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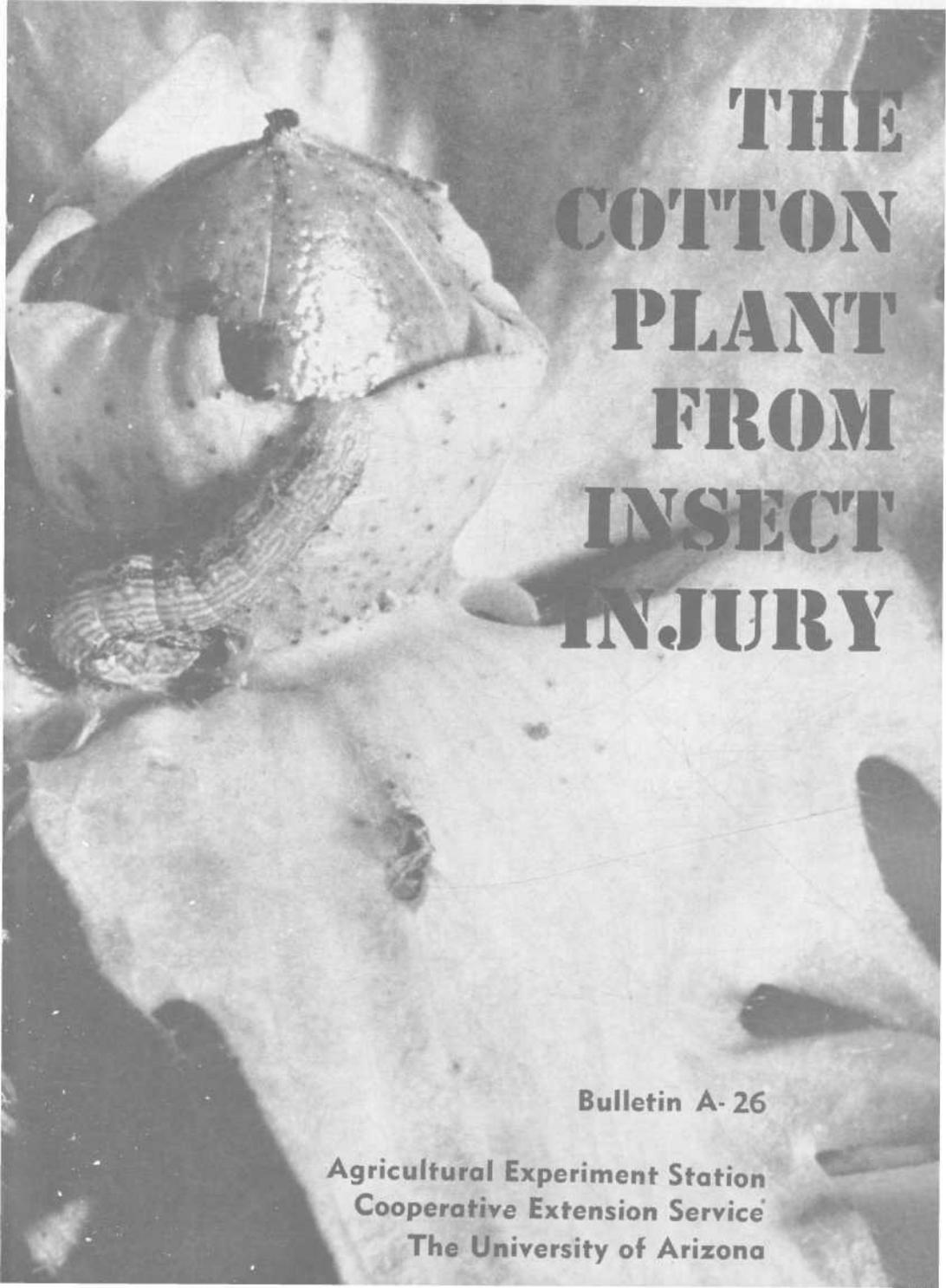
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PROTECT



THE COTTON PLANT FROM INSECT INJURY

Bulletin A-26

Agricultural Experiment Station
Cooperative Extension Service
The University of Arizona

CONTENTS

	Page
Know the Insects	
In Your Cotton Fields.....	3
Know What You Are Doing.....	4
Double Check	5
Watch Out for Drift	6
Protect Your Cotton Plants	
From These Insects.....	7
Early Season	7
Seed Corn Maggots.....	7
Cutworms	7
Darkling Ground Beetles.....	8
Thrips	8
Black Fleahoppers	
& Lygus Bugs.....	9
Aphids	9
Spider Mites	9
Beet Armyworms	9
Midseason & Late Season.....	10
Lygus Bugs, Black Fleahop-	
pers, Cotton Fleahoppers,	
Superb Plant Bugs.....	10
Bollworms	11
Cabbage Loopers	12
Cotton Leaf Perforators.....	12
Leaf Rollers	13
Salt Marsh Caterpillars.....	13
Beet Armyworms (Late).....	14
Pink Bollworms	14
Boll Weevils	14
Spider Mites	15
Stink Bugs	15
Aphids (Late)	16
Cotton Leafworm	16
Whiteflies	16
Tips on Airplane Application.....	16
Latest Research Report.....	17
Read & Heed the Label.....	19

ARIZONA PESTICIDE USE LAW OF 1964

Agricultural users of pesticides in Arizona are reminded of the state law, which became effective in 1964, requiring an annual permit for the sale, purchase, or use of insecticides. This law also provides, upon recommendation of an advisory committee, and after a public hearing, for the establishment of special regulations regarding named insecticides and for the designation of areas within which the use of such insecticides may be restricted or prohibited. This law is administered by the Arizona Board of Pest Control Applicators.

All pesticides mentioned in this publication are registered and cleared for the suggested use in accordance with Federal laws and regulations. They also are registered by the State chemist in Arizona for use in Arizona.

READ THE LABEL before using ANY insecticide.



Use Pesticides Safely
FOLLOW THE LABEL

Trade names used in this publication are for identification only and do not imply endorsement of products named or criticism of similar products not mentioned.

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture. George E. Hull, Director of Extension Service, The University of Arizona College of Agriculture, Tucson, Arizona.

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PROTECT THE COTTON PLANT FROM INSECT INJURY

By
J. N. RONEY
Extension Entomologist

And
GEORGE WENE
Experiment Station Entomologist

THE UNIVERSITY OF ARIZONA

PLAN AHEAD

Protection of the cotton plant from harmful insects is very important to you as a grower.

Insect control alone, however, will not give high yields or good quality cotton. Neither will just following good farming practices. **It takes a combination of good seed, good farming practices, and proper insect control on your part.**

Check the "good farming" practices listed below. Be certain that they are being followed on your farm:

- ✓ **Always prepare a good seed bed.**
- ✓ **Use certified seed.**
- ✓ **Treat all seed with a seed disinfectant.**
- ✓ **Follow good planting practices.**
- ✓ **Follow a good fertilizer program.**
- ✓ **Follow recommended irrigation practices.**
- ✓ **Practice good weed control in fields, on ditch banks, and along fence rows.**
- ✓ **Set up a plan for adequate protection to the cotton plant from insects and diseases.**
- ✓ **Practice crop rotation.**
- ✓ **Plan for and use a good program of quality harvesting and ginning.**
- ✓ **Destroy cotton stalks as early as possible. Plow them under.**

Know The Insects In Your Cotton Fields

PROTECT COTTON FROM INJURIOUS INSECTS

Learn to recognize the insects which cause injury to your cotton plants.

Use a bug net to check sucking

insects. With a net 15 inches in diameter, make sweepings in at least 5 points in a field. Swing the net so as to collect the insects from the tops of the cotton plants.

Make insect-net sweepings early in

the morning or late in the evening for lygus, cotton fleahoppers, and superb plant bug. Make sweepings for black fleahoppers during the middle of the day.

In small seedling cotton, the sweeping of a bug net often fails to tell the story of injury to the plant. When plants are very tall, it is almost impossible to get a correct count.

In early season, watch your plants. If small squares are being blasted by insects and you have 25 percent injury, it would pay to protect the plants by controlling the insects. (See control details as listed under each insect.)

For chewing insects, especially the cotton bollworm, look for and count the worms in the growing tips of the plants. (See details under bollworms and other worms as listed.)

Note: When injurious insect populations are causing economic damage to the plant, **never delay controls in order to protect a high population of beneficial insects.** If your examinations show the plants need protection, **act at once.**

LEARN THE IMPORTANCE OF BENEFICIAL INSECTS

Remember that there are beneficial as well as harmful insects in a cotton field. Learn to know these beneficial insects. Most of them are predators.

Some of the insects you will catch in the bug net are big-eyed bugs, aphid lions, Orius, nabids, assassin bugs, and several plant spiders. These feed on lygus, stink bugs, and rapid plant bugs. They also may feed on the eggs and small stages of the cotton bollworm and other worms.

You may catch the ladybird beetle in both larval and adult stages. This insect feeds on aphids and thrips. The larvae look like tiny gila monsters.

Nearly all of these insects feed on aphids.

There are many **other beneficial insects.** You may see them in field demonstrations your County Agricultural Agent holds in your area.

(For further information on identifying cotton insects, see Bulletin A-23, "Descriptions & Habits of Arizona Cotton Insects.")

Know What You Are Doing

● There are some state laws in regard to the use of insecticides. A permit for use of insecticides is required.

● **Remember, some cotton fields are capable of producing only very low yields of cotton. Insect control on these types of fields should be limited to a minimum use of any insecticide.**

● Do not dust or spray as a preventive measure or just because your neighbor does these things.

● **Protect your plants with insecticides when needed and when weather conditions are favorable. Consider other crops and beneficial insects when controlling the injurious insects.**

● There are many types of ground spray equipment for sale. Be sure to secure a sprayer that gives a good coverage of the plant from bottom to top at all times, with 40 pounds or more of pressure.

● **Never use spray equipment that has been used for applying 2,4-D or other herbicide.**

● Apply insecticides as recommended. But remember that rank stalks and heavy foliage need more materials per acre than plants of open growth.

Tall rank cotton may require heavier applications than those recommended in the circular.

● When applying insecticides always do a good thorough job of plant coverage. **Never underdose.** Sub-marginal dosages often do more harm than good

Double Check

Some crops may be injured by cotton insecticides. Always be careful to learn and follow precautions.

Never use sulfur in dust when cotton is near or adjoining cantaloups or melons.

Never use toxaphene or strobane alone or in mixtures near or adjoining melon fields.

Never use any organic phosphate insecticides other than malathion on cotton adjoining a field of grain sorghums.

In areas where cotton fields adjoin alfalfa fields or other feed or food crops, or where drift is a problem, read the label and use only those materials that are cleared for the adjoining crops.

Be careful not to dust or spray apiaries. Honeybees may be injured by some insecticides, so consider your beekeeper when dusting or spraying. Notify beekeepers of your intentions to use control measures if beehives are near the fields to be sprayed or dusted.

If fish are present in tanks or ponds near areas to be controlled, be sure not to let insecticide drift get into the water.

Be careful when applying insecticides around livestock or in suburban areas. Use sprays in place of dusts to minimize the amount of drift.

Heavy desert foliage, alfalfa seed or hay, safflower, and sugar beets grown for seed may be sources of infestations of thrips, stink bugs, lygus, and superb plant bugs. Also, small grains may be a source of thrips, lygus, stink bugs, mites, and other insects.

Remember that desert land may have a heavy rabbit population. This may result in rabbit injury to your cotton. It is best to fence out these pests.

Always destroy insecticide containers as soon as they are emptied.

Sometimes control of sucking insects may be especially troublesome because of climatic conditions affecting the insecticides and continued migration from alfalfa, safflower, and other crops.

Because most of the new organic insecticides are insoluble in water, it is not necessary that the plants be wet with dew when the insecticide is applied.

BE CAREFUL: Always follow directions when using insecticides. Use only recommended materials.

All applicators and handlers of insecticides need to follow the explicit directions on the labels of materials. (Look at page 19 for a sample.) Certain phosphate insecticides are very dangerous, so be sure to wear protective clothing, gloves and respirator according to directions.

Never wear clothes more than one

day. Wash all clothes in soap and water before wearing them again.

Be sure to check all water when using sprays. Water should be clean. Also be sure that it will mix with emulsifiable formulations of insecticides. Many samples of water in Arizona, when mixed with insecticide, have given very poor results. The addition of a good surfactant will aid in overcoming this problem.

Watch Out For Drift

Cotton growers must prevent the objectionable drift of insecticides to nearby crops, particularly those feed crops used for dairy cows or animals being finished for slaughter.

DRIFT ON ALFALFA AND OTHER FORAGE CROPS

Take special care to prevent drift of DDT from cotton to nearby alfalfa or other forage crop. To reduce danger of hay contamination with illegal residues, **do not use DDT sprays within 1½ miles, or DDT dust within 5 miles, of the nearest alfalfa or other forage crop.** These minimum isolation distances for DDT whether used alone or with other pesticides should be increased whenever possible. **Use of DDT dust is forbidden except by special permit.** Check with your County Extension Agent.

When alfalfa is small and 30 to 40 days from harvest you may not have a problem from drift of toxaphene, malathion, dieldrin, endrin, sulfur, dibrom, methyl parathion, demeton, dylox, BHC, lindane or sevin.

Alfalfa that is two weeks from har-

vest does not have a problem of drift from malathion, dibrom, phosdrin, methyl parathion, sevin, sulfur or dylox.

Alfalfa that is one week from harvest may not have a problem of drift from malathion, dibrom, phosdrin, or sevin.

DRIFT ON SORGHUM FOR GRAIN

Grain sorghum before heading is not contaminated from drift of endrin provided it is 35 days before harvest, or from dieldrin provided it is 40 days before harvest. Toxaphene has no limit on grain, but do not feed the crop to dairy animals or animals being finished for slaughter.

DRIFT ON SORGHUM FOR SILAGE

Sorghum being grown for silage is not contaminated by the drift of dieldrin provided it is 40 days before harvest. Endrin is satisfactory provided it is used 35 days before harvest. Sevin has no limitations for sorghum for forage.

Protect Your Cotton Plants From These Insects

The principal injurious insects of Arizona and their controls are on the following pages. These recommendations are based on research conducted by workers of The University of Ari-

zona Agricultural Experiment Station together with the United States Department of Agriculture, Agricultural Research Service, Cotton Insects Research Branch

EARLY SEASON PROTECTION

In the higher elevations of Arizona, the protection of the cotton plant from early season insects is of paramount importance.

Early season plant protection from thrips and aphids assures an early set and earlier maturity of bolls. It is a "must" in the higher elevations especially during late cool spring weather.

Protect the plant from thrips, aphids, beet armyworms, darkling ground beetles, and cutworms if you can determine by close examination that these insects are injuring the plants. Protection of the plant by control of the above insects insures a stand as well as early fruiting of the plant. Early fruiting helps prevent rank growth and encourages early maturing bolls.

SEED CORN MAGGOTS

You can protect cotton seeds and seedlings from seed corn maggots by treating the seed. Seed treatment has given the best results and it is wise to treat before planting if your field has a history of this insect being present.

CONTROL

To treat seed, use 2½ ounces of 75 percent wettable lindane powder per 80 pounds of seed. Be sure it is thoroughly mixed.

Or you may use 3.2 ounces of actual chlordane to 80 pounds of seed.

Another control is 1.6 ounces of technical dieldrin to 80 pounds of seed mixed in a slurry treatment.

Best results have been secured when the insecticides have been mixed with a fungicide; however do not treat seed except a short while before planting. See your County Agricultural Agent for specific details on seed treatment.

CUTWORMS

CHEWING INSECTS

Cotton plants in the seedling stage often need to be protected against injury by cutworms. There are several species of cutworms involved but all do the same type of damage. They usually cause the greatest injury in cotton fields that are following alfalfa, grain, or vegetables.

CONTROL

Insecticides may be applied as dusts, sprays, or granules. If cutworms appear and plants need protection, treat with toxaphene spray of 2 to 3 pounds of technical toxaphene in 6 gallons of water per acre.

Endrin at 0.3 pounds of technical per acre also is effective.

Best results are secured if the mate-

rials are applied with ground sprayers or dusters. Many times a preventive spray is needed where cutworms have a history of having been present.

DARKLING GROUND BEETLES CHEWING INSECTS

Darkling ground beetles often become so numerous on seedling cotton plants that they have to be controlled to protect the plants. They have been found injuring cotton especially when it is following alfalfa or grain.

CONTROL

Use 0.3 pounds of endrin as a spray in 6 gallons of water per acre. Apply only with a ground sprayer.

Or you may use 0.5 pound of technical heptachlor in 6 gallons of water per acre.

THRIPS

RASPING AND PIERCING MOUTH PARTS

The cotton plant, especially in the seedling stage, is very vulnerable to injury by thrips. Not all fields become infested, but when thrips are present and feed on the tender growing tips they can present a very serious problem.

Cotton fields adjoining alfalfa, weeds, or small grains may become heavily infested with migrating thrips, especially at harvest time. Heavy desert growth also may produce large populations of thrips.

When the plants do become infested, they need protection against attack. Curled leaves and rolled-under growing tips often will indicate thrips injury by a silver appearance on the undersides of the leaves.

In the higher elevations, the cotton plant must be protected from thrips just after the cotyledon stage appears. At this time you may find thrips feeding in the fold of the growing tip.

CONTROL

Best protection to the plant can be obtained if you start controls with an insecticide by applying granules at planting time or just after the plants are in the 2-cotyledon stage. Thrips control is of little value after injury to the leaves has become evident.

In the lower elevations, plant protection is needed when you have an average of 1 thrips per plant on 100 plants. Check five different points in a field.

Two applications of any foliar spray or dust of the recommended insecticide should be applied at ten-day intervals for best results.

A 10 percent toxaphene or strobane dust, plus 40 percent sulfur, at 15 pounds per acre, gives good control. As a spray, use 1.5 pounds of technical toxaphene or strobane per acre.

A 5 percent malathion dust applied at 15 pounds per acre is also good. As a spray, use 1 pound of technical malathion in 6 gallons of water per acre.

Or use dieldrin 2.5 percent dust at the rate of 15 pounds per acre. As a spray use $\frac{3}{4}$ pound of technical dieldrin in 6 gallons of water per acre.

Also, Dimethoate at 0.25 pound, Bidrin at 0.25 pound or phosphamidon at 0.25 pound per acre may be used.

Thimet or Di-syston granules used at the rate of 1 pound of actual toxicant per acre and applied in the seed bed at planting time have given excellent control when adequate moisture is available. Sometimes it is necessary to irrigate early to make systemics effective.

Better protection is given to the plants if the materials are put on with a ground duster or sprayer. When airplane application is used, increase the dosage by 50 percent.

You may wish to use insurance when you plant your seed. This can be done by treating the seed with phorate

(thimet) or by applying the granular form of phorate at time of planting. In the higher elevations good control of thrips was secured with both treatments.

Phorate may also be applied to the seed at the rate of 1 pound per acre. However, during cool weather and with wet soils, this seed treatment has reduced stands at times. Granules have not reduced stands under adverse weather or moisture conditions.

Phorate (Thimet) and Di-Syston are very poisonous and should be used only when you are willing to follow the directions as written on the container.

Where Phorate or Thimet has been used at planting time for thrips control, aphids and red spider mites also are controlled.

BLACK FLEAHOPPERS AND LYGUS BUGS

Best control is obtained with a mixture containing either 0.6 pound malathion or 0.5 pound Dylox with 3 pounds toxaphene or Strobane per acre.

Good control also is given by 1 pound of malathion, or 1 pound of Dylox, or 0.25 pound of Bidrin or 4 pounds of toxaphene, or 4 pounds of Strobane, or 0.25 pound phosphamidon per acre in 7 gallons of water.

Sprays containing 0.25 pound dimethoate (Cygon) or 0.75 pound diazinon per acre have also given good control.

APHIDS

SUCKING INSECTS

Sometimes the seedling cotton plant needs protection from aphids. These insects can cause serious injury if not controlled, especially in the higher elevations.

CONTROL

In the higher elevations, seedling plants of cotton often need protection from the cowpea aphid. During a very cool spring the aphids may injure the plants in the lower elevations, and plant protection may be needed.

CONTROL

Use 5 percent malathion dust or a 2 percent BHC dust, at 15 pounds per acre. As a spray use 0.5 pound technical malathion or 0.5 pound of gamma isomer BHC, or 0.5 pound phosphamidon, in 6 gallons of water per acre.

BHC should not be used on land where root crops will be grown within five years.

SPIDER MITES

In early season in certain areas, spider mites are a problem shortly after the cotton emerges from the ground. This is especially true where fields adjoin alfalfa.

CONTROL

Use Kelthane or Aramite dusts or sprays applied with ground equipment at the rate of 1 pound of toxicant per acre.

Granular formulations of Di-Syston or Thimet, at the rate of 1 pound of toxicant per acre, applied in the seedbed at planting time, have given good control of early season infestations.

BEET ARMYWORMS

CHEWING INSECTS

The beet armyworm feeds on the cotton plant when it is in the seedling stage. In some instances it may partially destroy the crop.

Plant protection from beet armyworms is not needed every year, as parasites and predators often keep the worms under control.

Protection of the plant is needed

when beet armyworms start reducing the stand of seedling plants in injurious numbers.

CONTROL

Sprays seem to be more effective than dusts. Use toxaphene or strobane, DDT, 4-2 emulsions at a rate of $\frac{3}{4}$ gal-

lon per acre. (This is equivalent to 3 pounds of technical toxaphene or strobane and 1.5 pounds of DDT).

Or use $\frac{3}{8}$ pound Dieldrin in 6 gallons of water per acre as a spray.

Do not use DDT near alfalfa or other forage crop. (See page 6.)

MIDSEASON & LATE SEASON PROTECTION

(Starting about June 20)

LYGUS BUGS BLACK FLEAHOPPERS COTTON FLEAHOPPERS SUPERB PLANT BUGS

SUCKING INSECTS

Plant protection from lygus bugs, cotton fleahoppers, black fleahoppers, and superb plant bugs is very much needed in many fields when the insects are feeding on all sizes of squares and soft bolls. The superb plant bugs are injurious to cotton mostly in the higher elevation counties of the state.

Start protection of smaller plants about June 20 when 6 lygus per 100 net strokes are present. Larger plants can tolerate more lygus, therefore control measures should start when 10 to 12 lygus per 100 sweeps are found or when 25 percent of the squares are "stung."

It is wise to use the two methods of checking together to minimize any error due to adult migration, time of day, etc. Do not control if plants are not being injured.

Another good method to use early in the season when plants are just starting to square is to examine plants for black or brown blasted squares. Sometimes the sweeping of the insect net does not show a count of any insects large enough to be causing

damage. However, examination of small squares sometimes shows a 50 percent loss from insect injury. This, then would mean protection of the plant was needed to assure a good early set of bolls.

To begin protection of plants from black fleahoppers alone, you should have 50 to 60 adults and nymphs per 100 net sweeps. Make sweepings for black fleahoppers during the middle of the day. Also look for injured squares of all sizes to see if the insects are feeding.

If the cotton plant needs protection from the cotton fleahopper alone, start control when 16 to 20 insects per 100 sweepings of the bug net are present. We would also again suggest examination of the plants to see if injury is present. If no more than 25 percent of the forms are injured, controls are not needed.

Later in the season, after July 15, punctured squares just prior to blooming are also a good indication that lygus or cotton fleahoppers are causing injury. You are not able to do a complete job of checking with the bug net, so examine or pull off 20 squares at 5 points in a field. If as many as 5 per 20 squares are punctured, multiply by 5 and you have a 25 percent infestation and the plant needs protection.

When making counts with an insect

net, always sweep early in the morning or late evening for lygus and cotton fleahoppers. When checking for black fleahoppers, make counts during mid-day.

CONTROL

You may use any of the following controls:

A 20 percent toxaphene-sulfur dust mixture applied at the rate of 25 pounds per acre.

A spray of 4 pounds of technical toxaphene per 6 gallons of water per acre, or 4 pounds of Strobane in 6 gallons of water per acre.

A spray of 4 pounds of technical toxaphene plus 2 pounds of technical DDT in 6 gallons of water per acre.

A spray of 4 pounds of technical strobane plus 2 pounds of technical DDT in 6 gallons of water per acre.

A spray mixture of methyl-ethyl Guthion technical of 1 pound plus 2 pounds of technical DDT in 6 gallons of water per acre.

In using a spray of methyl parathion and endrin together, be sure to use 0.5 pound of endrin with 0.5 pound of methyl parathion in 6 gallons of water per acre.

A 5 percent malathion dust, plus 10 percent DDT, plus 40 percent sulfur at 25 pounds per acre; or 1 pound of technical malathion, plus 2 pounds of technical DDT in 6 gallons of water per acre.

Another effective control is the addition of 0.5 pound Dylox or 0.5 pound Dibrom or 0.5 pound malathion to 3 pounds of toxaphene or strobane. Note: DDT is added to some mixtures to prevent bollworm infestations.

Do not use DDT near alfalfa or other forage crops. (See page 6.)

In areas where cotton fields adjoin alfalfa fields, or where drift is a problem, you may use sprays containing either diazinon at 0.5 pound per acre

or Dylox at 1 pound per acre of actual toxicant or dibrom at 1 pound per acre of actual toxicant.

Three new materials — Bidrin at 0.3 pound per acre, phosphamidon at 0.5 pound per acre, or dimethoate at 0.25 pound per acre — also are very effective in controlling lygus bugs. These materials greatly accentuate the bollworm problem, however, and DDT at 3 pounds per acre should be added to any application after July 5, or if bollworms start to appear.

BOLLWORMS

CHEWING INSECTS

The cotton plant needs protection from bollworms when the larvae are damaging squares, blooms, or bolls.

The plant also needs protection when the small worms appear in the growing tips in damaging numbers. Fifty plants, or 50 growing tips, should be examined. If you find 3 to 4 small worms in these counts at several points in the field, start dusting or spraying.

Remember, you cannot get very good control of large bollworms, so don't delay controls when you find the small worms in sufficient numbers.

Bollworm eggs are laid on the tender growing tips, where the very small worms hatch. The worm eats its egg shell before feeding on the cotton plant, squares, or bolls. Bollworm eggs also are laid on the lower portions of the plants at times.

If you wish to obtain good plant protection you must control the worms when they are small.

In recent years, heavy parasite and predator populations have often kept bollworms in check; however, during rainy spells, this may not be true.

CONTROL

A dust mixture of 15 percent toxaphene or 15 percent Strobane, with 10 percent DDT, and a high percentage of

325-mesh conditioned sulfur will give control when applied at 20 to 30 pounds per acre per application.

Also, a dust mixture of 20 percent toxaphene or 20 percent Strobane, plus 40 percent sulfur will give good commercial control where DDT cannot be used.

Also effective are the following:

A spray of 2 pounds of technical toxaphene or 2 pounds of technical Strobane, plus 3 pounds of technical DDT in 6 gallons of water.

Azodrin, a recently developed insecticide, applied at 1 pound per acre when applied at 4-day intervals gave good bollworm control. However, if 8-day interval is used, bollworm populations will increase.

A dust of 2 percent gamma isomer BHC plus 10 percent DDT, plus 40 percent sulfur, at 20-30 pounds per acre; or a spray containing 0.5 pound gamma isomer BHC plus 2 pounds of technical DDT in 6 gallons of water.

A dieldrin spray of $\frac{3}{8}$ pound of technical plus 2 pounds of technical DDT in 6 gallons of water per acre.

A spray of 1.0 pound of technical malathion plus 2 pounds of DDT in 6 gallons of water.

A spray of 1 pound of methyl parathion plus 0.5 pound of endrin in 6 gallons of water per acre.

A spray containing 4 pounds of toxaphene or Strobane plus 2 pounds of DDT per acre.

In areas or fields where DDT cannot be used, adequate control can be obtained with the following spray applied at these rates — 4 pounds of Strobane, or 4 pounds of Toxaphene plus $\frac{1}{2}$ pound of Methyl Parathion, or 6 pounds of Toxaphene alone. This gives adequate control on an 8-day program.

When certain phosphates such as methyl parathion, ethyl parathion, Bidrin, phosphamidon, and malathion

are used for lygus bug control the bollworm population is accentuated and the proportion of DDT added to such formulations should therefore be increased.

Do not use DDT near alfalfa. (See page 6.)

CABBAGE LOOPERS CHEWING INSECTS

The cotton plant does not need protection from the feeding of cabbage loopers unless foliage damage is very heavy.

Delay control of the cabbage looper until ragging of the leaves is very heavy since a virus or disease may give the desired control.

CONTROL

A mixture of 3 pounds of toxaphene plus 1.0 pound of dibrom in a spray at 6 gallons per acre has been very effective against the looper.

A spray mixture of 1 pound of dibrom plus 0.5 pound of endrin in 6 gallons of water also is effective in protecting the plant from looper injury.

Or you may use a spray of 1 pound of technical Thiodan in 6 gallons of water per acre; or a spray mixture of 1.0 pound of technical methyl parathion plus 0.5 pounds of technical endrin in 6 gallons of water per acre. (**Note:** Methyl parathion is more effective than ethyl parathion.)

None of the above materials will give over 75 percent control of loopers, but the reduction of looper population will often allow time for the virus to control the loopers before severe damage can be done.

COTTON LEAF PERFORATORS CHEWING INSECTS

The cotton plant often needs protection from the feeding of the leaf perforator in mid-to-late season. Heavy

infestation will retard growth for 30 days in midseason.

Eggs are laid in the leaves. They hatch into small leaf miners that feed within the leaf tissues for a very short period of time. On emerging from the leaf tissues, the small larvae feed for 1½ days, then spin horseshoe webs where they remain for about 2 days. The larvae emerge from the web and feed for 2 more days and then pupate.

Due to this insect's habit of feeding for only short periods, the cotton plant must be protected at the time the larvae are feeding. Successful protection of the plant depends upon starting controls before infestation develops to damaging numbers.

Usually two or more applications of an insecticide are necessary for control.

CONTROL

Start control when the underside of the leaf surface shows some feeding injury. Time the applications so that they are made when a majority of the larvae are feeding and not in the common "horseshoe web" stage. Heavy infestations will injure the plants to the extent that they will be stunted.

Effective protection may be secured with the following materials:

A spray of 4 pounds of technical toxaphene plus 2 pounds of technical DDT in 6 gallons of water; **or** a spray mixture of 0.6 pound of technical malathion plus 2 pounds of technical DDT; **or** a spray mixture of 0.5 pound of technical endrin plus 0.5 pound of technical methyl parathion. Use spray material in 6 gallons of water per acre.

Four pounds of technical Strobane plus 2 pounds of technical DDT in 6 gallons of water per acre.

A 10 percent Sevin dust plus 40 percent sulfur; **or** 2 pounds of sprayable Sevin in 6 gallons of water.

One pound of Dibrom plus 0.3 pound of endrin; **or** 1.5 pounds of

Dylox; **or** 0.7 pound of Dilan — in 6 gallons of water per acre. Do not apply Dilan after the bolls open.

One pound of Thiodan in 6 gallons of water per acre.

One pound of methyl-ethyl Guthion in 6 gallons of water per acre.

NOTE: Sprays are more effective than dusts. DDT is added to prevent infestations of bollworms. Do not use DDT near alfalfa. (See page 6.)

LEAF ROLLERS

CHEWING INSECTS

The leaf roller causes injury in some areas at times.

The protection of the cotton plant from feeding by the leaf roller is best accomplished by proper timing of the applications of the insecticides, and by heavy poundages of the material being used.

Start controls when sweepings of an insect net show an average of one leaf roller moth per sweep.

CONTROL

Early in the season, a dust mixture of 10 percent DDT plus 15 percent toxaphene, plus a high percentage of 325-mesh conditioned sulfur is effective. A 2 percent parathion dust is also effective. Either should be used at 20 pounds per acre.

The leaf roller is difficult to control. One application of an insecticide may not control this insect. Three applications are necessary for control when the worms are present in great numbers.

SALT MARSH CATERPILLARS

CHEWING INSECTS

The salt marsh caterpillar, also known as "woolly worm," may cause some injury to cotton.

Start controls of salt marsh caterpillar when larvae have left the flag leaves and are visibly damaging the

foliage during late August or early September.

CONTROL

Sprays containing 0.5 pound of technical endrin plus 1.0 pound of technical methyl parathion, or 1.5 pounds of technical Dylox in 6 gallons of water per acre are effective.

Or use one of the following:

A spray of 0.7 pound of technical dilan in 6 gallons of water per acre.

A sprayable sevin at the rate of 2 pounds per acre in 6 gallons of water.

A spray of 0.5 pound of diazinon.

A dust mixture of 10 percent sevin at 20 pounds per acre.

BEET ARMYWORMS (LATE)

The cotton plant has needed protection from the beet armyworm in late season during recent years, especially where repeated applications of DDT were used in early season. Sometimes under natural conditions this insect develops in late season on the cotton plant.

Research has shown that the plant needs protection when the beet armyworms are feeding on terminals, squares, blooms, and bolls.

CONTROL

The following sprays applied by air have given plant protection:

A spray of 1.5 pound of Dylox plus 2 pounds of strobane or toxaphene, plus 1 pound of Dibrom, plus 0.5 pound endrin. Use either mixture in 6 gallons of water per acre.

A dust mixture of 5 percent Dylox plus 40 percent sulfur at 30 pounds per acre.

A spray of 1 pound of methyl parathion plus 0.5 pound of endrin in 6 gallons of water per acre.

Two or three applications are needed when heavy infestations are present on older cotton.

NOTE: Sprays give more effective control than dusts.

PINK BOLLWORMS

CHEWING INSECTS

Farmers in regions where the pink bollworm has been found should consult Circular 274, "The Pink Bollworm in Arizona"; also Technical Bulletin UofA No. 170, "Winter Survival of Pink Bollworms."

Important: We suggest that you consult Quarantine Regulation No. 5 "Pertaining to Pink Bollworm of Cotton in Arizona" of the Arizona Commission of Agriculture and Horticulture, Office of the State Entomologist, Phoenix, Arizona. There may be a new change in 1966. Consult your County Agricultural Agent for complete quarantine regulations.

CONTROL

If sprays are needed, use 4 pounds of toxaphene or strobane with 2 pounds of DDT applied three or four times at 7-day intervals. A good bollworm control program during August has prevented pink bollworm from building up to injurious proportions.

BOLL WEEVIL

The boll weevil has done some damage in Stanfield and Dateland areas.

CONTROL

Effective control can be secured by cleanup measures of previous infestation. Chemical controls can be obtained with use of 0.5 pound methyl parathion plus 3 pounds of toxaphene or strobane applied at intervals of 5 to 7 days. Start spot treatments when 25 percent of squares are punctured by weevils.

SPIDER MITES

NOT TRUE INSECTS

The cotton plant at times needs protection from spider mites. There may be several species involved.

CONTROL

You may protect the cotton plant from spider mites with a demeton spray mixture of 1 pint of demeton in 6 gallons of water per acre.

A 3 percent aramite dust, or a spray mixture of 1.0 pound of 25 percent wettable powder aramite in 6 gallons of water per acre may be used. **Do not spray with aramite after cotton bolls open.**

A 3 percent Kelthane dust at 40 pounds per acre, or 1 pound of technical Kelthane in 6 gallons of water per acre may be used. Ground applications are more effective than applications by air.

Chlorbenzilate at 0.75 to 1.0 pound per acre also is effective.

In some areas, mites have been found to be resistant to some organic phosphates. In the resistant areas, Aramite gives the best control but more than one application is necessary.

Sprays containing 1 pound of Tedion or 1 pound of Kelthane in 6 gallons of water per acre, applied by ground equipment also have given good control of mites.

A 3 percent Tedion dust at 20 to 25 pounds per acre is very effective.

An application of 40 pounds of dusting sulfur per acre will control mite infestations that may develop during July.

STINK BUGS

SUCKING INSECTS

The cotton plant, and especially its squares and bolls, often need protection from several species of stink bugs. In areas where safflower, small grains,

grain sorghums, and alfalfa are adjoining cotton fields, the stink bugs may move back and forth from cotton to these crops all summer.

Stink bugs "sting" the bolls and cause the cotton in these stung bolls to develop spotted cotton. The insects stick their beaks into the boll to suck out the juices from the seed, and leave a liquid that stains the lint. Many times they reduce the yields of the cotton by preventing the locks from opening.

Plant protection from stink bugs is needed when you catch 1 to 2 stink bugs per 100 sweeps of the bug net at five different points in a field.

CONTROL

A dust mixture of 2 percent gamma isomer benzene hexachloride, plus 10 percent DDT, plus a high percentage of 325-mesh conditioned sulfur will give best control of stink bugs. Apply it at the rate of 30 pounds per acre per application.

If a spray is used, be certain to apply not less than 0.5 of a pound of gamma isomer benzene hexachloride per acre plus 2 pounds of technical DDT in 6 gallons of water.

Dieldrin in a 2 percent dust mixture, plus 10 percent DDT, plus 40 percent 325-mesh conditioned sulfur at 30 pounds per acre will give good control.

Also effective are:

A dieldrin spray containing $\frac{3}{8}$ pound of technical material plus 2 pounds of technical DDT per acre in 6 gallons of water.

A 15 percent toxaphene and 5 percent DDT plus 40 percent 325-mesh conditioned sulfur applied at the rate of 30 pounds per acre.

A mixture of 4 pounds of strobane plus 2 pounds DDT in 6 gallons of water per acre.

A spray using 4 pounds of technical toxaphene plus 2 pounds of technical DDT in 6 gallons of water per acre.

A spray of one pound of technical

thiodan in 6 gallons of water per acre.

For a quick kill, use one pound of methyl parathion in 6 gallons of water per acre.

Do not use DDT near alfalfa or other forage crops. (See page 6.)

APHIDS (LATE)

Late in the season the cotton plant, and especially the lint, may need protection from an infestation of the true cotton or melon aphid. This aphid feeds on the leaves and gives off a sticky honeydew that will stain the cotton lint.

When aphids first appear in late season they must be controlled at once if you wish to secure good protection.

CONTROL

Use demeton (Systox) at the rate of 4 ounces, or malathion at the rate of 1.0 pound, plus 2 pounds of DDT as sprays in 6 gallons of water per acre.

A dust of 5 percent malathion, plus 10 percent DDT, plus 40 percent 325 mesh conditioned sulfur is also effective.

Or use 0.5 pound of phosphamidon per acre in 6 gallons of water.

Note: DDT is added for bollworm control.

COTTON LEAFWORM

The cotton leafworm at times becomes a serious pest in Greenlee, Graham, Cochise, and parts of Pima and Santa Cruz counties. If not con-

trolled, it may destroy many squares and defoliate plants, thus reducing yields.

The plant should be protected from the cotton leafworm when the insects appear rather uniformly over a field.

CONTROL

Good plant protection has been obtained with a dust mixture of 15 percent toxaphene, plus 10 percent DDT, plus 40 percent 325 mesh conditioned sulfur applied at 30 pounds per acre.

A dust mixture of 2 percent gamma isomer BHC, plus 10 percent DDT, plus 40 percent 325 mesh conditioned sulfur at 25 pounds per acre is very effective.

A spray of 3 pounds of technical toxaphene, plus 1 pound of DDT in 6 gallons of water is effective.

If BHC spray is used, apply 0.5 pound gamma isomer plus 2 pounds of DDT in 6 gallons of water.

WHITEFLIES

Whitefly adults and nymphs have caused considerable alarm in recent years in Arizona.

CONTROL

The best control is to forget about these insects! If you are unduly alarmed, you can use 25 pounds of 5 percent malathion dust per acre.

A spray mixture of 0.4 pound of endrin plus 0.4 pound of methyl parathion in 6 gallons of water also is effective.

Presence of white flies is a symptom of stress, possibly a lack of water.

Tips On Airplane Application

TO FARMERS

Control of insects is big business. Why not treat it in that manner? You

are paying the crop duster to dust or spray your crop, so see that it is done correctly.

Before dusting or spraying, be sure

this activity will not affect livestock, livestock crops, bees, or dwellings nearby.

DO THESE THINGS

When applying insecticides by airplane, be sure to do the following:

1. Furnish competent flagmen in the field.
2. Furnish one person at the flying strip to insure proper loading.
3. Have prearranged signal with the airplane and ground crew, and flag the airplane out if the insecticide is not being applied *correctly* and on the right fields.
4. Become familiar with the Arizona Aircraft Applicators Law.
5. **Destroy all containers immediately after emptying.**

TO AIRPLANE APPLICATORS

Your job is to apply insecticides under best weather conditions. Know the hazards of the insecticide you are applying.

Remember that you are working for the farmer. The insecticide is his. The crop is his. So make the application

under his direction and not just the way you desire.

DO THESE THINGS

1. Have one man to assist the farmer's worker at the loading field.
 2. Be sure to know the location of the field and the insecticide you are to apply.
 3. Always follow the flagman. Have pre-arranged signals and if he flags to stop dusting or spraying, follow his request. He is paying for the service you are giving.
 4. Do not make swaths wider than the power of your plane will cover. Usually a swath by a 450 HP motored plane should not be over 50 feet in width for dust, and 35 feet in width for sprays.
 5. Become familiar with the Arizona Aircraft Applicators Law.
 6. **Destroy all containers immediately after emptying.**
 7. As an airplane pilot or loader, follow directions explicitly, especially when using phosphate insecticides.
- In many areas, the farmers and applicators sign contracts. Crop dusting or spraying is a business proposition; so why not follow business procedures?

Latest Research Progress Report

BOLLWORM VIRUS

The bollworm virus failed to control bollworms in three large scale experiments when used at the rate of 100 diseased larvae per acre. In a small, replicated plot experiment the bollworm virus failed to control bollworms even when used at the rate of 200 diseased larvae per acre.

AZODRIN

Azodrin at 1 pound per acre gave

excellent control of salt marsh caterpillar.

METHYL PARATHION

Methyl parathion used at the rate of one pound per acre gave commercial bollworm control when applied on a **4-day schedule**. A severe spider mite infestation resulted from these repeated applications.

BANOL

A 10 percent Banol dust at 30 pounds

per acre gave commercial control of bollworms. Spider mites developed to destructive numbers in the Banol plots.

LOW VOLUME SPRAYS

Technical malathion applied at 1 pint (1.25 pounds) per acre gave excellent control of lygus bugs and thrips, but accentuated bollworm infestations. Salt-marsh caterpillar infestations built up in a field which had received repeated applications of malathion.

Rothane, applied at the rate of 3 pounds per acre as a low volume spray, gave excellent control of bollworms but created a mite problem. Applying the 3 pounds of Rothane from a height of 6 feet above the cotton plants instead of the usual 20 feet resulted in a severe leaf drop which was caused by insecticide injury.

A low volume mixture of 1 pound malathion with 1 pound Rothane gave excellent lygus bug control but failed to control bollworms. Good bollworm control was obtained by doubling the application rate of the mixture. The LV (low volume) mixture of malathion-Rothane also created a spider mite problem.

A LV concentration of Dylox at 1 pound per acre gave excellent lygus bug control.

Naled (Dibrom) gave excellent control of lygus bugs when applied at the rate of 0.5 pounds per acre. Repeated applications resulted in severe leaf injury. Naled failed to control bollworms when applied as a low volume spray.

A low volume ground sprayer developed by the Chapman Chemical Company was effective in controlling lygus bugs and bollworms with a total spray volume of either 1.5 or 2 gallons per acre.

SYSTEMIC INSECTICIDES (GRANULES)

Soil applications of Union Carbide's 21149 (Temik) applied at 1 pound per acre in the seedbed, gave better thrips control than either Phorate or Disyston granules applied at the same rate.

Soil applications of Union Carbide's 21149 (Temik) side-dressed, in the first week of June, at the rate of 2.4 pounds per acre gave excellent control of lygus bugs and black fleahoppers. The predatory insect populations were also reduced. Disyston, Phorate, and Niagara's NIA-10242, when similarly applied, failed to control lygus bugs and black fleahoppers.

Experiments showed that when Phorate was applied along with the cotton seed by spacer-planter, effective thrips control was obtained with 25 percent of the commonly recommended dosage of 10 pounds of the 10 percent granules. The cotton seed was spaced 9 inches apart in the row and the granules were applied only in the seeded area.

3 GALLONS AERIAL APPLICATIONS

Good control of lygus bugs and bollworms was obtained when the insecticide was used in a spray volume of 3 gallons per acre instead of the conventional 5 gallons per acre. This also results in a saving for growers since lower volume applications cost less.

LIGHT TRAPS

Light traps again failed to control lygus bugs. In one experiment low volume malathion was used to control lygus bugs and bollworms built up in such large numbers that chemical controls were required.

PINK BOLLWORMS

Cage tests in a heavily infested field of growing cotton at Solomon showed that an average of 5500 moths emerged from the soil between September 15 and October 15. Cage tests showed that pink bollworm adults emerged in numbers until November 1 at Safford and until November 27 at Phoenix.

First instar larvae were observed in the field on November 15 near Phoenix, indicating that pink bollworms were in an active stage of growth at such a late date.

In Maricopa County heavy infestations were observed as early as July 5 in a number of "stub" fields. Damaging infestations were observed in "stub" fields by October 1.

Six insecticide applications applied to a heavily infested field between September 15 and October 15 significantly reduced the number of larvae per boll in the top crop.

This publication is issued by the Cooperative Extension Service and the Agricultural Experiment Station of The University of Arizona. See your local County Extension Agent for additional information.

SEE YOUR COUNTY AGENT

See your local County Extension Agent for additional information on controlling cotton insects, and for other information on agricultural and home-economics subjects. Ask for a copy of the following University of Arizona circulars on cotton:

Circular 223, "Diseases of Cotton."

Circular 249, "When You Buy or Build a Field Sprayer."

Circular 261, "Operating Field Dusters in Arizona."

Circular 274, "The Pink Bollworm in Arizona."

Bulletin A-1, "Chemical Weed Control Recommendations for Irrigated Areas."

Bulletin A-28, "Chemical Control of Annual Weeds in Cotton."

Bulletin A-17, "The Use of 2,4-D on Crops in Arizona."

Folder 82, "Sprayer Calibration."

Folder 97, "Soil and Petiole Analysis Can Pinpoint Cotton's Nitrogen Needs."

Also see Bulletin A-23, "Descriptions & Habits of Arizona Cotton Insects" to help identify both injurious and beneficial insects.

READ & HEED THE LABEL

Read the Label on the next page.



Always follow directions for safe use of insecticides. Note the term "active ingredients" on the label. It means the amount of **technical material** in each 100 pounds, or if liquid, the amount in each gallon of the concentrate material.



DANGER

Be careful at all times!

Read the Label

BRAND

P. 2

(A DUST CONTAINING PARATHION)

SUGGESTIONS FOR DUSTING

Almonds Apply 20 to 40 lbs. per acre,
Walnuts not later than 30 days before
crop to be planted

VEGETABLES OR CROPS GROWN FOR SEED*

Broccoli Apply 20 to 40 lbs. per acre,
Brussels Sprouts not more than two applica-
Cabbage tions. Do not apply after the
Cauliflower heads begin to form or with-
in 30 days of harvest, which-
ever is earliest.

*Restrictions not applicable to crops grown for seed.

Onions Apply 20 to 40 lbs. per acre,
Thrips not later than 30 days before harvest.
Apply 15 to 30 lbs. per acre.
Peas Do not apply after bloom.
Aphids
Consult your local Agricultural Authorities or State Experi-
ment Station for recommendations as to timing and number
of applications.

NET WEIGHT 50 LBS.

Active Ingredients:

Parathion* 2.0%
INERT INGREDIENTS 98.0%

100.0%

*O, O-diethyl O-p-nitrophenyl thiophosphate

Warning—EXTREMELY POISONOUS if swallowed or
inhaled or absorbed through the skin.

Rapidly absorbed through the skin.

Wear protective gloves, clothing and goggles.

Do not breathe dust or spray.

Wear a respirator or mask of a type passed by the U.S.
Dept. of Agriculture for parathion protection.

Keep away from feed or food products.

Wash hands, arms, and face after handling and before
eating or smoking.

Keep all persons out of the operating area or vicinity
where there may be danger of drift. Vacated areas
should not be re-entered until drifting insecticides and
volatile residues have dissipated.



Poison



First Aid Treatment: Call a physician immedi-
ately. Until he arrives, follow the directions
here given.

INTERNAL: If swallowed, make patient vomit by giving
warm salt water or soapy water. Administer milk or
water freely. Have patient lie down and keep warm.
Never give anything by mouth to an unconscious patient.

SKIN: Immediately remove all contaminated clothing
and flush skin with water for at least 15 minutes.

EYES: Immediately flush with water for at least 15
minutes.

NOTE TO PHYSICIANS ONLY: Therapeutic doses of
atropine appear to be effective as an antidote.

NOTICE TO USER: Chemical mixtures strong enough to be effective against insects involve the possibility of injury or damage to other animal or plant life with which they come in contact. Climatic, soil and other conditions beyond the manufacturer's control, moreover, will necessarily affect results in the use of this material. The manufacturer, therefore, makes no claims, representations or warranties, express or implied, as to the results to be obtained from the use of this material and will not be responsible for any damage to persons, crops, soil or other property arising from its use. The manufacturers only claim, representation or warranty is that the material conforms in content to the description on the label.

CARE SHOULD BE TAKEN TO REMOVE RESIDUE AT HARVEST TIME