly useful on crops because it does not harm plants as easily as emulsions and oil solutions. It can also be used inside buildings if its whitish deposit is of no concern.

3. Emulsifiable concentrates which mix directly in water. These insecticides are prepared in an oily liquid with an emulsifier which produces a milky dispersion when mixed with water. These concentrates may contain 23 to 25, 43 to 47, 60, or 72 to 75 per cent active insecticide by weight. Certain ones may be available in the 14 to 16 per cent range. Most 25 per cent materials contain 1 pound of the insecticide in every

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This bulletin does not cover the control of fruit and livestock insects or the European corn borer. Control of these insects is explained in the publications listed below. These may be obtained from your county agent or by writing to the Bulletin Room, University Farm, St. Paul 1, Minnesota.

FRUIT INSECTS—Extension Bulletin 255, "The Home Fruit Planting."

LIVESTOCK INSECTS—Extension Folder 147, "Livestock Pest Control."

CORN BORER—Regional Publication 22 (Iowa State Pamphlet 164), "1951 Recommendations for Insecticidal Control of the European Corn Borer."

2 quarts, the 45 per cent concentrate 1 pound of insecticide per quart, the 60 per cent concentrate 6 pounds per gallon, and the 75 per cent 1 pound of insecticide per pint. Emulsions are seldom used on animals and plants although most emulsions can be used on corn, peas and other leguminous crops, and over forest areas. Emulsions, used carefully, can also be applied to potatoes and cabbage. Only slight agitation is necessary in the tank for spraying.

4. Oil solutions which contain from ½ to 50 per cent insecticide. With the right concentration oil solutions may be applied directly on surfaces of buildings or nonliving objects with ordinary spray equipment. DDT and toxaphene are commonly used at a 5 per cent and chlordane at 2 to 5 per cent concentrations where a lasting effect is desired. Oil solutions, using a high concentration, may be applied by a fog applicator or mist-blower or by airplane where plants are present if proper care is taken to prevent burning of foliage by the oil. **Do not use oil solutions on animals and on plants unless you have special equipment and know the plant tolerance.**

5. Aerosol "bombs" which contain DDT, pyrethrum, an oil solvent, and freon gas have been available for several years. There is now a cheaper "beer can" type bomb which contains a gas held at low pressure and which produces a fine mist for spraying rooms to kill houseflies and mosquitoes. These bombs are not designed to control many crawling insects such as roaches, silver fish, carpet beetles, and clothes moth larvae.

Several insecticides including tetraethyl pyrophosphate, tetraethyl dithiopyrophosphate, and parathion are made in large cylinders for greenhouse insect control. They are convenient and efficient. However, they are dangerous and operators must wear an all-service type gas mask when applying them.

The aerosol bomb is one form of insecticide used in controlling some household insects

What Insecticides are Available?

ALL INSECTICIDES mentioned here are available, usually in hardware stores, from feed and seed dealers, and in some grocery stores. If materials are not available, have your dealer contact his suppliers. Many drug stores also carry a limited line.

DDT

DDT is the most widely used of all new insecticides. In some cases newer chemicals have replaced DDT. In Minnesota DDT does not control all grasshoppers and crickets, nor most plant and animal-feeding mites, certain aphids such as the cabbage aphid, most ants, the plum curculio, and the German and Oriental cockroaches.

DDT is available as a dust, a 25, 50, or 75 per cent wettable powder, an emulsion concentrate, oil solution, and in aerosol bomb form usually combined with pyrethrum.

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. DDT can also get in milk if cows eat crops, such as corn and peas, sprayed with DDT. DDT decomposes much more rapidly outdoors than indoors but under certain conditions may last over 30 days outdoors.

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

Chlordane

Chlordane (a chlorinated oil soluble material) is available as a dust, a 25, 40, or 50 per cent wettable powder, an emulsion concentrate, and an oil solution.

Chlordane dusts, wettables, and emulsions are all used to control grasshoppers, cutworms, and ants. Solutions are used primarily for control of household pests such as roaches, silverfish, bedbugs, clothes moths, carpet beetles, and box elder bugs. The most important use of chlordane with livestock is for mange mites.

Until evidence that chlordane accumulates in fatty tissues is disproved or found unimportant do not apply chlordane in any form to dairy cattle producing milk for human consumption. Chlordane is somewhat more harmful to some animals than DDT when absorbed through the skin. As with DDT, chlordane can be applied to plants except for cucurbits, tomatoes, and some delicate flowering garden species.

Toxaphene

Toxaphene is a very effective grasshopper poison in dust or liquid form or mixed in baits. Usually it is used at slightly higher concentrations than chlordane. Baits are more useful when

NOTE—DDT, methoxychlor, TDE, chlordane, toxaphene, lindane, and benzene hexachloride deteriorate slowly with alkaline materials and so should not be used with lime or lime-containing materials.

vegetation is short or otherwise less attractive to the grasshopper. Toxaphene is also effective on cutworms, webworms, the sheep tick, and hornflies, and on ticks and lice of cattle, swine, and sheep. When used on calves and sheep, toxaphene is more harmful than DDT in a single application. Use it only where recommended and do not exceed dosage. Toxaphene does not accumulate in animal tissues as much as DDT, however.

Methoxychlor

Methoxychlor is a good replacement for DDT on many insects where there is a hazard to animals, humans, or susceptible plants. It is one of the safest materials to use on livestock. It is safer to use on cucurbits and tomatoes than DDT, toxaphene, chlordane, and benzene hexachloride. Methoxychlor is ineffective against those Minnesota insects that are difficult to control with DDT. Methoxychlor should replace DDT on those parts of vegetables which are to be eaten.

At present methoxychlor is available as a 50 per cent wettable powder, as a dust, and in the 25 per cent emulsion form.

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

Lindane and Benzene Hexachloride

Lindane is a product containing at least 99 per cent of the gamma isomer of benzene hexachloride. This part of benzene hexachloride is the most toxic to insects and certain mites. In addition lindane does not have the taste or odor problem characteristic of technical grade benzene hexachloride. This musty taste has been found in edible portions of many treated vegetables and fruits. The odor is also highly objectionable during application and persists after treatment. Dairy products readily pick up this odor and taste. For most purposes, lindane is preferable to benzene hexachloride.

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 and from that standpoint is comparatively safe.

Lindane is available as a 25 per cent wettable powder and as 20 and 25 per cent emulsions. More concentrated powders or dusts are available for seed treatment against wireworms, and low percentage dusts are available for other problems.

TDE

TDE, often referred to as DDD, is closely related chemically to DDT and resembles it in effectiveness against many insects. In general, it lasts a shorter time. During mixing and application of a spray or dust TDE is considerably less hazardous than DDT. However, repeated exposure to TDE results in accumulation in fatty tissues like DDT and so TDE has little if any advantage here. TDE is also somewhat safer on plants, and if methoxychlor is not on hand, TDE could be used on sensitive plants against insects which are controlled by DDT.

Aldrin

This insecticide differs from DDT and others in that it can be mixed with lime or lime-sulfur. It does not last on field crops as long as toxaphene, chlordane, DDT, and dieldrin. The residue problem is thus less serious. Since aldrin is a highly effective grasshopper poison, this is important because treatment is often made on legumes and grasses used as pasture. Usually it is safe to allow

livestock to graze on treated plants after three weeks. Aldrin is particularly effective against grasshoppers, crickets, ants, wireworms, and white grubs.

Dieldrin

This insecticide is very similar to aldrin, chemically, differing particularly in its stability. Often it is just as or more persistent than DDT, limiting its use on edible portions of field crops. Dieldrin holds some promise in adult fly control, but DDT-resistant flies soon show a resistance to dieldrin. Dieldrin is chemically stable in alkaline media and to most acids used in crop work. Therefore it may be used with most agricultural chemicals.

Ryania

Ryania is a ground 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 DDT. The advantage over DDT is that it does not accumulate in body tissues of cattle and other livestock.

The 100 per cent product can be used as a wettable powder in water although the resulting suspension is much poorer than with the synthetic insecticides. Ryania clogs most ordinary sprayers. If it is to be used as a spray, excellent continuous agitation and other devices in the lines to prevent clogging are necessary. Improvements in grinding Ryania may make this difficulty less serious. A 37 to 40 per cent dust can be used directly on plants. Dusts of lower concentrations are now available.

Organic Phosphates

Two of these highly effective chemicals are available to large growers. They are tetraethyl pyrophosphate (TEPP or TEP) and parathion. Home gardeners may not find them readily available in small packages. The materials are the most poisonous of our insecticides, being many times more toxic than DDT to humans and warm-blooded animals. Because of their danger they are not recommended for general use for any pest in Minnesota.

They are especially efficient on all aphids and plant-feeding mites. Phosphates should be used only as a last resort and then only if all safety precautions necessary can be taken.

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 or 40 per cent of TEPP. For a severe infestation of mites or aphids use ¾ pint per 100 gallons of the 40 per cent product unless the plants are sensitive. For sensitive plants, or when the infestation of aphids and mites is not so severe, use no more than ⅓ pint per 100 gallons of the 40 per cent product. Tomatoes are sensitive to TEPP so use parathion if an organic phosphate is needed for aphid control. 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. Dusts of TEPP are being marketed but must be used shortly after opening the container as the effectiveness is soon lost. The larger aerosol bombs are available for greenhouse work.

Parathion has some residual effect, being much more stable than TEPP. It is effective for a shorter time than any of the chlorinated materials discussed. It is usually available as dust, 15 or 25 per cent wettable powder, and an emulsion concentrate. The aerosol bomb is available for greenhouse use. For aphid and mite problems 1 to 1½ pounds of 15 per cent wettable powder gives good results. Mealy bugs are some-

what more difficult and would require 1¾ pounds of the wettable powder per 100 gallons. A 1 per cent dust is satisfactory for most insect problems.

The hazard from parathion and TEPP is about equally serious at the time of mixing. During application parathion may be absorbed through the skin quite easily. Since parathion persists on foliage a long time, wait 15 days before handling treated crops. On fruit wait 30 days between spraying and handling or eating.

Since parathion is a known hazard to those handling or applying it, its use is not recommended for the general public. However, in view of the value of parathion for certain specific pests, its use may be justified for commercial plantings where situations demand and when the operator is in a position to enforce proper precautions.

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.

BE CAREFUL WITH PHOSPHATES

1. **Use natural rubber gloves to prevent absorption through the skin. Remove and wash contaminated absorbent clothing.**
2. **Avoid breathing any wettable powder 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 Division of Entomology, University Farm.**
3. **If the eyes, nose, mouth, or other parts of the skin contact organic phosphates, wash off affected areas immediately. If any sizeable quantity of material has been contacted, call a physician after washing and use the proper antidote.**
4. **Avoid using parathion dusts, especially by ground application, where operator may contact dust considerably.**

Mite Killers

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

EPN or ethyl p-nitrophenyl benzenethiophosphonate is used to control plant-feeding mites. This phosphate is about one eighth as toxic as parathion. It will be available for the first time in 1951 and must be given preliminary field trials. The wettable powder will probably be available at a 28 per cent concentration. The suggested rates are ¼ and ½ pounds of this material per 100 gallons of water. It probably will be safe on most plants at this rate but proceed with caution on sensitive or valuable plants.

DMC or di-(p-chlorophenyl) methyl carbinol contains no phosphorous and is much less hazardous than the new organic phosphorous compounds in use. DMC is quite effective on a number of plant-feeding mites and chiggers, but it is specific enough so that most aphids and other insects are not controlled. The material is sold as a 25 per cent emulsion concentrate to be diluted with water. The usual rate is 1 pint per 100 gallons of water.

Aramite (beta chloroethyl - beta-[p-tertiary butylphenoxy] - alpha methylethyl sulphite) is effective on several different plant-feeding mites. It is likely to be useful on animal mites and ticks, but more experimental work

PHOSPHATE POISONING SYMPTOMS AND ANTIDOTE

All of the organic phosphates discussed (TEPP, parathion, tetraethyl dithiopyrophosphate, and EPN) are hazardous to man and other warm-blooded animals, produce similar symptoms, and require the same antidote. The symptoms may be produced by absorption through the skin, inhalation, or swallowing. Signs of poisoning include blurred vision (pin-point pupils), abdominal cramps, tightness in the chest, digestive upsets, sweating and excessive salivation, restlessness, giddiness, headache, and twitching of the facial and eye muscles.

If any of the symptoms occur, discontinue your work, remove contaminated clothing, and apply soap and water to remove all traces of the insecticide. If the chemical has been swallowed, induce vomiting.

A physician should be consulted when symptoms appear and he should give the antidote, atropine sulfate. Additional doses may be given every hour at the physician's discretion. He may advise further treatment.

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.

is needed. A 15 per cent wettable powder may be used at the rate of 1¼ pounds per 100 gallons of water. The material 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.

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

Rotenone

Rotenone is one of our oldest insecticides and is prepared from a tropical plant called cubé. 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.

Pyrethrum

Pyrethrum is prepared from 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.

Household Insects

MANY HOUSEWIVES prefer to use a dust rather than a spray since it may be put in inconspicuous places and later picked up with the vacuum cleaner. Sprays containing water may leave some spots on waxed floors and may show on certain colored wallpaper, particularly light blues and greens. Oil sprays must be of the refined, deodorized type. Our specific recommendations are given in the table on page 16.

Fly Resistance

On some farms in Minnesota house flies have become resistant to DDT. Elsewhere they have even become resistant to some newer chlorinated insecticides. This first became apparent where DDT was used for 1, 2, or 3 years. House flies resistant to DDT are usually quite resistant to methoxychlor as well. Flies pass on this resistance from generation to generation. This resistance may be increased if succeeding generations of flies are exposed to DDT or other insecticides to which they have some resistance. A DDT-resistant fly strain soon shows resistance to other chlorinated insecticides. We do not know how many generations of untreated flies are necessary before a resistant strain will become susceptible again. Such a reversion cannot be expected in less than three years.

Fly Control

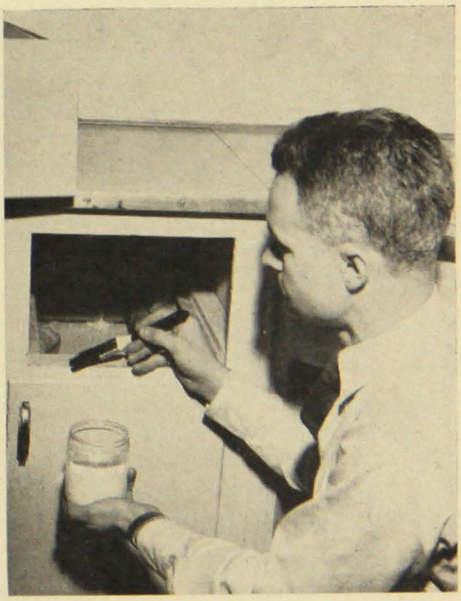
Sanitation is the first step in fly control. Promptly dispose of manure, garbage, or other materials which serve as breeding places for flies.

The house fly maggots live in garbage, manure, and other moist waste material. Their entire life cycle may be completed in ten days in midsummer.

The stable fly larvae or maggots live in accumulations of moist straw, grain, hay, weeds, piled grass, or fibrous materials that have been contaminated with manure. Periods of rainfall often produce good breeding material for the stable fly.

Blow flies live as maggots in garbage cans or wherever liquid food wastes have been allowed to seep into the soil. Fish and meat waste, too, provide ideal situations for blowfly maggots. All of these possible breeding places are involved in sanitation practices for fly control.

After sanitation, spraying may give supplementary control. If DDT sprays do not give control, use lindane and



Brushing on insecticides with an ordinary paint brush reaches corners otherwise missed in applying insecticides

chlordane. Chlordane, however, is not recommended in dairy barns. House flies may be found resistant to lindane in some places.

Whenever fly sprays are applied for a residual effect apply them thoroughly. Include application on the outside of buildings especially at doors and windows and on porches. If some fly breeding is taking place in refuse which cannot be thoroughly cleaned up, use lindane, benzene hexachloride, or chlordane for fly maggot control. Use a different insecticide for fly maggot control than for adult flies.

Some space spraying within barns or houses may be desirable particularly if fly control becomes difficult. The spray should contain pyrethrins plus a synergist such as piperonyl butoxide. Flies are quite susceptible to this spray material but it lasts only a short time. It is not a residual-type spray material.

The lasting effect of many spray materials is prolonged if the treated barn is closed during the day and livestock are not permitted to move in and out.

The use of window and door screens and mechanical fly traps is also desirable when there are many flies.

The problems of resistant flies are not present now with other fly pests such as stable flies, blowflies, hornflies, horse flies, or deer flies.

Mosquito Control

Control measures may be directed at both the larval (wriggler) stages and adult mosquitoes. Adults can fly as far as 10 to 15 miles but are more abundant closer to pools formed by heavy rains. Remember, too, that heavy doses of the insecticide can endanger fish or other wildlife and that treatment of two or three breeding sites when a dozen or more are present will do little good. A 1 per cent DDT solution should be used sparingly at about 1 to 1½ gallons liquid per acre using a knapsack sprayer. For most problems ⅛ pound of actual DDT per acre is enough when applied from the ground. Air application may require 3/10 pound of DDT. Complete oil films must be avoided if any DDT is in the oil.

A new technique, preseason application of DDT to a breeding site, uses heavier doses of DDT, about ½ to ¾ pounds of DDT, if there are no fish in the area. Do not use this method unless you are thoroughly familiar with the types of sites where mosquitoes lay eggs.

Spraying your lawn and shrubbery will give some control. Mosquitoes like grass, weeds, and dense shrubbery for resting. To protect foliage use a dust or the wettable powder as a spray. Both leave a whitish appearance on foliage. To avoid any whitish coloration, use the emulsion but at a lower concentration when a handsprayer is used.

New mist- and fog-producing equipment offers promise of extending mosquito control over larger areas. Careful manipulation of the DDT-containing mist will cover large breeding areas inaccessible by boat and hand application. When such insecticidal mists remain in still air for some time, the adult mosquito population may be eliminated, particularly in sheltered areas. Although the danger to wildlife is minimized by applying very fine particles, considerable skill is required for efficient mosquito control by this method. Airplane application, when carefully controlled, may also help. The rate of application of DDT for mosquito control should be accurately determined for each piece of equipment.

The maximum dosage for larval mosquito control should not exceed ¼ to ⅓ pounds of DDT per acre.

Control of adult mosquitoes may be disappointing because they may fly into small treated areas in large numbers. When the mosquitoes are breeding in large numbers, the only solution is com-

plete treatment of all the breeding areas of the area. A coordinated program using mist blowers and aircraft is usually necessary.

Brown Dog Tick

This tick is entirely dependent on the dog. During the fall and winter it may be found on dogs and in houses. The female ticks engorge on dogs, drop off, and seek a hiding place to lay eggs. They lay up to 3,000 brown eggs in cracks behind baseboards or other out-of-the-way places. In from three weeks to two months the small "seed ticks" hatch and crawl around in search of a dog. When successful they attack the dog, fill with blood in a few days, drop off and hide, shed their skins which permits an increase in size, and then prepare for a second blood meal. A third meal is taken to become an adult. They then mate and drop off to lay a single batch of eggs. The females then die.

Chlordane, lindane, and DDT dusts may be used on infested dogs. If the ticks are appearing in the home, spray or dust where they have been seen. Direct sprays along baseboards and on rugs so that crawling ticks will have to contact the insecticide. Dusts may be used but are usually more difficult to get into cracks where the ticks may be resting. Lindane is probably the most satisfactory material.

Fleas and Lice on Household Pets

Treat infested dogs with a 5 or 10 per cent DDT dust. If possible, combine the DDT with rapid-acting chemicals such as pyrethrins because DDT alone stirs the fleas to great activity and causes a treated dog considerable discomfort.

Do not use DDT on cats because they may lick off enough DDT to become sick. Use a relatively harmless dust such as pyrethrin-piperonyl cyclonene dust combination or use methoxychlor.

Treating the floor in and near the sleeping quarters of the dog or cat with DDT spray or dust also is effective.

Vegetable Insects

TO MINIMIZE the danger of sprays and dusts on vegetables which are to be eaten, we are recommending methoxychlor and pyrethrum-type materials and rotenone wherever effective. For gardens and small acreages dusts are safest though a wettable powder type of spray can be used without harming most plants. If you cannot apply parathion safely do not attempt to use it. Complete recommendations for vegetable insect control are given on page 17. When considering applying insecticides on vegetables it is a good idea to evaluate your problem carefully to see if insecticides will pay.

Corn Earworm

Control of the earworm is difficult and requires special techniques. The earworm deposits eggs in the fresh silks of the ear so insecticides must be applied here. Spray in mid to late summer since earworm moths are not present much before August.

For a single application use either of the following at the "full silk" stage just before wilting of the silks occurs.

1. Mix 1½ pounds of technical DDT in 25 gallons of white mineral oil.
2. Mix ¼ pint of 25 per cent DDT emulsifiable solution with 2 pints of white mineral oil. Shake the mixture

first, then add water to make a total of 1 gallon. Mix well until uniformly white. If a knapsack sprayer is employed use 40 pounds pressure or above, using a hollow cone nozzle which produces a fine mist. The first solution is somewhat more effective but will prevent filling out of kernels at the ear tips.

For two or three applications mix ¼ pint of 25 per cent DDT emulsifiable solution with ¾ pint of white mineral oil. Shake the mixture **first,** then add water to make a total of 1 gallon. Keep the mixture well shaken or agitated and use a knapsack sprayer. At least 40 pounds pressure should be used with the knapsack sprayer.

Apply one day after 7 to 10 per cent of the ears are in silk; make the second application 2 or 3 days later. For three applications use 2-day intervals and reduce mineral oil content from 10 to 5 per cent.

In all three spray mixtures the white mineral oil should be of 40 to 90 seconds Saybolt viscosity.

If for some reason you cannot spray, use a 5 per cent DDT dust in a hand plunger type duster directing the dust at the silk. Two or three properly timed applications will be needed. The dust will not give as effective control.

Tomato and Potato Insects

For most economical application combine the recommended insecticide with a fungicide. In most seasons in Minnesota the fungicide need not be applied early but can be mixed with the insecticide at the first signs of late blight. In some seasons it may also be desirable to use a fungicide-insecticide mixture on tomatoes. Both DDT and parathion in wettable powder and dust form can be used safely with the fixed coppers or carbamate fungicides. Avoid combinations of DDT and Bordeaux mixture and parathion and Bordeaux. TEPP can be used with a DDT spray but not too satisfactorily with fixed coppers, carbamates, or Bordeaux mixtures.

1. **Evaluate your problem carefully. If the crop is near harvesting you may not need to use an insecticide. Consider what will be gained by your operation.**
2. **Do not use oil solutions on plants and concentrated emulsions on most plants.**
3. **Treat only a portion of the crop if you are uncertain of the effect of the spray through your equipment.**
4. **On sensitive crops (especially certain cucurbits and young tomatoes) do not apply dusts when leaves are damp. Avoid balls or masses of dusts on leaves.**
5. **Except for methoxychlor, TEPP, pyrethrum, and rotenone, never treat edible portions of vegetables or fruit with the newer insecticides less than 30 days before consumption.**
6. **Avoid insecticide applications at blossoming time to protect bees and other pollinators. If treatment is justified the safest ones, in order, appear to be methoxychlor, toxaphene, and DDT. Never make any blossom-time applications during bright daylight. Treat at dusk, at night, or early morning.**

Field Crop Insects

WITH THE exception of grasshoppers, DDT is the most efficient insecticide for most field pests. In this bulletin we deal with all these insects except the corn borer which is covered by a separate publication.

The best control of insects in alfalfa, alsike, and the clovers is still uncertain, particularly in relation to maximum seed set. At present DDT is valuable for most pests except grasshoppers. For grasshopper control use chlordane or toxaphene or aldrin. Methoxychlor is the least toxic to animals which might eat the treated crop, but is less effective than DDT. Both aldrin and chlordane disappear from a treated crop more rapidly than toxaphene and DDT.

When using insecticides on legumes (alfalfa, alsike, red and sweet clover) remember that pollinating insects, especially bees, are needed for seed production. The use of insecticides will not necessarily insure a seed crop. One application of DDT may be made at the bud stage but not later than one tenth bloom. When leafhoppers are abundant earlier use DDT if crop is not to be fed as forage. DDT in emulsion form sticks to the foliage better and lasts longer than the dust. **Never use insecticides during the time of flowering,** unless there is some serious insect problem which could not be predicted in advance. If insecticides are used during this period apply at night when bees are not in the field. Most newer insecticides should not be applied at all during the blossoming period. Toxaphene, which is effective against grasshoppers and reasonably good on *Lygus* bugs is to be preferred during blossoming if application is absolutely necessary. Toxaphene is not very effective on blister beetles, however. If blister beetles are abundant at blooming methoxychlor may be used.

Wireworm Control

Surface application of chemicals on the soil for wireworm control is promising when dusts are applied and mixed into the upper layer with a grain drill. Application may be alone or with a fertilizer which contains no lime.

Side dressing plants with the insecticides is necessary where wireworm abundance is not realized before planting. Effective dusts include 5 per cent chlordane, 2½ per cent aldrin, and 1½ per cent lindane. Wettable powders of these materials can also be used, and emulsions will also give good results providing the emulsion is used very cautiously around plants to prevent burning or stunting. The rates of actual insecticide per acre may vary as follows: chlordane 5 to 10 pounds, aldrin 2 to 6 pounds, and lindane 2 to 8 pounds. Heavier doses are usually required with heavier infestations. If plant tubers or other parts of the plants are not going to be eaten by humans, crude benzene hexachloride may be used at rates of ½ to 1 per cent gamma isomer.

Seed treatment is also used, but pretreatment of the soil is more effective. The 25 per cent wettable powder of lindane has been successfully used at 3 to 4 ounces per 100 pounds of seed of a number of different crops. A similar formulation of aldrin appears very promising at a 2 to 4 ounce rate.

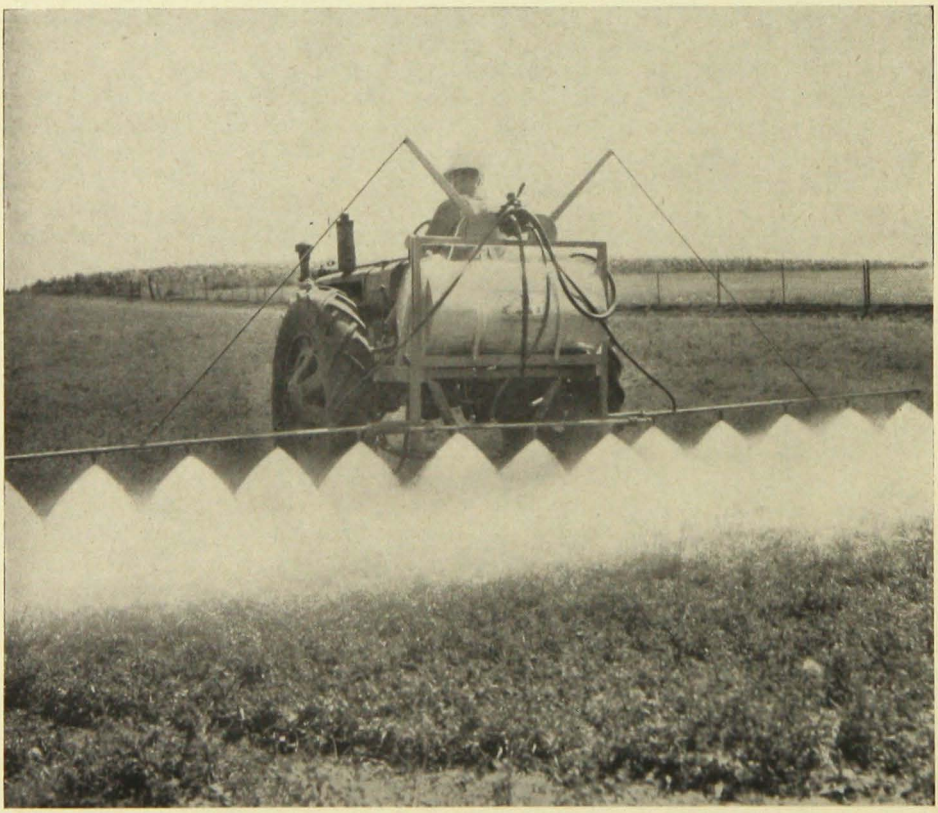
White Grubs

Although the new insecticides are effective in fairly small doses in controlling white grubs it is not always wise to rely on chemical control entirely. Certain cultural controls are important with white grubs. Adult white grubs are beetles known as June bugs. There are three broods in Minnesota.

Brood A is most common and the June bugs lay eggs in thin grass sod areas every third year (1953, 1956, 1959, etc.). In some localities Brood C is most common. June bugs of Brood C lay eggs in 1952, 1955, continuing every third year. The greatest damage from the grubs occurs one year after the eggs are laid. You may prevent considerable damage by disking or plowing the thin grass sod areas before May and June of the egg-laying year. If possible plant legumes in such areas since June bugs avoid legumes. If possible use crops that are not harmed, soybeans, buckwheat, peas or other legumes, and sunflowers. Late summer plowing of infested fields is of some help because of damage to the grubs and possible exposure to birds.

Treating the soil with insecticides before planting is effective in controlling white grubs. White grub infestation is more predictable than wireworms. If sod is being broken up for a garden it is usually wise to treat. Grub infestation is apt to be severe. Strawberries especially are very susceptible to attack from grubs.

In treating use the same materials as for wireworms. Ordinarily increase chlordane to 10 pounds per acre. Treat the field in strips of at least one foot wide leaving untreated intervals of about one foot. The grubs will contact the insecticides, and less material may be used per acre. Side dressing may be used, but it is less effective and more laborious than pretreatment.



Ground sprayers are becoming increasingly popular in insect control

Tree and Shrub Insects

MANY LEAF-FEEDING insects on trees and shrubs are susceptible to DDT. The elm leaf beetle, sawfly larvae, cankerworms, walnut caterpillar, tent caterpillar, fall webworm, and tussock moth larvae may be treated effectively with a DDT spray at the rate of 2 pounds of the 50 per cent DDT wettable spray powder per 100 gallons of water. DDT emulsions used at from 1/10 to ¼ per cent DDT in the final spray can be safely applied to trees.

In certain areas walking sticks will be abundant in 1951, 1953, and 1955. DDT used at 2 to 4 pounds of the 50 per cent wettable powder or lead arsenate at 4 pounds per 100 gallons of water are effective. Emulsions and oil solutions of DDT by airplane or mist-blower equipment may be applied as more concentrated liquids using as little as 3 to 4 gallons of solution per acre.

Spraying tree trunks with a 5 per cent DDT emulsion during early fall and early spring kills some of the female cankerworms which are wingless and must climb the trees to lay eggs. This seldom kills all of the moths yet may be more efficient than the familiar sticky bands if the application is thorough and properly timed.

In valuable shade trees control of heavy aphid infestations may be desirable. The 15 per cent wettable powder of parathion used at 1 pound per 100 gallons of water would be effective if proper precautions are taken in using parathion.

Use Tables for Concise Recommendations

The tables on the following pages give in concise form the various recommendations for the control of insects in the household, on field crops, and on vegetables. If more than one insecticide is listed for an insect, the one listed first is our first recommendation, the second our second, etc.

The abbreviations in the "form" column refer to the following:

- **D—dusts and powders ready for application.**
- **W—wettable powders containing 50 per cent active ingredient unless preceded by a different percentage number.**
- **E—emulsions ready for mixing with water; 25 per cent active ingredient unless preceded by a different percentage number.**
- **S—oil solutions of the insecticides ready for application.**

Other abbreviations:

- **T = tablespoon**
- **t = teaspoon**

RECOMMENDATIONS FOR CONTROL OF HOUSEHOLD INSECTS

Insect	Insecticide	Form	Per cent concentration of Spray	Per cent concentration of Dust	Remarks
Ants	Chlordane	D, W, E	2 or 1/4	2-5	For lawn ants use the lowest concentration in sprays. Spray all indoor areas where they might be crawling.
	Aldrin	E, D	1/10	2	
	Lindane	25 W, E	3/10 to 1/2	.....	
Bedbugs	DDT	E, S, D	5	5	Sprays can be directed behind baseboards, under moldings, etc., to better advantage than dusts. Treat mattresses thoroughly.
	Chlordane	E, S	2	2	
	Lindane	E	1	.....	
Carpet beetles and clothes moths	Chlordane	S, E, D	5	5	Spray backs of rugs, along baseboards, and seams of garments. DDT does not seem as effective against carpet beetles. See text for use of a mixture. An oil can is useful for applying liquids along baseboards.
	Lindane	E	1	1 or 1 1/2	
	DDT	S, E, D	5	5	
	Chlordane—DDT	S, E	2-5 (each)	.....	
Fleas	DDT	D, S, E	2 1/2	5	Dosages for spray application are not for animal use. Dusts of methoxychlor or rotenone may be used on dogs and cats.
	Methoxychlor	D	.....	5	
	Rotenone	D	.....	1	
House flies	DDT	E, S	5	.....	Rates are not for application on living animals and plants. Spray just to the point of run-off. Surfaces should be treated with 1 gallon liquid for every 900 to 1,000 square feet.
	Lindane	E, 25 W	1/4 to 3/10	.....	
	Methoxychlor	W	2 1/2	.....	
	Chlordane	E, S	2 or 2 1/2	.....	
	Pyrethrins and Synergist*	S, E (concentrations vary, use label directions)			Will serve as a space spray, not a long residual.
Lice	DDT	D	.....	5	See discussion in text.
	Methoxychlor	D	.....	5 or 10	
Mosquitoes: Adults	DDT	W, E	1/4	3-5	Emulsion must be used with caution around growing plants. Spray concentration could be 1/2 or 3/4 per cent if used as a wettable powder type of spray.
	Chlordane	W, D	1/4	2	
Larvae	DDT	S, E, W, D	1	3-5	
Cockroaches	Chlordane	E, S	2	2-5	Thorough applications to cracks, crevices wherever roaches may be hiding. Use about 1 gallon spray to 1,000 square or lineal feet. DDT not very effective except against large American roach.
	Lindane	E, D	1	1-1 1/2	
	DDT	E, S	5	5	
Silverfish	DDT	E, S	5	5	Applications along baseboards, in bathrooms, closets, clothes chutes, and hampers are desirable.
	Chlordane	E, S	2	2	
Tick, brown dog	Lindane	E, D	1/2-1	1-1 1/2	Use dusts only on dogs. Sprays will have to be applied liberally and thoroughly to baseboards and walls if many young have hatched.
	Chlordane	E, S, D	2	2	
	DDT	S, E	5	5	

* Synergist is usually piperonyl butoxide or n-propyl isome; some sticking agents also may be used.

RECOMMENDATIONS FOR CONTROL OF VEGETABLE INSECTS

Crop	Insects	Insecticides	Forms	Dust concentration	Spray concentration: Tablespoons per gallon water	Spray concentration: Amount per 100 gallons water	Remarks
				per cent		pounds unless indicated	
Asparagus	Asparagus beetles	DDT	D, W	3 or 5	2	2	Do not treat cutting asparagus with DDT or lead arsenate.
		Methoxychlor	D, W	5	3	3	
		Rotenone*	D, 4W	1	4	4	
		Lead arsenate	100 W	.....	3	3	
Beans	Leafhoppers	DDT	D, W	5	2	2	Avoid late treatment (blooms and pod setting).
		Pyrethrins*	D (usually 0.2 to 0.4 per cent; use label directions)				
Beets	Webworms	Toxaphene	D, W	5 or 10	4	3½	Cover under sides of leaves.
		Lindane	25 W, D	1 or 1½	1	1	
		Methoxychlor	D, W	10	3	3	
Crucifers: Broccoli, Brussels sprouts, Cabbage, Cauliflower, Rutabaga, Turnips	Cabbage maggots	Chlordane	D, W	5	2	2	At base of newly set plants.
		DDT	D, W	5	2	2	
	Cabbage worms	DDT	D, W	3 or 5	2	2	DDT may be used early before head forms, rotenone or methoxychlor later.
		Rotenone*	D, 4W	¾-1	4	4	
		Methoxychlor	D, W	5	3	3	
	Aphids	Nicotine sulfate*	40 S	.....	2 tsp.	1 qt.	Treat before leaves fold.
		TEPP	20 S	.....	1 tsp.	1 pt.	
		Parathion	15 W	No	1	1	
Carrots	Carrot weevils	Parathion	15 W, D	1	1	1	Apply when roots start enlarging.
		DDT	D	5	.....	.....	
	Leafhoppers	DDT	D, W	5	2	2	
Corn, sweet	Corn borers	DDT	W, D	5	3	3	Use Ryania for second brood, particularly if treated parts are to be fed to livestock.
		DDT	E	.....	3	3 qts.	
		Ryania	100W, D	37-40	5	6	
	Corn earworms	DDT (methods discussed under vegetable insects)					
Cucumbers	Cucumber beetles	Lindane	D, 25W	1	1	1	Dust lightly and evenly only when foliage is dry; be particularly cautious with DDT.
		Rotenone*	D, 4W	¾-1	4	4	
		Methoxychlor	D, W	3	2	2	
		DDT	D, W	3	2	2	
	Aphids	(see recommendations under crucifers)					

* Safer insecticides which are especially desirable for home gardeners.

RECOMMENDATIONS FOR CONTROL OF VEGETABLE INSECTS—Continued

Crop	Insects	Insecticides	Forms	Dust concentration	Spray concentration: Tablespoons per gallon water	Spray concentration: Amount per 100 gallons water	Remarks
				per cent		pounds unless indicated	
Muskmelon and watermelon	Cucumber beetles	(see recommendations under cucumbers)					
	Aphids						
	Squash bugs	Sabadilla	D	10	.....	.....	
		Lindane	D, 25W	1	1	1	
Onions	Onion maggots	Chlordane	(see recommendations under cabbage maggots)				
		DDT					
	Onion thrips	DDT	E, D	5	1⅓	2 qts.	Emulsion better; use about 100 gallons per acre.
Peas	Pea aphids	DDT	D, W, E	5	2	2	See discussion under field crop insects.
		DDT	E	.....	1⅓	2 qts.	
		Rotenone*	4W, D	1	7	6	
Potatoes	Colorado potato beetles	DDT	D, W	3 or 5	2	2	Apply at about 10-day intervals after plants are 4-6 inches high (see discussion in text).
		DDT	E	.....	1⅓	2 qts.	
	Leafhoppers						
	Tarnished plant bugs						
	Flea beetles						
	Aphids	DDT	E	.....	1⅓	2 qts.	Parathion may be justified for certified seed growers; it is more effective than DDT.
		Parathion	15W	.....	1	1	
Radishes	Flea beetles	DDT	D, W	5	2	2	
Squash and pumpkins	Squash bugs	Sabadilla	D	10	.....	.....	
		Lindane	D, 25W	1 or 1½	2	1½	
	Cucumber beetles	(see recommendations under cucumbers)					
Tomatoes	(see general and discussion in text)						
General feeders	Aphids	Nicotine sulfate	40S	.....	2 tsp.	1 qt.	Add soap to spray.
		TEPP	20S	.....	¾-1 tsp.	¾-1 pt.	To be used only when other control poor.
		Parathion	15W	.....	1	1	
		Pyrethrins*	D	0.2-0.4			

* Safer insecticides which are especially desirable for home gardeners.

RECOMMENDATIONS FOR CONTROL OF VEGETABLE INSECTS—Continued

Crop	Insects	Insecticides	Forms	Dust concentration	Spray concentration: Tablespoons per gallon water	Spray concentration: Amount per 100 gallons water	Remarks
				per cent		pounds unless indicated	
General feeders—continued	Leafhoppers	DDT	(see recommendations under potatoes and beans)				
	Cutworms	Toxaphene	45E	.....	1	1½ qts.	
		Toxaphene	W, D	10	3	3	
		DDT	E	.....	1⅓	2 qts.	
		DDT	D, W	5	2	2	
		Chlordane	44E	.....	2 tsp.	1 qt.	
		Chlordane	D, W	2 or 5	2	2	
	Ants	Chlordane	D, W	5	2	2	If there are only a few hills, treat individual hills.
		Aldrin	15 W, D	2-5	2	2	
		Aldrin	E		¾-1	1-2 qts.	
	Blister beetles	DDT	W, D	5	2	2	
		Methoxychlor	W, D	10	3	3	
	Plant bugs	DDT	D, W	5	2	2	Avoid blossoming periods on legumes.
	Slugs	Metaldehyde bait	(use commercial preparations)				
	Spider mites	Lindane	25W	.....	2-4	1-2	If lindane is ineffective and other materials not available, parathion may be used.
		Ovotran	W	.....	2	2	
		Aramite	15W	.....	2	1¼-1½	
		EPN	28W	.....	½	½	
	Wireworms	Chlordane	D, W	5	5-7	8-10	Apply under soil surface 3-5 inches away from plants. For treatment before planting see text.
		Aldrin	15W	.....	7-8	10-12	
		Aldrin	E	.....		1 gal.	
	White grubs		(see discussion under Field Crop Insects)				

* Safer insecticides which are especially desirable for home gardeners.

RECOMMENDATIONS FOR CONTROL OF FIELD CROP INSECTS

Crop	Insect	Insecticide	Forms	Amount of material per acre per application: Actual insecticide	Spray: Comm. preparation	Spray: Gallons liquids*	Dust: per cent	Dust: pounds	Remarks
Alfalfa	Plant bugs	DDT	E	1½ lbs.	3 qts.	5-35			Pre-blossom application, but see text discussion with respect to possible application during bloom.
	Leafhoppers	DDT	W, D	1½ lbs.	3 lbs.	15-50	5	30-40	
		DDT	D	1½ lbs.			10	20-25	
		Toxaphene	45E, D	1½ lbs.	1½ qts.	5-35	10	20-35	
Beets, field	Webworms	Toxaphene	W, D	1½-2 lbs.	3-4 lbs.	15-50	10	25-35	Early application desirable for more effective control.
		Toxaphene	45E	1½-2 lbs.	1½-2 qts.	5-50	.....	.....	
Clover, alsike	Plant bugs	DDT	E	1½ lbs.	3 qts.	5-35			Pre-blossom application appears most effective but efficiency on weevil may not be too high.
	Weevils	DDT	W, D	1½ lbs.	3 lbs.	15-50	5	30-40	
Clover, red	Weevils Thrips Plant bugs	(evidence lacking for value of chemical control in seed set; use chemicals for grasshoppers)							
Clover, sweet	Sweet clover weevils	DDT	W, D	2 lbs.	4 lbs.	25-50	5	35-40	Apply in spring when new growth is less than 6 inches high.
		DDT	E	2 lbs.	4 qts.	10-50			
		Parathion	15W	½ lb.	3⅓ lbs.	30-50			
		Toxaphene	W, D	2 lbs.	4 lbs.	25-50	10	30-40	
		Toxaphene	45E	2 lbs.	2 qts.	10-50			
Corn, field	Corn borers	DDT	W, D	1½ lbs.	3 lbs.	15-50	5	30-40	
		DDT	E	1½ lbs.	3 qts.	5-50			
Corn	Corn earworms	(see discussion under vegetable insects)							
Grain, small	Green bugs Grain aphids	Parathion	15W, D	¼ lb.	1½ lbs.	25-50	1	20	Effectiveness is not immediately apparent if temperature is cool.
		Parathion	16E	.20-.25 lb.	1½ pts.	5-25			
		TEPP	20S	.20-.33 lb.	1-1½ pts.	10-30			Best results if temperature is 75° F. and above. May get little or no control if temperature is low.
		TEPP	40S	.20-.33 lb.	½-¾ pts.	10-30			
Peas	Pea aphids	DDT	25E	1 lb.	2 qts.	10-50			Make net sweepings before blossoming to determine need for spray; parathion more efficient but hazardous during application.
		DDT	W, D	1 lb.	2 lbs.	15-50	5	30-40	
		Rotenone	4W, D	¼ lb.	6 lbs.	30-50	1	30-40	
		Parathion	15W, D	.20 lb.	1⅓ lbs.	25-50	1	25-35	
		Parathion	16E	.20 lb.	1 pt.	5-25			

RECOMMENDATIONS FOR CONTROL OF FIELD CROP INSECTS—Continued

Crop	Insect	Insecticide	Forms	Amount of material per acre per application: Actual insecticide	Spray: Comm. preparation	Spray: Gallons liquids*	Dust: per cent	Dust: pounds	Remarks
General	Grasshoppers	Chlordane	44E, D	¾-1 lb.	¾-1 qt.	5-25	5	30-35	'Hoppers should be treated when young if possible; lower doses may be used then if vegetation not thick. There is least residue from aldrin.
		Toxaphene	45E, D	1-1½ lb.	1-1½ qts.	5-25	10	20-35	
		Aldrin	E, D	⅛-¼ lb.	½-1 pt.	5-25	2	20-35	
		Aldrin	15W	⅛-¼ lb.	1-1¾ lbs.	25-50			
	Armyworms	Toxaphene	45E, D	1½-2 lbs.	1½-2 qts.	5-25	5	30-40	An entire area of a field may be treated or if insects are starting to migrate, put down a heavy barrier of the insecticide. Direct spraying or dusting simpler than baits.
		Toxaphene	D	1½-2 lbs.			10	20-35	
		Chlordane	44E, D	1 lb.	1 qt.	5-25	5	30-40	
		DDT	E, D	1 lb.	2 qts.	5-25	5	30-40	
		Aldrin	E, D	½ lb.	1 qt.	5-25	2	30-40	
	Cutworms	(insecticides listed under armyworms)							One application for cutworms often not sufficient; preferable to follow with a second application 5 to 7 days later. Treat close to plants if field is already planted.

* Suggested gallonages for conventional ground spraying equipment; for most legume and small grain insect problems application rates of 2 to 4 gallons liquid per acre can be made by aircraft and mist blowers; dense foliage makes control more difficult.

Diluting Concentrates and Powders

THE EMULSION concentrates and wettable powders which you buy must be properly diluted with water to give best results. The two tables which follow will simplify your calculations and save time. Make certain of the percentage of active ingredient in the concentrate. Next, look at the columns on the left for the percentage desired in your final spray mixture or the pounds of insecticide needed for a 50- or 100-gallon mixture. The amount of concentrate needed may then be found in the body of the tables.

EMULSIFIABLE CONCENTRATES

Dilution table for properly mixing liquid emulsifiable concentrates with water

Per cent actual insecticide desired (by wt.)	Pounds insecticide per acre if applying 100* gals.	50 gals.	Insecticide per gallon 2 pounds (23-25 per cent concentrate)				Insecticide per gallon 4 pounds (44-47 per cent concentrate)			Insecticide per gallon 8 pounds (72-77 per cent concentrate)		
			Gallons of liquid desired in mixture for spraying									
			1	3	5	100	1	3	100	1	3	100
			t	t	t	pts.	t	t	pts.	t	t	T
0.025	0.2	0.1	¾	2¼	4	¾	⅜	1¼	⅜	.20	½	6
0.031	0.25	0.13	1	3	5	1	½	1½	½	¼	¾	8
				T	T							pt.
0.063	0.5	0.25	2	2	3	2	1	3	1	½	1½	½
0.094	0.75	0.38	3	3	5	3	1½	4½	1½	¾	2¼	¾
						gals.						
0.125	1	0.5	4	4	6	½	2	6	2	1	3	1
			T	C	C						T	qts.
0.25	2	1	2¼	½	¾	1	4	12	4	2	2	1
							T	C	gals.			
0.50	4	2	5	1	1½	2	2½	½	1	4	4	2
										T		
0.75	6	3	7½	1½	2⅓	3	4	¾	1½	2	6	3
1.00	8	4	10	2	3¼	4	5	1	2	2½	8	4
1.25	10	5	12½	2½	4	5	6	1¼	2½	3	10	5
1.50	12	6	15	3	4¾	6	7½	1½	3	4	12	6
			C									
1.75	14	7	1⅛	3⅓	5½	7	9	1⅔	3½	4½	13½	7
					qts.						C	gals.
2.00	16	8	1¼	3¾	1½	8	10	2	4	5	1	2
2.50	20	10	1½	4¾	2	10	12½	2½	5	6	1¼	2½
							C					
3.00	24	12	2	5¾	2½	12	1	3	6	8	1½	3
4.00	32	16	2½	7½	3¼	16	1¼	3¾	8	10	2	4
5.00	40	20	3¼	9½	4	20	1½	4¾	10	12½	2½	5

The following abbreviations and values are used:
T = tablespoon = ½ fluid ounce; t = teaspoon = 1/6 fluid ounce; pt. = pint = 16 fluid ounces; C = cup = 8 fluid ounces = ½ pint.

For dilutions not given in the table use values given in 100 gallon columns for the basis of calculations, as cup and spoon values must be approximate in some cases.

* For gardeners: if spraying small areas where acreage is not known use the 100 gallon column (at left) to calculate proper dilution. For example: if a 1 pound per acre application of a 25 per cent concentrate is being mixed in a 3 gallon sprayer you would use 4 tablespoons of the concentrate. This assumes a fairly thorough wetting of the foliage as you are spraying.

WETTABLE POWDERS FOR SPRAYS

Dilution table for properly mixing wettable powders of different insecticides with water

Desired concentration of insecticide		Amount of finished spray material desired in gallons											
		50 per cent wettable			40 per cent wettable			25 per cent wettable			15 per cent wettable		
per cent	pounds per 100 gallons	1	3	100	1	3	100	1	3	100	1	3	100
		t	t	ozs.	t	T	ozs.	t	T	ozs.	t	T	ozs.
0.0125	.10	⅓	1	3¼	½	½	4	⅔	1	6½	1	1	10.6
0.025	.20	⅔	2	6½	1	1	8	1½	2	13	2½	3	21⅓
0.031	.25	1	3	8	1	1¼	10	2	2	16	3½	4	26⅔
0.050	.40	1½	5	13	2	2	16	3	3	26	5	5	42⅔
													lbs.
0.063	.50	2	6	16	2½	2½	20	4	4	32	6	6½	3⅓
								T					
0.094	.75	3	9	24	4	3½	30	2	6	48	9	10	5
							lbs.						
0.10	.80	3	9	26	4	4	2	2	6	51	10	10	5⅓
			C	lbs.					C	lbs.	C	C	
0.125	1	4	¼	2	5	5	2½	2½	½	4	¼	¾	6⅔
0.25	2	7½	½	4	10	10	5	5	1	8	½	1½	13⅓
		T				C							
0.50	4	5	1	8	19	1¼	10	10	2	16	1	3¼	26⅔
					C								
0.75	6	8	1½	12	⅝	1¾	15	16	3	24	1½	4¾	40
1.00	8	10	2	16	¾	2⅓	20	20	4	32			
		C											
1.25	10	¾	2⅓	20	1	3	25	26	5	40			
1.5	12	1	3	24	1¼	3⅔	30						
1.75	14	1⅛	3⅓	28	1⅓	4¼	35						
2.0	16	1¼	4	32	1⅔	5	40						
2.25	18	1½	4⅓	36									
2.50	20	1⅔	5	40									

Make dilution on a weight basis whenever possible since dry powders vary so much in weight per unit volume.

t = level teasponful = 1/12 oz.; T = level tablespoonful = ¼ oz.; C = level standard measuring cup = 4 ozs.

These values are only approximate since powders vary a great deal in weight by volume. For more accurate dilutions use weight values in the 100 gallon column and multiply by 0.01 and 0.03 to convert for 1 and 3 gallon mixes.

Be Careful - - - Be Safe

Use Insecticides Properly

1. Keep all insecticide preparations labeled and store in a tight container in a cool, dry place where they *cannot be reached by children, pets, and livestock.* Dispose of any unknown materials.
2. Avoid skin contact, especially with emulsion concentrates and oil solutions.
3. Wash off exposed skin immediately with warm, soapy water. If materials have gotten into the eyes wash immediately with large quantities of water.
4. Make dilutions at recommended doses—avoid overdoses.
5. Avoid inhaling dusts, wettable powders, and sprays.
6. Do not apply inflammable oil solutions near fire.
7. Keep insecticide treatments away from food, water, food-preparing boards, dishes, and cooking utensils.
8. Wear gloves, respirator, and goggles if *considerable* spraying or dusting is to be done. If air movement is poor do not remain in an area long during spray operations.
9. When an exposure occurs or symptoms appear, CALL A PHYSICIAN.
10. Act quickly when exposure occurs. Use the ANTIDOTES below.

★ If poison is inhaled, remove patient to open air and apply artificial respiration if necessary.

★ If skin is contaminated, wash off affected areas immediately.

★ If a poison is swallowed, induce vomiting as soon as possible. Use 1 tablespoon dry mustard in a glass of warm water, or insert index finger or tongue depressor far down the throat. After emptying the stomach feed milk, raw eggs to help absorb the toxin and to soothe irritated areas.

★ If phosphates are absorbed through the skin, inhaled, or swallowed, follow the specific recommendations given on page 8.

UNIVERSITY FARM, ST. PAUL 1, MINNESOTA

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