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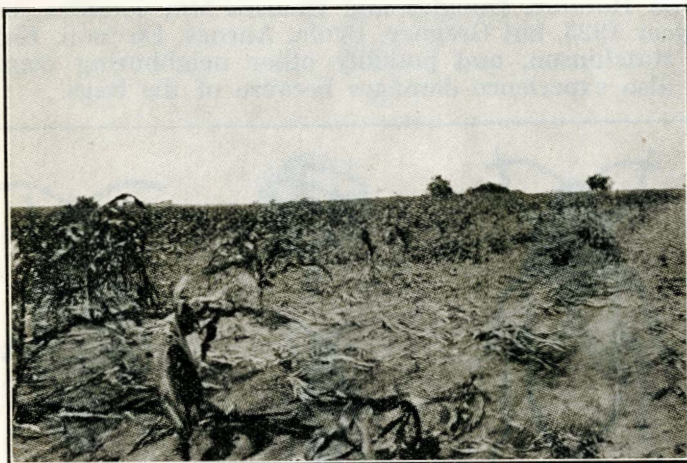
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# THE CHINCH BUG

H. C. SEVERIN



**Cornfield in Charles Mix county, South Dakota, injured by chinch bugs. The bugs migrated from a harvested barley field into the corn. When this picture was taken, the bugs had attacked and killed only the outermost rows of corn.**

**AGRICULTURAL EXPERIMENT STATION  
SOUTH DAKOTA STATE COLLEGE OF  
AGRICULTURE AND MECHANIC ARTS**

**Brookings, South Dakota**

## INTRODUCTION

Chinch bugs\* are distributed over a large portion of the eastern half of South Dakota, but it is only during exceptional years that the bugs increase in such large numbers as to become seriously harmful. During the past 14 years in which the writer has been a resident of South Dakota, chinch bugs have been troublesome only during the years 1921 and 1922. The area that was overrun by the pest during these two years included portions of Bon Homme, Douglas and Charles Mix counties. Before the bugs went into hibernation in the fall of the year 1922, there was a dissemination of the pest over a large area. As a consequence, not only is there danger of a chinch bug outbreak in Bon Homme, Douglas and Charles Mix counties during the year 1923, but Gregory, Brule, Aurora, Davison, Hanson and Hutchinson, and possibly other neighboring counties, may also experience damages because of the bugs.

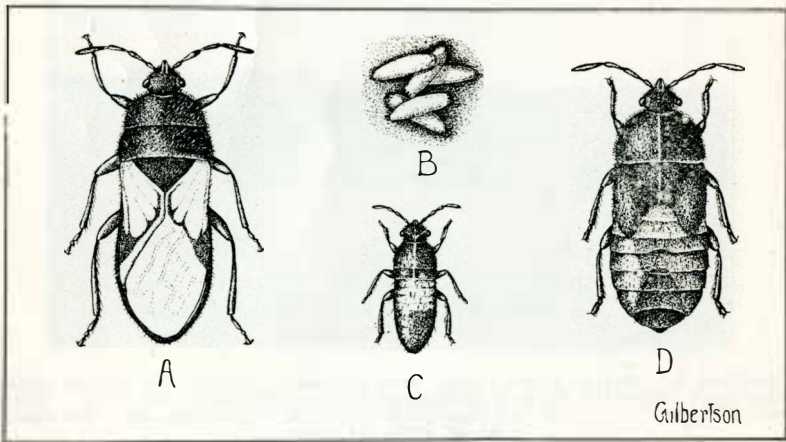


Fig. 1.—Life cycle of chinch bug: A, adult female; B, eggs; C, nymph of first stage; D, nymph of last stage. A, C, D, enlarged 9 times; B, enlarged 12 times.—Original.

## DESCRIPTION OF STAGES

The chinch bug passes through several distinct stages before completing its life cycle. These in the order of their sequence are the egg, the five nymphal stages and the adult (Fig. 1, B, C, D, A).

The adult chinch bug is a small, oval, 4-winged insect measuring one-fifth of an inch or less in length and about

\**Blissus leucopterus* Say.

one-twentieth of an inch in breadth. The body (including the head, thorax and abdomen) is black, while the legs and the base of the feelers (antennae) are reddish brown. During 1921, slightly more than 99 percent of the adult chinch bugs in South Dakota possessed wings that covered the entire abdomen, while the remainder of the bugs had such short wings that these did not cover more than the base of the abdomen. The long winged bugs are capable of flying long distances, but the short winged forms are unable to fly at all. When the wings are not used for flying purposes they are folded flat over the back, the first pair covering the second (Fig. 1, A). The first pair of wings are heavier than the second and are milky-white in color except for some black markings, the size and location of which are indicated in Figure 1. The second pair of wings are delicate, iridescent structures without any black markings whatever.

The eggs (Fig. 1, B) are minute, slightly curved, oval bodies measuring about one thirty-second of an inch in length. They are rounded at one end and cut off square at the other. Three to five minute projections are attached to the truncate end of each egg, but these projections are visible only when the egg is examined with a magnifying instrument. When the eggs are first laid they are opaque and white in color, but as the young nymphs develop within them, the color changes to an amber and then to a deep red.

The young chinch bug that hatches from the egg is said to be in the first nymphal stage. It now has the following general appearance: Length, .04 inch; head, brown; eyes, dark red; antennae, dusky; division of thorax next to head, brown; remainder of thorax, pale except for small patches which are brown; legs, pale; abdomen, pale yellow at base, light red over middle portion and black at tip.

Through a molting process the nymphs pass through a second, third, fourth and fifth stage. During each molt the firm covering of the body, of the legs, of the antennae, etc., is shed. This permits the body and appendages to grow and develop and take on a different coloration.

The second stage differs from the first principally because of its larger size. In addition to this, the spots on the thorax and abdomen have become larger and the red color of the abdomen deeper.

In the third stage the bugs have increased in size and now the free ends of the antennae are black, the entire thorax is dark brown and the abdomen is mottled with two shades of red. The spots on the abdomen which were

present in the nymphs of the second stage have increased in size and wing pads are just beginning to make their appearance on the thorax.

The bugs of the fourth stage are slightly larger than those of the third, the head and thorax are brownish black, the wing pads have increased in size so that they are quite conspicuous and the red portion of the abdomen has become much darker in appearance. The dark spots on the abdomen have also increased in size.

In their fifth and last nymphal stage, the chinch bugs measure about one-sixth of an inch in length. They differ from the insects of the fourth stage chiefly in their larger size, in their larger wing pads and in the darker coloration of the body. The wing pads now cover nearly all of the basal part of the abdomen, a portion which in former stages was very conspicuous because of its pale yellowish-white color. The head and thorax are black as is also the tip of the abdomen. The remainder of the abdomen is colored a very dark red except for three velvety black areas.

#### LIFE CYCLE AND HABITS

In the fall of each year, chinch bugs may be found in all stages, in the egg, in the five nymphal stages and in the adult. Upon the approach of cold weather, the nymphs and adults crawl into sheltered nooks and here they remain until the weather warms up. Should the weather become sufficiently warm again in the fall, the bugs may feed and even come out to exercise and sun themselves, but if the weather remains cold, the insects hibernate until spring.

Upon the approach of cold weather, the great mass of the bugs seek shelter in the mold at the base of bunch grass growing in the field. Many thousands may also make their way into and under the matting of grasses along the edges of fields, groves, windbreaks or hedges. Some crawl in and under shocks of corn, between the leaves and stems of standing or shocked corn, beneath the husks of corn, under leaves, boards, stones and rubbish lying on the ground, under dry pieces of manure, etc.

The bugs remain in their places of shelter over winter, but with the advent of warm weather in the spring, those bugs that are alive come out of their hibernating quarters and seek food. It is surprising that only a small fraction of one percent of nymphs are able to endure the rigors of winter, the remainder of the live specimens being adults. So far as our present knowledge goes, the eggs do not seem to be able to survive the winter.

The bugs do not all come out of their hibernating quarters on the first warm day of spring, but the spring emergence may continue for a month or more. The distance over which the bugs fly in search of food and later in search of favorable fields in which to lay their eggs may be many miles, but should an attractive field be in the close vicinity of their hibernating quarters they settle in this field in large numbers. Ordinarily, fields of winter wheat and winter rye are in a condition to attract the bugs at this time, but later, spring wheat and barley become inviting. If such plants are not available, then certain other grass plants are sought.

The eggs of the overwintering bugs may be deposited in a variety of different places. They may be laid on the surface of the ground near plants, they may be laid in cracks in the ground near the roots of plants, or they may be glued directly to the plants. If the eggs are deposited upon a plant, they may be glued to the roots, stems or leaves. A female chinch bug may lay eggs over a period of two months and during this time she may have produced between 100 and 200 eggs. However, shortly after the egg-laying period is over, the bug dies. In South Dakota most of the eggs of the hibernating bugs are deposited during May and June.

The incubation period of the eggs depends upon the prevailing temperature, as short a period as 10 days being sufficient for this purpose during hot weather, while a month or more may be required during cool weather. The young nymphs that hatch from the eggs have been described in a preceding paragraph. They are active creatures and if they are not already in touch with their food plants they quickly make their way to them. They feed by sucking out the sap. The nymphs grow and pass through the remainder of their nymphal life and then become adults. As short a time as 60 days may be used by a chinch bug in passing through its egg and nymphal development, but, on the other hand, as long a period as 100 days may be needed for this purpose. This variation may be due to different temperature and moisture conditions to which the bugs are exposed, to a difference in the availability of choice food, to individual variation, etc.

At the time when wheat, rye and barley are ready to be cut, ordinarily but a small percentage of the bugs of the first generation have reached maturity. Many of the bugs are in their last nymphal stage, while others are still younger, or even in the egg stage. Should the grain be cut now and should there be a lack of green grass in the fields, the

bugs migrate and seek food elsewhere. If, however, there is available an abundance of pigeon grass, foxtail, witch grass, barnyard grass or other grass that may be used as food, then the young chinch bugs may remain in the cut-over fields until they become adult. The migrating bugs make their way into neighboring fields of corn, sorghum, millet, grass, etc., on foot, but should the long winged adults meet with an obstruction at this time, they may fly.

During the chinch bug outbreak of 1921 and 1922, most of the first brood of bugs became mature during the last half of July and early in August. Some of these insects became adult in fields of small grain, while others became mature in corn and sorghum fields which they invaded when the fields of small grain were harvested. Still others migrated into native prairie land and acquired maturity there. Those bugs that found their way into corn and sorghum laid their eggs either on corn or sorghum plants or upon suitable grasses growing in these fields or they deposited their eggs on or in the ground close to these plants. Some of these eggs were laid so late that cold weather overtook them and they never hatched; others, on the other hand, hatched and gave rise to another brood of young chinch bugs. Many of these young were able to complete their growth and become adults before cold weather set in, but others were in the first, second, third, fourth or fifth instar when they were forced to seek hibernating quarters.

Thus it is seen that in South Dakota there is produced one complete and in addition one partial generation of chinch bugs per year. Only the adults and a few nymphs of the partial second generation of bugs are able to survive the winter.

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### INJURY DONE BY CHINCH BUGS

Chinch bugs injure plants by sucking out the sap. This they do through four, fine, needle-like structures located in a beak attached to the head and held underneath the body when it is not in use. These needle-like parts are firm enough to penetrate plant tissue and they may be locked together to form a tube through which sap may be sucked into the food tube. Each time a chinch bug feeds upon a plant, sap is withdrawn, and tissue is destroyed. The damage which a single bug does is negligible, but when the insects occur by the hundreds upon a single plant, the damage soon results in the death of that plant (see frontispiece).

In South Dakota chinch bugs have been most harmful

to wheat, barley, rye, corn and sorghum. The insects also attack millet, speltz, timothy, bluegrass and many of our wild grasses. Strange as it may seem, oats do not suffer nearly as much as do wheat, barley or rye.

The injury which chinch bugs do to wheat, rye, barley, corn or sorghum is directly proportional to the number of bugs which attack these crops. With the small grains the injury is frequently not noticed until harvest, for the insects may be evenly distributed throughout the fields. However, at harvest time, as the plants begin to dry, the bugs begin to become more conspicuous, for then they are forced to feed at the nodes and near the heads where the plants tend to remain green a longer time. If the bugs are very numerous in the grain fields, the plants are killed off when they are still small or they are stunted and the heads whiten prematurely and fill only partially or not at all.

When the fields of small grain are harvested the bugs are usually forced to leave such fields and they then migrate into adjoining corn and sorghum. Such migration takes place almost wholly on foot, the bugs concentrating in immense numbers upon the first corn or sorghum plant that they meet. As a consequence the outermost rows of corn or sorghum may become covered with the bugs. Such plants are soon drained of their sap and completely killed. The bugs then move forward row by row, destroying the plants as they go (see frontispiece). However, before the entire field of corn or sorghum is destroyed, most of the bugs may become mature. These bugs fly about and scatter over wide areas and then lay eggs. From these eggs another brood of young hatch. Since the bugs are not so concentrated now and since the corn and sorghum is growing larger day by day, less injury is suffered by the plants. Heavy rains at this time may also kill off large numbers of the bugs.

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#### CONDITIONS FAVORABLE TO CHINCH BUG OUTBREAKS

The principal conditions that favor a chinch bug outbreak are the following:

- (1) The presence of a large number of choice food plants;
- (2) The presence of suitable hibernating quarters;
- (3) The absence of natural enemies;
- (4) The occurrence of warm, dry weather extended over a large portion of the hatching period of the first and second generation of eggs.



The first condition is always to be found existing in South Dakota. Winter wheat and rye and spring wheat and barley furnish the bugs with a bountiful food supply early in the spring while corn and sorghum are available to the bugs when the small grains are harvested. Such a combination of plants is much more favorable to an enormous increase in the numbers of chinch bugs than are the native prairie grasses upon which the bugs may also feed.

The second condition, the presence of suitable hibernating quarters, always prevails in South Dakota. The large amount of native prairie grass furnishes a wonderful protection in which the bugs may pass the winter. This coupled with the fact that not a very large amount of our native prairie grasses are burned over during any one year furnishes the bugs with ideal winter quarters.

The natural enemies of chinch bugs are quite numerous in South Dakota, but it would be only under exceptional circumstances when they would increase in such large numbers as to suppress a chinch bug outbreak.

Warm, dry weather extended over a large portion of the hatching period of the eggs of chinch bugs is essential if the pest is to increase in large numbers. Such weather conditions prevailed in the southern part of our state during the past two years. On the other hand, had the weather been humid during the hatching periods of the eggs and had this been accompanied by a series of driving, drenching rains, then a serious outbreak of chinch bugs would probably have been prevented.

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### CONTROL OF CHINCH BUGS THROUGH NATURAL ENEMIES

With the exception of an egg parasite,<sup>1</sup> the chinch bug does not have an animal enemy which is able to play an important part in suppressing a serious outbreak of these insects. It is true that several species of insects feed upon chinch bugs in one or another stage of their existence and that toads and several species of birds also eat them, but the egg parasite does more efficient work from the standpoint of control than do all the rest of the animal enemies combined. And yet the egg parasite referred to destroys less than 50 percent of the eggs of chinch bugs except under very favorable circumstances.

The most efficient plant enemy of chinch bugs is the chinch bug fungus.<sup>2</sup> This organism attacks and destroys

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<sup>1</sup>*Eumicrosoma benefica* Gahan.

<sup>2</sup>*Beauveria globulifera* (Speg.) Picard.

both the immature and adult bugs, as well as a large number of other insects. But it is only during cool, wet seasons that the fungus thrives and at such times it attacks and destroys an enormous number of chinch bugs. Because of its economic importance, the fungus has been experimented with considerably for the purpose of learning whether or not it would be possible to propagate the disease organism artificially and then scatter it amongst the chinch bugs of a region and thus destroy them. It was learned, however, that it was worth neither the time nor energy to sow the fungus throughout such areas, because the disease occurs naturally in all regions where conditions are favorable for its survival and that it only awaits favorable weather to develop. In regions where it is not found, its introduction would have no effect, for here weather conditions would not tolerate its survival.

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### CONTROL OF CHINCH BUGS BY MAN

Chinch bugs may be most effectively combatted either by burning the cover in which they are hibernating or by killing them as they are migrating from wheat, barley or rye into neighboring fields of corn or sorghum. Additional methods of control should be adopted, but these should be looked upon as supplementary to those already mentioned. The most important of the supplementary methods of control are the following:

(1) Spraying or scorching the outermost rows of corn or sorghum into which the bugs have made their way from the cut-over grain fields.

(2) So far as possible, growing crops that are immune from chinch bug injury and planning an arrangement of all crops to avoid chinch bug losses.

(3) Destroying the bugs through the aid of trap crops into which the bugs are enticed and later killed.

(4) Destroying the bugs in the cut-over grain fields by plowing, harrowing and rolling.

#### Destruction of the Pest by Burning

A farmer who has been troubled with chinch bugs during the year should find out in November or December whether or not his premises are infested with the hibernating pests. All representative areas liable to harbor chinch bugs should be examined. Bunch grass from several different areas in the fields should be pulled up and picked apart over a piece of white paper or cloth. If chinch bugs are present in numbers they should be readily seen as they drop

upon the white background. The grass-covered edges of all fields should likewise be examined. From such areas a quantity of matted dead grass and loam should be removed and picked apart over a white paper or cloth. Now, again, if bugs are present in numbers, they should be readily noticed. The grass and leaf-covered edges of groves, wind-breaks and hedges should be investigated for the presence of chinch bugs, as should also shocked and uncut corn in the field, rubbish lying on the ground, etc.

If bugs have been found in abundance, then it should be planned to burn over the areas in which they are found if it is at all possible to do so. The type of fire that will be most effective in destroying the pests is one that will burn bunch grass within one inch of the crown. A moderately windy day in November or December should be chosen for burning and in addition the vegetation should be as dry as possible.

The effect of burning over the hibernating quarters of the bugs is two-fold. First it kills many of the bugs through heat, and, second, it removes the protective cover of such bugs as are not killed, thus exposing them to quick changes in temperature, moisture, etc. If a good burn is obtained during November or December, 90 or even 100 percent of the bugs in the burned-over areas may be dead by spring.

All rubbish should be removed from the farm early in winter, while corn either shocked or uncut should be disposed of before spring opens up. In South Dakota it is highly probable that only a small percent of the bugs that attempt to hibernate in corn ever survive the winter, but by disposing of the corn at the proper time no risk is run of any of these bugs being alive in the spring.

To get the best results from a burning and clean-up campaign, cooperation between the farmers of a community should be practiced. If such cooperation does not exist the good work done by many individuals may be neutralized by the negligence of a few.

#### **Destruction of Chinch Bugs with the Aid of Barriers**

When a field of small grain is infested with chinch bugs, nothing practicable can be done to prevent injury to this crop. It is advisable to cut such grain as early as possible and thus stop further drain upon the plants and in addition force the bugs, while most of them are still wingless, to migrate in search of other food. These immature bugs may be prevented from entering neighboring fields of corn and sorghum by proper barriers, and through the help of these same barriers, the pests may be destroyed. Should

the grain be thin and weedy, merely cutting the grain may not remove sufficient food to force all of the bugs to migrate immediately. On such occasions the stubble and weeds should be plowed under to a depth of seven inches and then the field should be harrowed and rolled. If the grain is ripening so slowly that it cannot be cut before many of the chinch bugs have become winged, such bugs if they are of the long winged type cannot be stopped through barriers, for they readily fly over them.

Two types of barriers are in common use, the dust barrier for dry weather and an oil barrier for wet weather. The dust barrier should be constructed before the small grain is cut and all necessary materials to be used for the destruction of the bugs should be on hand. As a matter of precaution, everything should be in readiness to lay down an oil barrier in addition to the dust barrier should rainy weather occur.

#### THE CONSTRUCTION AND USE OF DRY WEATHER BARRIERS

A dry weather barrier consists essentially of one or preferably two dusty furrows that are constructed between a field that is overrun with chinch bugs and one that is to be protected from the pests should they attempt to migrate into it. As a preliminary process to the construction of the furrows, a strip of land six to ten feet wide should be plowed along the edge of the field that is to receive protection. This strip should then be disked and harrowed until the ground is as nearly dust-like as it is possible to make it. Any additional contrivance that will bring about this condition of the soil in a shorter time should be used.

If one furrow is to be constructed, a log eight to ten inches in diameter and about four feet long, or better yet a triangular wooden trough rounded at the front end and heavily laden with rock or bags of sand, earth, etc., should be dragged lengthwise back and forth through the pulverized soil. The trough may be made by spiking a plank 2 by 12 inches by 5 feet to the edge of another 2 by 14 inches by 5 feet. The top of the trough should be strengthened by nailing a short 2 by 4 across each end. Both of these planks should have had one of their ends rounded off before they were nailed together.

If two furrows are to be constructed, they may be made by running a pair of logs or troughs through the soil. By means of 2x6's the logs or troughs should be fastened together so that they are parallel and at least 12 inches apart. Short boards may be nailed to the top of the troughs or logs and these boards may serve as a platform upon which the driver may ride.

The migrating chinch bugs in attempting to make their way into the protected field of corn or sorghum, meet the barriers prepared to check their advance. As soon as the bugs crawl upon the loose, dust-like soil of the first furrow they lose their footing and tumble down the inclined side. The bugs now crawl along the bottom of the furrow or they attempt to climb up and out of the furrow, but as long as the sides remain dusty and free from straw, etc., they are unable to reach the top. As more and more bugs make their way into the furrows and as they are all pulling down particles of dust in their attempts to climb the dusty wall, sooner or later the slope of the wall will be lessened here and there and over these areas the bugs will be able to make their way out. Consequently it will be necessary to watch the barrier when the bugs are moving and to touch it up with a hoe now and then.

When the pests are in the dusty furrow and if the ground becomes exceedingly hot, many of the bugs will perish without any further work on the part of the farmer. However, it is advisable not to rely upon the heat of the sun to accomplish this but to use one of the methods discussed in the following paragraphs to bring this about.

After the bugs are in the furrow the best method of killing them is to scorch them with a gasoline or kerosene blast torch. The best torches to use are those which throw a flame 8 to 10 inches long and whose flame is not blown out in a moderate wind. Usually one torch is sufficient to destroy the bugs in a furrow a mile in length, but should the run of bugs become especially heavy, then an additional torch may be necessary. Ordinarily chinch bugs migrate from three to seven o'clock in the afternoon, but when the weather is cool or cloudy or both, migration may take place during the entire afternoon and even forenoon. Torches should be in operation during the entire time when the bugs are migrating.

Instead of using a blast torch to kill off the bugs in a furrow, some farmers make it a practice to drag a log or trough back and forth through that furrow to destroy the insects. The principal objection to this method of control lies in the fact that many of the bugs, instead of being crushed, are brushed out of the furrow and these then may be free to enter the corn or sorghum unless an additional barrier is used to trap them.

If neither of the methods discussed are used to destroy the migrating chinch bugs, then the post hole system of trapping them should be adopted. In this method, post holes 18 inches deep and 20 to 35 feet apart should be dug

in the bottom of the furrows. The tops of these holes should be flaring and kept dusted in order that the insects that reach these holes may lose their footing and drop into them. The bugs trapped in the holes should be killed each evening by pouring kerosene upon them or by crushing them.

The length of time that it will be necessary to maintain and watch the barriers will depend upon the amount of food material that is permitted to remain in the fields from which the insects are migrating. If such fields are plowed and harrowed, the migration will be over in a week, but if grasses are permitted to grow after the grain has been harvested, then the migration may continue for three weeks or longer.

As long as the migration continues, the furrows should be dragged daily shortly after dinner. If post holes are used in connection with the furrows, it will be necessary to clean out the post holes after the dragging has taken place and to make their edges flaring and dusty.

#### THE CONSTRUCTION AND USE OF WET WEATHER BARRIERS

If the soil is such that an efficient dust barrier cannot be maintained or if a light shower or heavy rain occurs, then the farmers must be ready to put a wet weather barrier into operation. Such a barrier should be placed next to the field that is to be protected and should consist of a line of oil that the insects cannot or will not cross. The most efficient oil barriers that can be used, according to W. P. Flint, entomologist of the State of Illinois, are the creosote barrier, the coal-tar barrier, the road-oil barrier, and the kerosene and salt or kerosene and limestone barriers.

**Creosote barrier:** Of the four barriers mentioned, the creosote barrier is the most satisfactory. It is formed by running a small stream of creosote along a strip of compact level soil or preferably along the crest of a ridge of compact soil. An excellent compact level strip of soil may be made with a hoe or by dragging a heavy log, weighted plank, or clod crusher over the ground. A satisfactory compact ridge of ground may be made by plowing a back furrow and then dragging over this an inverted heavy trough made of planks. The front end of this trough should be rounded off. The creosote should be applied to the ground in a stream having a diameter of a six penny nail. This may be done with a sprinkling can, the rose of which has been removed and the spout closed with a wooden plug of the proper size. Creosote acts as a barrier to chinch bugs because of its odor, but since this odor becomes weaker and weaker with time, it is necessary that a fresh application

of oil be made at about one o'clock each day. Care should be exercised to direct all additional streams of creosote along the same path. On an average, 50 gallons of creosote should maintain a barrier one-half mile long for a week.

**Road-oil and coal-tar barriers:** The effectiveness of these oils as barriers to chinch bugs depends largely on their sticky character. They should be applied only to hard, compact, level ground, but the diameter of the stream that is used should be at least that of a 10 penny nail. A fresh application of these oils must be made whenever the barrier is no longer effective, which under ordinary circumstances will be twice per day. As with the creosote, each fresh application should be made along the same path. In general, 100 gallons of road-oil or coal-tar should be sufficient to maintain a barrier one-half mile long for a week.

Flint of Illinois found that the most satisfactory road-oil was Number 7 Oklahoma oil containing 70 percent asphalt. Road-oil containing a smaller percent of asphalt dries out too quickly and consequently cannot be recommended.

**Kerosene and salt or kerosene and limestone barriers:** Barriers made of kerosene and salt or kerosene and limestone are effective when used against migrating chinch bugs. The salt or limestone should be put out in a continuous narrow line and should then be moistened with kerosene. The directions which were given for constructing the creosote barrier are also applicable here and need not be repeated. The advantages of using the kerosene and salt or kerosene and limestone barriers rest in the fact that the materials are always obtainable. The disadvantages are that the kerosene evaporates rather quickly, thus necessitating two or three applications of the oil daily. The salt is dissolved and washed away through a rain, while the kerosene may also be carried away.

The bugs which mass up against any of the oil barriers should be destroyed by scorching them with a torch as already described in connection with the use of dust barriers. Immediately after this has been done the barrier should be renewed.

#### **Destroying the Bugs on the Outermost Rows of Corn and Sorghum**

If some of the migrating chinch bugs have made their way into a few of the outermost rows of corn in spite of the barriers or before the barriers were thrown across their path, then two possibilities of destroying these bugs are open to the farmers. One is to spray the infested plants and the other is to destroy them with a gasoline torch.

If spraying is to be adopted, then the plants should be drenched early in the morning or late in the afternoon with one of the following sprays:

Black leaf 40 .....	½ pint
Soap .....	2 pounds
Water .....	50 gallons

or

Laundry Soap .....	8 pounds
Water .....	50 gallons

or

Kerosene Emulsion.....	3 parts of the stock
Water .....	17 parts

These sprays may injure the corn plants, but it is better that this should occur than to permit the bugs to work far into the field.

If neither a blast torch nor a system of spraying is adopted to kill off the bugs in the outermost rows of corn, then a system of dry or wet weather barriers should be constructed immediately between the infested and uninfested corn.

### GROWING IMMUNE CROPS AND PLANNING A PROPER ARRANGEMENT OF CROPS

Only plants of the grass family are injured by chinch bugs, while such crops as clover, alfalfas, soybeans, cowpeas, peas, beans, potatoes, flax, beets, sunflowers and rape are immune or practically immune from the attacks of this pest. Consequently such crops should be grown as largely as possible in place of wheat, barley and rye. Further, the arrangement of crops on a farm during a threatening chinch bug outbreak should be such that an immune crop is grown between corn and sorghum on the one hand and small grains such as wheat, barley and rye on the other.

#### Destruction of the Bugs Through the Aid of a Trap Crop

A trap crop such as millet may be planted between wheat, barley or rye on the one hand and corn or sorghum on the other, with the purpose of enticing the migrating chinch bugs into it when the small grain is cut. The millet should be sown early enough so that it will have made a growth of at least six to ten inches before the harvest of the small grain takes place. At least one drill-width of the millet should be sown. After the bugs are in the millet, they may be destroyed by plowing under the trap crop to a depth of seven inches and following this with a thorough use of a drag and roller.



### MANUFACTURERS OF BLAST TORCHES

Blast torches that are admirably adapted for chinch bug destruction may be purchased from the following manufacturers:

Turner Brass Works, Sycamore, Ill.  
Hauck Mfg. Co., Ellsworth Bldg., Chicago, Ill.

An excellent torch may be purchased from the Turner Brass Works for \$10.35 f. o. b. factory. The outfits made by the Hauck Mfg. Co. are more elaborate and also more expensive.

### MANUFACTURERS OF OR DEALERS IN OILS

**Creosote:** Creosote can usually be obtained from any of the large dealers handling coal-tar products or it may be bought directly from a manufacturer of the product. Some of the companies from which this material may be purchased are the following:

Barrett Co., Minneapolis, Minn.  
F. J. Lewis Mfg. Co., Chicago, Ill.  
Republic Creosoting Co., St. Louis Park, Minn.  
Standard Oil Co., Sioux City, Ia.  
Sinclair Oil Co., Sioux City, Iowa.  
Transcontinental Oil Co., Sioux City, Iowa.

**Coal-tar:** This product can be obtained from gas plants of the larger cities or from many of the dealers handling coal-tar products. A few of the companies that can supply this product are the following:

Minneapolis Gas Light Co., Minneapolis, Minn.  
Barrett Co., Minneapolis, Minn.  
F. J. Lewis Mfg. Co., Chicago, Ill.  
Standard Oil Co., Sioux City, Iowa.  
Sinclair Oil Co., Sioux City, Ia.  
Transcontinental Oil Co., Sioux City, Ia.

**Road-oil containing 70 percent of asphalt:** Road-oil of this quality may be purchased from the Standard Oil Company, either of Huron, South Dakota, or Sioux City, Iowa.