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CONTROL OF COTTON INSECTS

Prepared by the Division of Cotton Insect Investigations

The control of injurious insects is an important factor in the profitable production of cotton. It is estimated that an average of 15 percent of the United States cotton crop, or one bale out of every seven, is destroyed by insects. Much of this loss could be prevented and the quality of lint improved by intelligent use of approved methods of control. Often the difference between insect control and no control means the difference between a substantial profit and a loss on a cotton crop. Growers, merchants, bankers, and others interested directly and indirectly in increased cotton production per acre should realize the importance of planning ahead to provide funds and supplies for insect control.

The boll weevil is the most notorious of the cotton pests and causes the greatest total damage, but other insects are at times injurious in all cotton-producing areas. Insects vary in abundance from year to year and from field to field, and it is necessary to determine which insects are present in damaging numbers before insecticides can be used properly. Applying insecticides when insects are not abundant enough to justify it is a waste of time and money, and not to use them when needed may mean the loss of the crop. Insecticides must be properly applied to get the highest degree of control and to conserve vital war materials. Many cultural practices are also of great value in reducing insect damage and should not be neglected, especially under war conditions. Proper cultural practices reduce the quantities of insecticides needed and at times enable growers to produce good crops without using other control measures.

Recommendations are given in this circular for the control of several of the important cotton insects. They are based on experimental work by the Bureau of Entomology and Plant Quarantine and State experiment stations and are suitable for a wide range of conditions in the Cotton Belt. When more than one insecticide or method of application is recommended, follow the recommendation of your State experiment station or use the remedy which experience has shown to be effective in your locality.

War conditions have limited the supply of certain insecticides, such as paris green. The use on cotton of derris and other insecticides contain-

ing rotenone is at present prohibited, as it is necessary to conserve the available supply for use on important food crops and for military purposes. Normal supplies of calcium arsenate, nicotine, and sulfur are expected to be available for 1942. Allotments of materials for dusting machinery are sufficient for the manufacture of a slightly larger number of machines and nearly twice the quantity of repair parts made in 1941. The situation with reference to insecticides and equipment may change materially almost from day to day, and cotton growers must be ready to resort to substitutes, some of which are suggested herein.

CULTURAL PRACTICES THAT HELP PREVENT INSECT DAMAGE

(1) Plant cotton on good land that has been well prepared.

(2) Use fertilizer as recommended for your community by the State experiment station.

(3) Select an early-maturing, disease-resisting variety, recommended for your section.

(4) Plant as early and space as closely as recommended by your nearest experiment station.

(5) Cultivate thoroughly and use timely farm practices.

BOLL WEEVIL CONTROL

(1) Stop all fruiting by plowing out, cutting, or grazing cotton stalks as early as possible before frost in the fall. This will reduce the weevils on next year's crop.

(2) Select fields as far as possible from the fields that were in cotton last year. It is also helpful to select fields in large cleared areas where the opportunities for boll weevils to hibernate are not good. Many weevils pass the winter in woods and other protected places close to the cotton fields in which they developed.

(3) The most practical direct method of control after boll weevils reach the fields is to protect the cotton with calcium arsenate dust during the time the plants are fruiting. As a general rule it will not pay to dust cotton growing on soil that is not capable of producing at least a third of a bale per acre if no boll weevils were present.

Presquare or Early-Season Treatment

(1) Early in the season, before squares are large enough for weevils to puncture, examine the plants for boll weevils. If weevils are found at the rate of 25 or more per acre, presquare poisoning may be used as a preliminary measure.

(2) For presquare poisoning calcium arsenate may be applied as a dust or as a liquid mixture with a mop or sprayer.

(3) Dust with 4 to 5 pounds of calcium arsenate per acre, or mix it with equal parts of lime, talc, clay, or sulfur and apply at the rate of 6 to 7 pounds of the mixture per acre.

(4) If no dusting machines are available, less satisfactory results can be obtained by shaking the calcium arsenate or the calcium arsenate dust mixtures on the plants from a can with small holes in it, or from a cloth bag.

(5) The mixture most generally used for mopping consists of 1 pound of calcium arsenate, 1 gallon of blackstrap molasses or sirup, and 1 gallon of water, applied at the rate of 2 to 3 gallons per acre with a homemade mop. Other liquid mixtures containing calcium arsenate are also used for mopping.

(6) Dust or mop every 5 or 6 days until 2 or 3 early applications have been made. By that time large squares or blooms will be present and treatments should be stopped until square examinations show that the weevils are abundant enough to require dusting.

Mopping with sweetened poison early in the season has been helpful in weevil control in some sections but of little value in other sections. In many experiments in South Carolina, extending over a 12-year period, the average returns were only slightly larger from midseason dusting preceded by early mopping than from dusting alone. Mopping alone did not give satisfactory weevil control, and in years when weevils were abundant there were severe losses where mopping alone was used. Mopping is an early-season treatment that may delay for a week or 10 days the time when dusting is needed for boll weevil control, but mopping alone does not give satisfactory control in summers when conditions are favorable for boll weevils.

Mid-Season Dusting for Boll Weevil Control

(1) After cotton begins to fruit, examine the squares once a week or oftener for weevil-punctured squares. To determine the percentage of weevil-injured squares, walk diagonally across the field and pick 100 squares from the plants. Select squares large enough for weevils to puncture (half grown or larger). Pull only 1 square from each plant and take about the same number from the top, the middle, and the bottom branches. Keep the squares until 100 have been pulled and then examine them carefully for egg and feeding punctures. The number of squares found punctured in 100 squares examined is the percentage of square infestation. In a large field the counts should be made in several places to determine which parts of the field should be dusted.

(2) Begin dusting with calcium arsenate when 10 to 25 percent of the squares are infested. On light soils, where the cotton does not grow rank and where it matures early, dusting should begin when 10 to 15 percent of the squares are infested. On fertile soils, where cotton continues growing and

fruiting until late in the season, it is safe and often more profitable to wait until 20 to 25 percent of the squares are infested, before dusting.

(3) Dust with 5 to 7 pounds of calcium arsenate per acre every 4 or 5 days until the weevils are brought under control or a crop of bolls is set.

(4) Repeat the application if the dust is washed off by rain within 24 hours. Three to five applications that remain on the plants will usually control the weevils and result in the setting of a crop. From one to three later dustings are sometimes needed to protect bolls from weevil damage.

(5) Dusting may be done at any time of day or night when the air is quiet. It is more important to dust when the air is calm or nearly so than when the plants are wet with dew.

(6) On the light sandy soils of the Southeastern States, use only as much calcium arsenate as necessary to give satisfactory boll weevil control, in order to reduce the danger of arsenic injury to the soil. 1/ For cotton growing on light sandy soils where soil injury may occur, a mixture of equal parts of calcium arsenate and slaked lime, talc, clay, or sulfur is recommended. The mixtures do not kill the weevils so quickly as does calcium arsenate alone, but when used at the rate of 7 to 10 pounds per acre they have given satisfactory control during years of average weevil abundance.

(7) When cotton flea hoppers, rapid plant bugs, tarnished plant bugs, or other sucking bugs are present with boll weevils, dusting with 12 to 15 pounds per acre of a mixture of 1 part of calcium arsenate and 2 parts of sulfur is recommended.

(8) Low winter temperatures and hot, dry summers help control the boll weevil. Watch for a rapid increase of weevils during rainy spells in the growing season. The largest gains and most profitable returns from dusting are obtained in years when weevils are most abundant. Dusting usually pays better in wet than in dry seasons.

COTTON APHIDS

Cotton aphids (plant lice) often occur in damaging numbers, especially following the use of arsenical insecticides. They reduce the yield and grade of cotton.

(1) Aphids can be held in check if nicotine is added to the calcium arsenate or other dusts used on cotton.

1/ No soil injury has been noted from the calcium arsenate used for boll weevil control on clay soils, red soils, or dark soils, but there has been some injury to light sandy soils. In most cases of soil injury that have been investigated, excessive quantities of calcium arsenate had been used.

(2) Adding 1 percent of nicotine to the calcium arsenate used for each dusting or adding 2 percent of nicotine to the calcium arsenate used for every other dusting are equally effective in preventing serious aphid infestations.

(3) Preventing aphids from becoming abundant is more profitable than controlling them after a heavy infestation has built up. However, if a heavy infestation develops it may be necessary to use a 3-percent nicotine dust or a spray to check it.

(4) Liquid nicotine sulfate containing 40 percent of nicotine can be mixed with calcium arsenate to make the 1-percent, 2-percent, or 3-percent nicotine dust by adding 1 quart, 2 quarts, or 3 quarts of nicotine sulfate to approximately 100 pounds of calcium arsenate. 2/

(5) If spraying machines are available, 1 quart of 40-percent nicotine sulfate in 100 gallons of water to which about 5 pounds of laundry soap has been added can be applied at the rate of 30 to 40 gallons per acre in place of the 3-percent nicotine dust.

(6) Best results are obtained from nicotine dusts or sprays applied for aphid control when the air is very quiet, the temperature high, and the plants dry.

BOLLWORM

The bollworm is also called the corn earworm and tomato fruit worm. The bollworm moths prefer rapidly growing succulent cotton on which to lay their eggs. Generally bollworms do not cause serious damage to cotton until comparatively late in the season, that is, about the time corn silks are drying out and after dusting for boll weevils is over. Each bollworm destroys a large number of squares and bolls, and when the worms are numerous a crop of cotton may be ruined in a short time. Damage often occurs so late in the season that the plants do not have time to mature another crop of bolls.

(1) When it is about time for bollworms to appear, examine the tips of the plants frequently for eggs and newly hatched worms. The eggs are about half the size of a pinhead and pearly white when first laid but change to a darker color before hatching. They are laid singly on the tender growth and squares. When 20 to 25 eggs that are beginning to hatch, or such a number of eggs and very small worms, are found per 100 plants, dusting should be started immediately. Small worms feed largely on the tender buds and leaves and the outside of squares for several days after hatching and can be controlled. Large worms feed mostly inside the bolls, and it is very difficult if not impossible to poison them.

2/ In a limited number of experiments a dust containing 10 percent of free nicotine has been used instead of the nicotine sulfate for mixing with calcium arsenate in making 1-percent and 2-percent nicotine dusts, with good results.

(2) Heavy dosages of dust properly applied when the eggs are beginning to hatch and before the worms enter the bolls is the secret of successful bollworm control.

(3) Dust with 8 to 10 pounds of calcium arsenate, lead arsenate, or cryolite per acre at 5-day intervals. Use more pounds per acre when the infestations are heavy and the plants large.

(4) Two or three applications will usually control a brood of bollworms. However, there may be more than one brood or a steady movement of egg-laying moths to cotton from other crops with no distinct broods. In such cases several additional applications may be needed to keep the plants covered with insecticides for killing the newly hatched worms.

(5) Arrange the dust nozzles with one over each row and a few inches above the cotton so that the tops of the plants will be well covered with dust.

(6) Ladybird beetles and other natural enemies and extremely hot, dry, and windy weather often destroy large numbers of eggs and young bollworms and control threatening infestations without the use of insecticides.

(7) Sometimes the normal destruction of aphids, bollworm eggs, and small bollworms by natural enemies is upset by the use of arsenicals, with the result that increased aphid and bollworm populations follow. However, this complication that occurs at times should not discourage the proper use of the control measures recommended for various insects.

COTTON FLEA HOPPER

The cotton flea hopper occurs over the entire Cotton Belt but causes the most damage in Texas, Oklahoma, and Louisiana. Severe damage from this pest also occurs at times in other areas. The flea hoppers feed mostly on the growing tips and very small squares of young cotton. Injured squares turn brown or black and are shed when they are very small, often no larger than a pinhead.

(1) If cotton is not squaring properly or if young cotton fails to "set" the small squares, examine the tips of the main stem (terminal buds) of the plants for flea hoppers. Begin dusting when 15 to 25 flea hoppers (the number depending upon the size of the plant) are found per 100 terminal buds.

(2) Dust with 12 to 18 pounds of finely ground dusting sulfur (325-mesh or finer), or with 12 to 15 pounds of a mixture of 2 parts of sulfur and 1 part of calcium arsenate, per acre. Sulfur alone is satisfactory for young flea hoppers (wingless nymphs), but the sulfur-calcium arsenate mixture gives a better kill of the winged adults and will also control the boll weevil when both insects are present.

(3) Two or three applications at 5- to 7-day intervals will ordinarily give control, but where the infestation is heavy or large numbers of flea hoppers are continually moving into the cotton, from four to six dustings are sometimes needed.

(4) Often 2 or more weeks must elapse after flea hoppers are killed before the plants recover and squares again become noticeable.

(5) The rapid plant bug and the tarnished plant bug resemble the cotton flea hopper but are larger and cause more damage per insect. Their injury to cotton is similar to, and is sometimes mistaken for, that caused by the flea hopper, but they also cause the shedding of large squares and bolls. These insects are widely distributed, and if they are present in injurious numbers, the sulfur-calcium arsenate mixture recommended for flea hopper control should be used.

COTTON LEAF WORM

Early outbreaks of the cotton leaf worm, which strip the leaves from the plants before most of the bolls harden, require control. Late infestations, after the crop is nearly mature, cause little damage and are sometimes helpful by destroying the food for boll weevils late in the season, thus reducing the number of weevils that survive the winter and enter the cotton fields the following spring.

(1) Small to half-grown leaf worms are easily killed by any of the arsenical insecticides. Large worms are harder to kill and when numerous they cause serious "ragging" or completely strip the plants unless controlled promptly.

(2) Dusting with calcium arsenate as for boll weevils or bollworms will keep the leaf worms under control. Lead arsenate as a spray at the rate of 4 to 6 pounds in 50 gallons of water for about 3 acres, or as a dust at 5 to 6 pounds per acre, is also satisfactory. If a quick kill of large worms is needed to prevent stripping, add 7 to 8 pounds of paris green to each 100 pounds of calcium arsenate, or use 8 to 10 pounds of paris green mixed with 100 pounds of lime. Other arsenicals are also effective. White arsenic mixed with lime is sometimes used by growers, but is not recommended, as it is apt to burn the plants. Cryolite is not so effective against leaf worms as arsenical poisons.

DUSTING MACHINERY

For dusting cotton no method of application has been found that is so satisfactory as properly designed dusting machines. There are dusting machines varying in size from small hand guns to large power dusters and airplane dusters. The type and size of machine needed for different acreages are discussed in Farmers' Bulletin 1729, Machinery for Dusting Cotton, which may be obtained free from the United States Department of Agriculture,

Washington, D. C. If you are planning for cotton insect control, sufficient dusting machines should be available to dust the entire acreage every 4 or 5 days, with due allowance for unfavorable weather and breakdowns. The demands for war materials have restricted the manufacture of dusting machinery, and growers should order parts early to repair their dusting machines before the dusting season begins.

Machines with one nozzle for each row to be dusted are recommended. "Side delivery" or "broadcast" dusters do not give an even distribution, are wasteful of dusts, and are not recommended for the control of cotton insects. The nozzle should be directly over the row and slightly above the tops when the plants are wet, or touching the tops when the plants are dry. Most machines tend to put out more dust than is needed for small cotton. It is not necessary to "whitewash" the plants to secure good coverage.

Time of Day to Dust

In the past the Bureau has recommended dusting for boll weevil control when the plants are wet with dew and the air is calm. This has usually limited to the late afternoon, night, and early morning the hours during which dusting could be done, and has reduced the acreage that a machine could dust. Tests over a 6-year period at Tallulah, La., have shown that the average gains from cotton dusted during the middle of the day for weevil control were as large as from cotton dusted in the early morning. Gains from the late afternoon dusting (between 6 and 7:30 p.m.) were practically as good as from the early morning or midday applications. Experiments in Texas have shown that sulfur and sulfur-arsenical mixtures can also be satisfactorily applied for flea hoppers when the plants are dry, although better results were obtained when the plants were wet with dew. Dusting should not be done when there is enough breeze to cause any considerable drifting of dust beyond 3 or 4 rows, but it can be done at any time of day or night when the air is quiet, regardless of whether there is dew on the plants. Dust mixtures containing nicotine give best results during a hot, calm period of the day when the plants are dry.

MIXING INSECTICIDES

Dusting Mixtures

Calcium arsenate and sulfur mixtures are sold by many insecticide dealers, and in some localities calcium arsenate-nicotine mixtures can be obtained ready mixed. The nicotine mixtures tend to lose their strength after standing for some time and should be mixed during the year they are to be used. In closed steel calcium arsenate drums they can be safely kept for at least a dusting season. If factory-mixed dusts are not readily obtainable, the dusts can be made on the farm in a mixer such as is used on many farms for treating cottonseed; or a homemade mixer that will hold 100 pounds of dust can be made from a 50-gallon barrel fitted with supports and a crank. In mixing insecticides, from 40 to 50 pounds of stones about the size of eggs should be placed with 100 pounds of dust and the mixer turned slowly for at least 5 minutes to insure uniform mixing. Another method of

mixing insecticides is to roll the barrel on the ground. This can be done by making a mule-drawn frame sled so arranged that the barrel fits into the opening between the runners and is held by cross pieces so as to allow it to roll on the ground. The stones and lumps should, of course, be carefully screened out before the mixture is placed in the dusting machine.

Nicotine fumes are irritating and cause nausea when inhaled in quantities. Mixing should be done out of doors or in an open room or shed. Keep to the windward side when filling or emptying the mixer and dust guns.

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