FIGHTING GRASSHOPPERS
(Including the Results of a Campaign Conducted in 1916 and Suggestions for the Control of this Pest)
By CHARLES R. JONES
Colorado Agricultural College
FORT COLLINS, COLORADO
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FIGHTING GRASSHOPPERS
(Including the Results of a Campaign Conducted in 1916 and Suggesti0ns for the Control of this Pest)
BY CHARLES R. JONES

During 1916, the losses caused by grasshoppers in Colorado were particularly large. Word was received by the Extension Service from various parts of the State reporting outbreaks and requesting information relative to their control. The prevailing condition that favored this increase of hoppers is not exactly known, but in every locality where grasshoppers occur this same increase may be looked for in any season favorable to insect development.

Working in co-operation with the Extension Service, the writer spent several weeks in the field aiding in the campaign of extermination which was carried on. The first request came from County Agent C. E. Smith, of Trinidad, Las Animas County, June 1. On June 10th, a like request was received from County Agent F. H. Thomas, of the San Luis Valley. Later, these were followed by County Agents W. H. Lauck and G. C. Burckhalter of El Paso and Morgan Counties respectively, and others.

Evening meetings were held at various places in Las Animas County and these were followed by practical demonstrations in the field. Because of the fact that the hoppers were just hatching and a fresh supply being produced, the results did not appear to be as effective as some of the farmers thought they should. Proper attention to egg destruction and the use of poison at the proper time will prove effective in this district. This was well illustrated on a small garden tract near Trinidad. Mr. C. E. Smith had made an application of the Kansas formula for bran mash on this tract when the hoppers were over one-half grown. Here the results were clearly in evidence. Previous to the application, the hoppers were in a bean and cabbage garden in alarming numbers. Investigation showed these fields free of hoppers. In the adjacent, uncultivated weedy areas they were plentiful, but up to the line of poison, or where the bran mash had been spread, they disappeared entirely.

Through the efforts of County Agent E. H. Thomas, of the San Luis Valley, several methods of grasshopper control were in progress, such as sprays, poison bait and the hopper dozer.

In the San Luis Valley, the condition of hatching was about the same as in Trinidad, but the hoppers were slightly larger. The poisons
were doing their work, but the hoppers dying in secluded places made it appear otherwise.

At the "West Side Farm", Mr. McArthur had sprayed a fifteen-acre tract of alfalfa with Paris green and reported his results as negative. Upon a close inspection it was found that the spraying had been very effective. On making various examinations throughout the field, it was ascertained that there were, on an average, 25 dead grasshoppers for each square foot of area. Figuring from the size of the hoppers in question, this gave a total of 5 bushels of dead hoppers per acre. Mr. McArthur had previously stated that, in a previous inspection made by him, he found only three dead hoppers. This was due to the fact that he did not know where to look for them. However, he admitted that the number of live hoppers had decreased materially, but it was his opinion that they had migrated to an adjacent field. The apparatus used in this experiment was an ordinary barrel spray with a series of 13 nozzles attached, such as is shown on the front cover.

In fields where the Paris green bran-mash had been applied and reported ineffective, an estimate as to the efficiency of the poison was made, and it was found that the dead hoppers averaged 37 to the square foot. On computation, it was found that, at this rate, there would be about 9 bushels of dead hoppers per acre.

Demonstrations relative to mixing and applying sprays and poisons in various communities were held, and always with a good attendance of interested farmers. Several trips were made to fields of peas, part of which had been plowed in the early spring, and the remainder left uncultivated, the peas being simply drilled into the old stubble as is the common custom in that vicinity.

The plowed areas demonstrated quite clearly the effect of early spring or fall cultivation for the destruction of eggs, as there were very few, or in most cases, no grasshoppers in the cultivated plots, while where the peas were simply drilled in the stubble, there appeared about as many hoppers as in the uncultivated fields of that vicinity.

The writer visited the San Luis Valley in June, 1917, and in company with County Agent E. H. Thomas, carefully inspected the territory treated in 1916. In no area where the poison had been applied were grasshoppers to be found, although, in Saguache County, where remedial measures had not been used, they were quite abundant. In addition to this, cutworms did not appear this year in the fields treated in 1916, although heretofore they have been general throughout the districts.

In El Paso County, it was found that, because of improper mixing and application of the poison, poor results were being obtained. The
mixtures examined were poorly made, the syrup having been poured directly into the bran and Paris green, consequently causing it to be formed into small balls, so that it could not be properly applied. The applications were made from a tub of this mixture, placed in the back of a buggy and driven promiscuously thru the fields. Too much stress cannot be laid upon mixing and applying the poison, as the success of the application depends entirely upon these operations. If the points relative to mixing and applying, hereafter discussed, are carried out in detail, I believe there need be no trouble in controlling a plague of hoppers or from poisoning animals.

The outbreak in Pueblo County was not very alarming, but in most places where hoppers occurred, the bran mash had been applied with good results.

The campaign was taken up by County Agent Stanley V. Smith, thru the county commissioners, who furnished a given amount of Paris green to those who would apply it. This Paris green was distributed from various centers, consequently it had a wide distribution and was applied in many localities, but not in all cases where it should have been.

PEST DISTRICTS FORMED

In accordance with the pest law, several pest districts were formed thruout the State, three in the San Luis Valley, two in Rio Grande, one in Saguache County, one in the Fountain and Mesa district in El Paso County, and three were arranged for in Logan County, giving in the latter an almost continuous district thru the Platte Valley from Messex to Red Lion. This covers the principal irrigated section of said County.

On July 1, a second trip was made to the San Luis Valley at the request of the commissioners of Rio Grande County, to further the work commenced in the grasshopper investigations and assist Mr. W. E. Kistler, who was to be the pest inspector for the above mentioned district.

Four farms were visited where there had been from 70 to 105 acres each, poisoned three weeks previous. The results were surprisingly good. In three out of the four farms visited, a complete eradication, instead of a control, had been effected. On checking over the results on one farm one had to go, on an average, from 30 to 60 steps before seeing a live grasshopper.

EXPERIMENTS SHOW POISON DOES NOT INJURE STOCK IF PROPERLY APPLIED

Hog growers were skeptical about treating their fields for fear of poisoning their stock. While some were not afraid of the Paris green
THE FOLLOWING TABLE IS A SUMMARY OF THE INFORMATION OBTAINED IN AUGUST, 1916, RELATIVE TO THE RESULTS OF THE GRASSHOPPER CAMPAIGN IN THE SAN LUIS VALLEY, COLORADO.

The information in this table was supplied by the farmers whose names appear therein and the statements in the column headed "Remarks" were taken from their communications.

<table>
<thead>
<tr>
<th>REPORTED BY</th>
<th>ACREAGE</th>
<th>Stock Poisoned</th>
<th>Grazing Hoppers Appeared</th>
<th>Land Plowed</th>
<th>REMEDIAL MEASURES</th>
<th>RESULTS</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. McLeodgan</td>
<td>160</td>
<td>150 None</td>
<td>June  Spring &amp; Fall</td>
<td>Bran Mash</td>
<td>July</td>
<td>Good</td>
<td>Only a few hoppers left.</td>
</tr>
<tr>
<td>Alice B. Cheney</td>
<td>925</td>
<td>925 None</td>
<td>Spring &amp; Fall</td>
<td>Bran Mash</td>
<td>July</td>
<td>Splendid</td>
<td>Ravages effectively stopped. Killed cutworms also.</td>
</tr>
<tr>
<td>Anna McCormick</td>
<td>155</td>
<td>100 None May</td>
<td>...</td>
<td>Bran Mash</td>
<td>June</td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>F. S. Jones</td>
<td>144</td>
<td>115 None May</td>
<td>Spring &amp; Fall</td>
<td>Bran Mash</td>
<td>May</td>
<td>98 percent perfect</td>
<td>Used dozer on pasture Pastoral success.</td>
</tr>
<tr>
<td>Henry Seth</td>
<td>155</td>
<td>120 None June</td>
<td>Spring only</td>
<td>Bran Mash</td>
<td>June</td>
<td>Killed them all</td>
<td></td>
</tr>
<tr>
<td>A. J. Stoeber</td>
<td>249</td>
<td>100 None April</td>
<td>Spring only</td>
<td>Bran Mash</td>
<td>May</td>
<td>Good</td>
<td>Poisoned pasture; lost no stock.</td>
</tr>
<tr>
<td>A. O. Miner</td>
<td>170</td>
<td>120 None May</td>
<td>Spring &amp; Fall</td>
<td>Bran Mash</td>
<td>June</td>
<td>Fine</td>
<td>Results entirely satisfactory.</td>
</tr>
<tr>
<td>V. Drake</td>
<td>310</td>
<td>250 1 pig May</td>
<td>Spring only</td>
<td>Bran Mash</td>
<td>June</td>
<td>Good</td>
<td>Poisoned pasture, grazing 135 head hogs; lost one.</td>
</tr>
<tr>
<td>I. P. Taylor</td>
<td>160</td>
<td>103 None May</td>
<td>Early Fall</td>
<td>Bran Mash</td>
<td>June 15</td>
<td>Pest practically destroyed</td>
<td>Very favorable.</td>
</tr>
<tr>
<td>C. W. Myers</td>
<td>500</td>
<td>500 None May</td>
<td>Spring &amp; Fall</td>
<td>Bran Mash</td>
<td>June</td>
<td>Favorable</td>
<td>Bran mash a good remedy.</td>
</tr>
<tr>
<td>F. H. Johnson</td>
<td>150</td>
<td>130 None April</td>
<td>Spring</td>
<td>Bran Mash</td>
<td>June &amp; July</td>
<td>75 percent killed</td>
<td>Results very satisfactory.</td>
</tr>
<tr>
<td>W. H. Towne</td>
<td>160</td>
<td>103 None June</td>
<td>Spring</td>
<td>Bran Mash</td>
<td>June</td>
<td>Good</td>
<td>Dozer used, but abandoned it for poison.</td>
</tr>
<tr>
<td>Fred Schield</td>
<td>157</td>
<td>17 None July</td>
<td>Summer-1915</td>
<td>Bran Mash</td>
<td>June</td>
<td>Favorable</td>
<td></td>
</tr>
<tr>
<td>C. F. James</td>
<td>380</td>
<td>5 None June</td>
<td>Spring &amp; Fall</td>
<td>Bran Mash</td>
<td></td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Mortality</td>
<td>Treatment</td>
<td>Dates</td>
<td>Mash Type</td>
<td>Results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-------------</td>
<td>-----------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. W. Maxey</td>
<td>128</td>
<td>None</td>
<td>June</td>
<td>Spring &amp; Fall Bran Mash</td>
<td>Fair</td>
<td>Lost a few chickens.</td>
<td></td>
</tr>
<tr>
<td>E. C. Harper</td>
<td>116</td>
<td>None</td>
<td>May 15</td>
<td>Spring &amp; Fall Bran Mash</td>
<td>Very good</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. G. Mathias</td>
<td>160</td>
<td>None</td>
<td>Spring</td>
<td>Spring &amp; Fall Bran Mash</td>
<td>Good</td>
<td>Sawdust used with fair results.</td>
<td></td>
</tr>
<tr>
<td>W. E. Kistler</td>
<td>290</td>
<td>None</td>
<td>June</td>
<td>Spring Bran Mash</td>
<td>Good</td>
<td>Used 200 lbs. sawdust mixture; results good.</td>
<td></td>
</tr>
<tr>
<td>Cris Selters</td>
<td>503</td>
<td>None</td>
<td>June</td>
<td>Spring Bran Mash</td>
<td>Fair</td>
<td>Result fair.</td>
<td></td>
</tr>
<tr>
<td>Felix Kaiser</td>
<td>145</td>
<td>None</td>
<td>June</td>
<td>Spring Bran Mash</td>
<td>Very good</td>
<td>Plowing destroys many eggs.</td>
<td></td>
</tr>
<tr>
<td>James H. Neeley</td>
<td>148</td>
<td>None</td>
<td>May</td>
<td>Spring Bran Mash</td>
<td>Very satisfactory</td>
<td>Used spray, 2 lbs. Paris green to 1 bbl. water; results poor.</td>
<td></td>
</tr>
<tr>
<td>M. Metz</td>
<td>395</td>
<td>None</td>
<td>May</td>
<td>Spring Bran Mash</td>
<td>Very good</td>
<td>Poisoned mash, best control.</td>
<td></td>
</tr>
<tr>
<td>W. L. Starbuck</td>
<td>450</td>
<td>60 calf*</td>
<td>May</td>
<td>Spring &amp; Fall Bran Mash</td>
<td>Very good</td>
<td>Got to mixing pan and licked it.</td>
<td></td>
</tr>
<tr>
<td>W. A. Elwood</td>
<td>110</td>
<td>30</td>
<td>July 1</td>
<td>Fall &amp; Spring Bran Mash</td>
<td>Very good</td>
<td>No hoppers on fall plowed land.</td>
<td></td>
</tr>
<tr>
<td>C. G. Wright</td>
<td>296</td>
<td>None</td>
<td>May</td>
<td>Fall &amp; Spring Bran Mash</td>
<td>Very favorable</td>
<td>Land fall plowed had scarcely any hoppers.</td>
<td></td>
</tr>
<tr>
<td>J. W. Davis</td>
<td>368</td>
<td>None</td>
<td>May</td>
<td>Fall &amp; Spring Bran Mash</td>
<td>Good</td>
<td>175 hogs on poisoned pasture. Lost none.</td>
<td></td>
</tr>
<tr>
<td>O. A. Cramer</td>
<td>335</td>
<td>175</td>
<td>April</td>
<td>Fall &amp; Spring Bran Mash</td>
<td>Good</td>
<td>Used with good success elsewhere.</td>
<td></td>
</tr>
<tr>
<td>Seth Methias</td>
<td>440</td>
<td>440</td>
<td>April</td>
<td>Spring Bran Mash</td>
<td>Very favorable</td>
<td>Used dozer; results good.</td>
<td></td>
</tr>
<tr>
<td>H. M. Wright</td>
<td>155</td>
<td>None</td>
<td>June</td>
<td>Spring Bran Mash</td>
<td>Very good</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. Becraft</td>
<td>260</td>
<td>40</td>
<td>May 15</td>
<td>Spring Bran Mash</td>
<td>Extra good</td>
<td>Results very favorable.</td>
<td></td>
</tr>
<tr>
<td>E. W. Jackson</td>
<td>110</td>
<td>None</td>
<td>April</td>
<td>Spring Bran Mash</td>
<td>Very favorable</td>
<td>Used 700 lb. poison, poisoned pasture; lost none of 78 head.</td>
<td></td>
</tr>
<tr>
<td>W. W. Wright</td>
<td>605</td>
<td>100</td>
<td>May</td>
<td>Fall &amp; Spring Bran Mash</td>
<td>Good</td>
<td>75 hogs on poisoned alfalfa. Lost none.</td>
<td></td>
</tr>
<tr>
<td>Center</td>
<td>160</td>
<td>160</td>
<td>Fall &amp; Spring Bran Mash</td>
<td>Good</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. P. Warren</td>
<td>130</td>
<td>50</td>
<td>May</td>
<td>Spring Bran Mash</td>
<td>Very good</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. C. Dillon</td>
<td>155</td>
<td>20</td>
<td>None</td>
<td>Spring Bran Mash</td>
<td>Very favorable</td>
<td>Used 200 lbs. on 20 acres.</td>
<td></td>
</tr>
<tr>
<td>E. E. Newmeyer</td>
<td>205</td>
<td>150</td>
<td>May</td>
<td>Fall &amp; Spring Bran Mash</td>
<td>Good</td>
<td>Results very favorable.</td>
<td></td>
</tr>
<tr>
<td>B. H. Smith</td>
<td>150</td>
<td>140</td>
<td>June</td>
<td>Fall &amp; Spring Bran Mash</td>
<td>Cleaned up</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
directly, they were afraid that hogs would eat the dead hoppers and thus be poisoned. However, this point was cleared by Tiner, Drake, Arthur and Davis. Mr. Tiner had 28 spring pigs feeding at all times on the poisoned area, and the other men had 135, 243 and 175 pigs, respectively, of all ages, feeding upon grasshopper-infested pastures that had been sown with Paris green bran mash, and one pig had died. The owner thought this pig was poisoned, but it is possible that one pig out of 553 could have died from some other cause than poisoning from the bran mash.

In the Counties of Rio Grande and Saguache practically all the infested land, where control work was conducted was organized into pest districts and the farmers used the Paris green bran mash according to the Kansas formula. All materials used were purchased in large quantities and distributed from a central point, ready mixed.

In Rio Grande County, Mr. Fuller, a druggist of Monte Vista, furnished most of the poison used. During the campaign he mixed and distributed:

6,550 Pounds of Paris Green  
38 Tons of Bran  
41 Cases of Lemons  
1,380 Gallons of Syrup

However, this does not represent all the materials used in the two pest districts in his county, as a large quantity of Paris green was obtained from the sugar factory and some from Center.

In Saguache County, Mr. Sumpter, a druggist, furnished and mixed the materials used. An exact account of the amounts used was not kept, but it is safe to estimate that the quantity used was at least half that of Rio Grande County. A machine mixer was used by Mr. Sumpter which greatly lessened the work in mixing the poison. It consisted of a cylinder sufficiently large to hold at least 400 pounds of bran; revolving upon an axis, the power being furnished by an old Ford machine. Only 100 pounds, dry weight, was mixed at a time. This gave plenty of room for mixing. The time required to mix and sack one filling was eight minutes.

In the San Luis Valley and elsewhere where the Kansas formula for poisoned bait was used, the results obtained, as a whole, were entirely satisfactory. the County Agent, E. H. Thomas, reporting a gain of from $3 to $5 per acre on something over twenty thousand acres in favor of the treated areas. In many cases a complete eradication, instead of control, was effected. The results are shown by the table on pages 6 and 7, which is compiled from information obtained thru a circular letter.
The question of grasshopper control is a very important one in any district where grasshoppers occur in sufficient number to warrant remedial measures. It is hoped that the result of our experimental and field demonstration work will convince the most skeptical person that the destruction of this pest in future outbreaks will be a very simple matter.

Farmers living in districts where grasshoppers are destructive or threaten destruction to crops, should organize at an early date and order a sufficient quantity of necessary materials for distribution when necessity demands. The mixture should be applied in the evening, or in the early morning before the hoppers begin to feed. In fields where the hoppers are localized, the poison should be scattered over the infested areas. In fields where a total infestation occurs, it should be applied everywhere and at the rate of about 8 pounds to the acre.

METHODS OF CONTROL*

The problem of grasshopper control is one for concerted action, but co-operation is not always possible and the individual farmer should ever keep this question before him for consideration.

There is no longer any reason why farmers should allow their crops to be destroyed by the ravages of this pest as they are better informed as to the habits of the grasshopper and the most efficient methods of destroying them.

The general life history, habits and practical method of control of the grasshopper have been worked out and are briefly given here, in order that the farmers can successfully combat them. The information herein can be applied in any portion of our State.

Colorado's "Amended Pest Law" provides for forming pest districts for control of rodents and injurious insect pests and can be applied effectively in all localities. This measure should have the active support of all county commissioners to give a county-wide organization and the direct application of remedial measures for the complete control of the invading pests.

CONTROL

Grasshopper control may be considered under two principal heads:

First, Natural, which includes climatic conditions, predacious and parasitic insects, diseases, birds, etc.

Second, Artificial, which includes all methods employed by man, such as cultivation, hopper dozers, poisons, etc.

The eradication of a swarm of grasshoppers in any locality is almost impossible, but under favorable circumstances, with co-operation

*This material is condensed from a more complete account of the habits and remedies of our common grasshoppers published in Bulletin No. 233 of the Colorado Experiment Station, which will be sent upon request made to Director of Experiment Station, Fort Collins, Colorado.
and organization, enough can be killed to effect a complete control of the pest. However, this must be accomplished before the hopper develops wings, therefore, the attention of those engaged in grasshopper destruction should be directed against the young hoppers and eggs.

**Egg Destruction**

Exposing the eggs to the air, sunshine and weather conditions is very effective in hopper control. This may be accomplished by plowing, discing or harrowing. This should be performed before the eggs hatch. It is, therefore, an excellent plan, in late fall or early spring, to plow all ditch banks, fence rows or other places where grasshopper eggs are known to be deposited. Plowing should be at least 8 inches deep. This will bury the eggs to a sufficient depth to prohibit the young hoppers from making an exit thru the soil surface upon hatching. In alfalfa fields or other places that cannot be plowed, harrowing or discing will give excellent results in egg destruction. This should be to a depth of two inches, the ground thoroughly stirred and the egg cluster broken, to allow natural agencies to destroy them.

**Apparatus for Catching Grasshoppers**

There are two principal mechanical devices used in Colorado in catching young grasshoppers. These are of the same general plan, but may be classed as the "Hopper dozer", and the "Live Hopper Machine". The first is designed for use on level, cultivated fields, and is a most economical method for mechanically destroying grasshoppers, but its use will not insure as complete and effective control as the poison bait method. The live hopper machine is designed to operate on rough areas.

**Hopper Dozers**

A very cheap and practical hopper dozer consists of a sheet-iron pan 3 or 4 inches deep, placed upon wooden runners with an upright oilcloth or piece of canvas 2 1-2 feet high at the back. This is to prevent the insects from flying or jumping over the pan. When all is ready, put an inch of water in the pan with a little coal oil on top and drag it across the field and the hoppers will jump or fly into it. The horses should be hitched, well spread, at either end of the dozer, so as not to frighten the hoppers from in front of it, and then, as the machine approaches, many of the hoppers will jump and alight in the oil and water. The winged hoppers will, in most cases, fly against the back of the shield and fall into the pan and be killed by the oil. As the pan becomes filled with grasshoppers, it will have to be emptied and at intervals a fresh supply of oil and water will be needed. To prevent slopping from end to end, it is well to put partitions across the pan every three feet with a small opening beneath them.
THE "LIVE" HOPPER MACHINE

This apparatus was constructed and successfully used in Colorado in 1902 and later has given satisfaction in Utah and New Mexico and in the San Luis Valley the past season. Its construction is very simple. It consists of a box 2 feet square and 16 feet long fastened on runners. The top and back should be covered with screen wire and provided with a door for getting the hoppers out. The front should be concave, 3 feet high and covered with oilcloth or tin extending to within 2 inches of the bottom of the machine, the floor of which is extended about 4 inches in front of the shield. A two-by-four extends outward from either end to a distance of 4 feet and to this the horse is attached. An inverted V-shaped tin is fastened to the front end of the floor, the back part of the V being free and slightly curved upward, extending under the base of the shield. In operation this tin shakes up and down and the hoppers, jumping up, strike the curved shield, slide down to the inverted V front, and being unable to obtain a foothold, pass down and under the main shield into the box.

This machine operates in the same manner as the hopper dozer, with the exception that it is to be used on roughened areas and the hoppers must be killed before the machine is unloaded. This may easily be accomplished by spraying them with kerosene.

POISONING

When the hoppers are young and abundant, they may be destroyed in large numbers by a thorough application of some arsenical spray, such as Paris green or arsenate of lead, the former at the rate of 2 pounds, and the latter about 3 pounds of powder or 6 pounds of paste, to fifty gallons of water. Either of the above sprays can be used effectively after cutting alfalfa. In these cases, narrow swaths should be left standing at intervals throughout the field and these thoroughly sprayed with one of the above poisons. These green strips will act as trap rows and innumerable hoppers will be killed. Care should be taken not to use these poisons on plants where domestic animals are likely to feed, and the trap rows should be cut and burned to eliminate the danger of feeding it to domestic animals.

The one objection to the spray method is that it is rather hard to make the spray material adhere and spread on plants sprayed. This, however, can partly be overcome by adding 3 pounds of common laundry soap to 100 gallons of the spray.

ARSENIC-BRAN MASH

This can be used effectively, and it is one of the very best methods for controlling a grasshopper plague. Mix thoroughly 25 pounds of bran with 1 pound of white arsenic or Paris green and enough water to moisten it so that the mixture will adhere. About 3 gallons of water
will be sufficient. Add 2 quarts of some cheap syrup to keep the bran from drying out too readily and make it more attractive to the hoppers.

The above quantity of materials, properly strewn, is sufficient to sow around 5 or 6 acres and will completely cover 3 acres. This would cost about 30 cents per acre, figuring the cost of materials as they were the past season.

This poison should be sown broadcast where the hoppers are the most abundant. Avoid dropping it in piles, as more hoppers are reached and better results are obtained where the particles are as small as possible. This mixture should be used with care where domestic fowls are apt to feed, as there is danger of poisoning them. However, Dr. Merrill* reports that chickens will not eat this poison mash and that there is no danger to poultry when it is scattered broadcast.

Experiments were conducted the past season in Rio Grande County relative to the liability of poisoning pigs and cattle and no ill resulted. These experiments consisted in letting pigs and cattle graze on areas over which bran mash had been strewn. However, some stock died from poisoning, but upon investigation it was found, in all cases, that the poisoning occurred thru carelessness.

The following Kansas formula for poisoned bran mash for grasshoppers, developed by Professor M. F. Dean, is highly recommended by all who have used it, and gave decided results the past season in the grasshopper control in the San Luis Valley and elsewhere:

- Paris Green ------------------------ 3 pounds
- Bran ------------------------------- 50 pounds
- Syrup (a cheap grade)------------------ 1 gallon
- Water ------------------------------- 5 gallons
- Lemons ---------------------------- 10

Mix thoroughly the bran and Paris Green while dry; dissolve the syrup in the water; squeeze the lemons into this, and finally chop the peel and pulp and add them also; pour this mixture into the bran and Paris Green and stir so as to dampen the mash thoroughly. Then sow broadcast as thinly as possible. The above amount will cover, if properly applied, an area of 6 acres of ground.

This Kansas formula has been used and checked with four other formulas: Bran, Paris green and water; bran, Paris green, syrup and water; bran, Paris green, syrup, lemon extract and water; bran, Paris green, salt and water; and the results were decidedly in favor of the Kansas formula.

**NO DISEASE EFFECTIVE**

No disease has yet been found that will effectively control grasshoppers in the field.