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THE MEXICAN BEAN BEETLE

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The Mexican Bean Beetle

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The Mexican bean beetle prefers garden beans, including lima beans, as food plants, but it may also attack cowpeas and soybeans, and other legumes, including beggerweed, alfalfa and some of the clovers. Occasionally it has been found feeding on such plants as corn, grasses, okra, eggplant, potato, squash and a few weeds, when its preferred food plants have been destroyed.

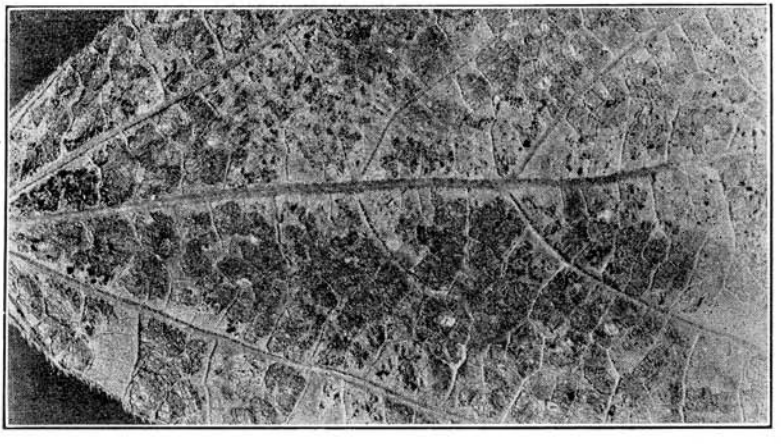

Fig. 1. Portion of leaf injured by young larvae of Mexican bean beetle.

CHARACTER AND EXTENT OF INJURY

The adults and larvae feed upon all parts of the bean plant above the ground, but the greatest amount of injury is done to

*The writer is indebted to Professor A. J. Olney who had supervision of the planting and care of the plots, for facilitating in many ways the carrying out of these experiments.

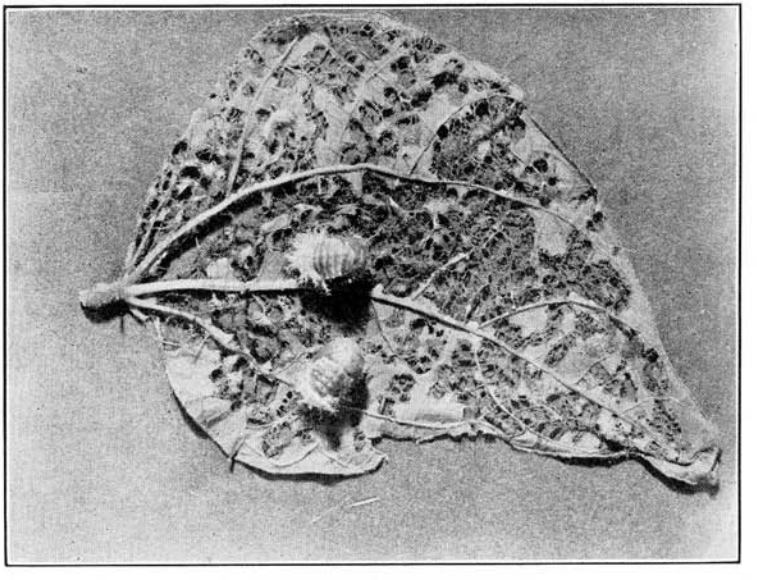

Fig. 2. Bean leaf injured by Mexican bean beetle.

the leaves. The adults, feeding on the under surface of the leaf, eat irregular holes thru the leaf, or at times only partly thru the leaf. The adults sometimes eat the blossoms and injure the small pods. They may at times eat irregular patches of epidermis from large pods and the stems.

The larvae are responsible for the greatest part of the injury to the plants. The young, upon hatching, feed in colonies for a short time near the egg masses and later move to other parts of the plants or to adjoining plants. The larvae feed upon the under side of the leaves, but they do not cut thru the upper surface of the leaves. The feeding is done in linear strips which results in a network pattern which is characteristic.

The Mexican bean beetle is the most destructive of our bean insects, and is difficult to control because the tender foliage of the beans makes it difficult to use poisons of proper strength for killing the insect. The extent of the beetles' injuries depends upon the degree of infestation and the size of the plants when

attacked. Complete destruction of a crop may result when the infestation is severe and remedial measures are neglected.

Fig. 3. Adult Mexican bean beetle enlarged.

THE STAGES OF THE BEETLE

Eggs. The eggs are approximately one-twentieth of an inch in length by one-half as wide and are oval shaped and yellowish colored. They are placed on end in irregular clumps of a few to fifty or more on the under side of the leaves.

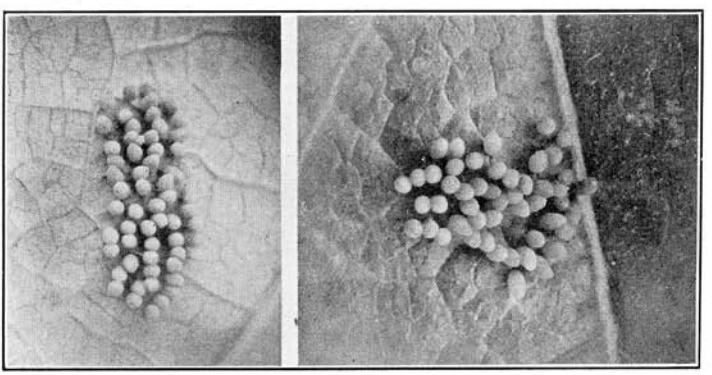

Fig. 4. Eggs of the Mexican bean beetle enlarged.

Larva. The larvae are light yellow in color when newly hatched and when mature are sulfur-yellow. They vary in

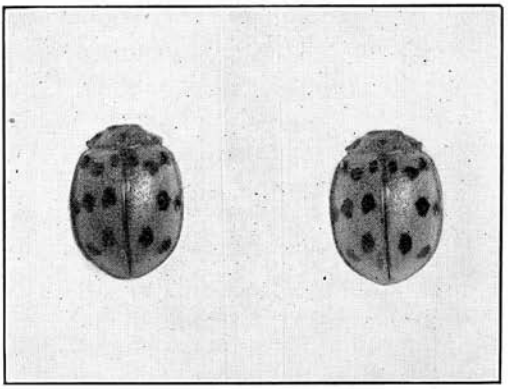

Fig. 5. Adult Mexican bean beetle enlarged.

length from one-sixteenth of an inch to two-fifths of an inch according to age. Their bodies are covered with rows of stiff, branched spines which at times are dark or black at the tips. The spines very likely protect the larvae from such enemies as the birds. The larvae have a humped like appearance, being thicker at the middle and tapering toward the ends.

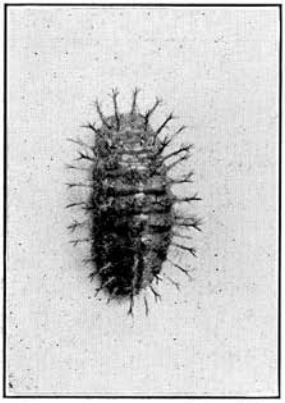

Fig. 6. Larva of the Mexican bean beetle enlarged.

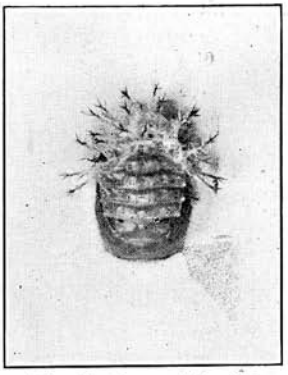

Fig. 7. Pupa of the Mexican bean beetle enlarged.

Pupa. The mature larva fastens itself to the plant and then moults, the cast skin being pushed back to the abdomen where it remains as a wrinkled mass with the black tips of the spines showing. The pupa is yellowish and of about the same size and shape as the adult.

Adult. The adult insect is about one-fourth of an inch in length by about one-fifth of an inch in width. The back of the beetle is arched. The newly transformed beetle is light yellow colored, later brownish and with a bronzy reflection in some specimens. There are generally eight dark spots on each wing-cover, but there is considerable variation in the size and shape of the spots; one or more may be lacking, or they may be joined to each other in rows. The spots are arranged three near the front, three near the middle and two toward the rear on each wing-cover. The males are slightly smaller than the females.

LIFE HISTORY AND HABITS

The Adult. The adult of the Mexican bean beetle is the only stage that lives thru the winter. The adults hibernate under loose litter or in similar situations and come out in the spring in May or the first week in June. Beetles and eggs were found May 27th, 1926.

The beetles begin to feed as soon as they get into the bean fields and the females begin laying a few days after feeding. The eggs are placed in clumps on the under side of the leaves. The beetles very frequently drop off the beans when the plants are disturbed and remain inactive on the ground for some time. They also have the habit of excreting an unpleasant smelling fluid from the knee-joints when they are touched or picked up. This is apparently a means of protection from their natural enemies. The beetles are rather long-lived and this leads to an overlapping of broods when the season is somewhat advanced.

The Egg. The incubation period varies considerably but as a rule lasts for about one week. In 1923, 331 eggs which were laid on July 12 to July 24 had an average incubation period of 6.28 days with a range of 5 to 7 days. This period for 181 eggs laid August 18 to August 24, 1923, was 8.07 days with a range

of 6 to 10 days. The average incubation period for 472 eggs which were laid in June, July and August, 1926, was 6.85 days with a range of 6 to 9 days.

The Larva. The young larvae begin feeding soon after hatching, at first eating a very thin layer of the epidermis; later devouring thicker portions of the leaf. The older larvae require a great deal of food and are the cause of the most serious damage to the plants. The bean fields should be examined frequently and carefully because an infestation by young larvae may be overlooked.

The larvae remain on the plant on which they have hatched or on adjacent plants. These infested patches of plants can easily be detected when infestation is not general in the field.

The larva moults four times, three times during the feeding period and a fourth time just before the pupal stage is begun. Before the last moult the larva attaches itself at the posterior end of the body to the leaf. The length of the larval period varies considerably. In 1923, when some rearings were made, the average larval period for 238 larvae was 18.44 days with a range of 14.5 days to 21 days. The average larval period for 89 larvae reared in 1926 was 17.5 days with a range of 15 to 21 days.

The Pupa. Full grown larvae have a tendency to collect together before pupating so that frequently a good many pupae may be found on one leaf. Sometimes the larvae go from food plants to other plants to pupate, especially when the food plants have been destroyed or lost their leaves. The pupae generally hang with the head downward when on a vertical surface.

The pupal period lasts from 5 to 10 days ordinarily. The average pupal period for 147 pupae of which records were kept in 1923, was 6.77 days and for 89 pupae in 1926, 6.6 days.

NUMBER OF GENERATIONS

Because of the rather long life of the beetles, the generations overlap to a certain extent. From rearings made in 1923 and 1926, it was found that three generations may develop during the season. On June 29, 1923, larvae and pupae which were a part

of the spring brood were received at the Insectary. The first adults from these pupae appeared July 2 and eggs were laid on July 10. Adults reared from these eggs began to appear on August 9 and these began laying August 18. Rearings made from the eggs which were laid on August 18 produced third brood adults, the first appearing September 13. In 1926, eggs collected in the field May 27 began to hatch May 28. First generation adults began to appear on June 23. These adults began to lay on July 2 and second generation adults began to appear on August 2. The second generation adults began laying August 11 and adults reared from these eggs began appearing September 15.

The period of development from egg-laying to the appearance of the adult is generally about 30 days. The females begin laying in a week or ten days after emergence from the pupae.

ARTIFICIAL CONTROL

Some tests of insecticides leading to the control of the Mexican bean beetle were made in 1925 and 1926. Dust insecticides were used in a number of experiments in 1925 and both dust and liquid insecticides were used in 1926.

TRIALS IN 1925

Sodium Fluosilicate 1 Part, Hydrated Lime 9 Parts. The sodium fluosilicate was a heavy product and the ingredients of the mixture were measured by volume. Two tests were made of this mixture.

The insecticide was applied on one plot on June 15, June 26, July 6, and July 13. The dust was used at the rates of 11.8, 16.5, 18, 20.8 pounds per acre. No apparent injury to the plants from the use of the insecticide was observed. The infestation on July 13 was 25 per cent.

The insecticide was used on one of the later plots of beans where the applications were made on August 6, August 10, August 14, August 19, August 26, and September 4. The dust was used at the rate of 9, 10.8, 12.8, 14, 12.7, and 19.9 pounds

per acre. The beans were not injured by the insecticide. The infestation on September 10 was 18 per cent.

Calcium Fluosilicate Compound. This compound was used undiluted on one plot and the applications were made on June 15, June 26, July 6, and July 13.

The insecticide was used at the rates of 10, 16, 16.6, 18.8 pounds per acre. These applications were a little light. The infestitation on July 13 was 19 per cent.

Calcium Arsenate 1 Pound, Sulfur 1 Pound, Hydrated Lime 4 Pounds. The beans in one plot were treated with this insecticide on June 15, June 26, July 6 and July 13, at the rates of 12.8, 13.3, 17.7 and 13.5 pounds per acre. A slight amount of injury from the use of this dust was observed on July 3. The infestation on July 13, was 8 per cent.

A second plot was treated on August 6, August 10, August 14, August 19, August 26 and September 4. The dust was applied at the rates of 10, 11.4, 15.8, 15, 15, 15.4 pounds per acre. No injury from the use of the insecticide was observed. The infestation on September 10 was 11 per cent.

Magnesium Arsenate 1 Pound, Hydrated Lime 3 Pounds. The magnesium arsenate dust was used on two plots. On one plot the dust was applied on June 15, June 26, July 6, and July 13, at the rates of 12.8, 13.2, 12.9, and 19.7 pounds per acre. This dust gave very good protection from the beetles and the infestation was only 3 per cent on July 13.

A second plot was treated on August 6, August 10, August 14, August 19, August 26 and September 4. The dust was used at the rates of 6 to 15 pounds per acre. The plants were not injured by the treatments and the infestation was only 7 per cent on September 10.

Calcium Arsenate 1 Pound, Hydrated Lime 9 Pounds. One plot was treated with this insecticide on August 6, August 10, August 14, August 19, August 26 and September 4. The amounts of the dust applied varied from 8.7 pounds to 20 pounds per acre. The dust gave excellent control of the beetle and no injury to the plants resulted from its use. The infestation on September 10 was two per cent.

CHECKS

There were two check or untreated plots to each set of four treated plots. Beetles began to appear in the first plots on June 10 and eggs were found on June 15. The infestation for the first two plots averaged 39 per cent. The injury, however, was not severe. Beetles began to collect on the second planting of beans on August 6 when the beans were about 3 inches tall. The beetles did not multiply rapidly, probably due to the hot dry weather. The infestation on September 10 amounted to 47 per cent but the total injury was light.

SUMMARY OF RESULTS

The fluosilicate both sodium and calcium gave less satisfactory control than the arsenical mixtures. The insecticide made of calcium arsenate 1 pound and hydrated lime 9 pounds gave slightly better control than any other of the insecticides used. No injury to the plants from the use of the insecticides was observed except slight injury in the earliest of two plots which were treated with the mixture of calcium arsenate 1 pound, sulfur 1 pound and hydrated lime 4 pounds.

EXPERIMENTS IN 1926

Plan and Methods. Three sets of plots of beans were planted for the purpose of testing insecticides for the control of the Mexican bean beetle in 1926. These were one-eightieth acre plots. The first set of plots was planted on May 14, the second on June 11 and the third on July 13. The beans in the first and third sets of plots made good growth but in the second set the beans were so severely injured by rains and by being flooded that only two plots could be used. The beans were drilled in the rows.

Infestation records were taken in order to determine the effectiveness of the insecticides. A foot of row, since the beans were drilled, was taken as a unit in measuring the percentage of infestation and was recorded as infested when either eggs or larvae were present. Frequently a rather high infestation was noted where there was only slight injury to the foliage.

The dust insecticides were applied with a bellows type of duster and the sprays with a good type of foot pump.

Infestation in 1926. Beetles and eggs were found as early as May 27 on beans on the Station farm, but beetles were not found till June 8 in the experimental plots. The infestation of the first plots was so slight that it was only by very careful searching that any of the stages of the beetles could be found on July 8 when the first mature bean was gathered. Infestation of the second crop was, also, very slight. The infestation of the third crop was high on some of the treated plots and all of the plants in the checks became infested.

Insecticides Used. First Plantings. The infestation of these plots was so slight that no treatments were needed. However, two treatments were given in order to determine the amounts of spray injury if any developed. The plants were treated on June 16 and June 29. The following dusts and sprays were applied:

Lead arsenate 1 pound, hydrated lime 9 pounds
Zinc arsenate 1 pound, hydrated lime 9 pounds
Calcium arsenate 1 pound, hydrated lime 9 pounds
Magnesium arsenate 1 pound, hydrated lime 3 pounds
Magnesium arsenate 1 pound, hydrated lime 5 pounds
Sodium fluosilicate 1 pound, hydrated lime 2 pounds
Sodium fluosilicate 1 pound, hydrated lime 3 pounds
Calcium arsenate 1 pound, sulfur 1 pound, hydrated lime 4 pounds
Lead arsenate 1 pound, water 40 gallons
Calcium arsenate 1 pound, lime 1.5 pounds, water 50 gallons
Zinc arsenate 1 pound, water 40 gallons
Magnesium arsenate 1 pound, water 50 gallons
Calcium arsenate ¾ pounds, 2-2-50 Bordeaux mixture

Effect of the Insecticides on the Bean Foliage. No injury to the foliage resulted except where sodium fluosilicate and arsenate of lead were used, and in these cases the injury was slight. The sodium fluosilicate where used at the rate of 1 pound to 2 of hydrated lime injured 11 per cent of the foliage and where used at the rate of 1 pound to 3 of the lime injured 5 per cent of the foliage. The spray made of lead arsenate 1

pound and water 40 gallons injured 3 per cent of the foliage and the dust made of lead arsenate 1 pound and hydrated lime 9 pounds injured 10 per cent of the foliage.

Insecticide Used. Second Plantings. Calcium Fluosilicate Compound. One lot of beans was dusted with this compound on July 12 at the rate of 28.5 pounds per acre. The beans were 8 to 10 inches tall at the time the plants were treated. The infestation on August 23 was 15 per cent and the injury was slight. The yield of beans was 55 pounds.

The check plot had an infestation of 18 per cent which was only slightly greater than the treated plot. The injury by the beetles was slight. The yield of beans from the check plot was 48 pounds.

Insecticides Used. Third Planting. Calcium Fluosilicate Compound. This dust was applied on one plot on August 6, August 23 and August 30, at the rates of 20, 21, and 30 pounds per acre. There was no apparent injury to the plants from the use of the insecticide. On August 30 the infestation amounted to 85 per cent with injury slight to severe in certain patches. The infestation on September 17 was general, all of the plants being more or less injured. The infestation was very noticeable when compared with the other plots. The yield of beans was 36 pounds.

Sodium Fluosilicate 1 Pound, Hydrated Lime 2 Pounds. This plot was treated on August 5, August 23 and August 30 with the insecticide at the rate of 20, 25 and 28 pounds per acre. The foliage injury was slight, amounting to only 5 per cent. The infestation on August 30 amounted to 80 per cent. The injury was not severe as yet because of the age of most of the larvae which were still small to medium sized. On September 17, all the plants were infested and the injury was severe. The yield of beans was 38 pounds.

Lead Arsenate 1 Pound, Hydrated Lime 9 Pounds. The beans in this plot were dusted on August 5, August 23 and August 30 at the rates of 10, 17.5 and 20 pounds per acre. The infestation on August 30 was 22 per cent and on September 17

30 per cent. The injury was severe in some places and very light in others.

There was considerable injury from the use of the insecticide, 25 per cent of the leaves being injured. This injury was readily seen and many of the leaves fell from the plants. The yield was 45 pounds.

Zinc Arsenate 1 Pound, Hydrated Lime 9 Pounds. The insecticide was applied on August 6, August 23 and August 30 at the rate of 12, 18.5, and 20.5 pounds per acre. There was no apparent injury from the use of the insecticide. The infestation on August 30 was 8 per cent and on September 16, the infestation was 35 per cent. The yield of beans was 42 pounds.

Calcium Arsenate 1 Pound, Sulfur 1 Pound, Hydrated Lime 4 Pounds. This insecticide was applied to the beans on August 6, August 23, and August 30, at the rate of 12.5, 15.5 and 18 pounds per acre. The infestation was 16 per cent on August 31, and 30 per cent on September 17. The insecticide did not injure the bean foliage. The yield of beans was 56 pounds.

Calcium Arsenate 1 Pound, Hydrated Lime 9 Pounds. Applications of the insecticide were made on August 5, August 23, and August 30 at the rates of 12.5, 16 and 20.5 pounds per acre. No injury resulted from the use of the insecticide. The infestation August 30 was 6 per cent and on September 17, 18 per cent. The yield of beans was 65 pounds.

Magnesium Arsenate 1 Pound, Hydrated Lime 3 Pounds. The dust was applied on August 5, August 23 and August 30 at the rates of 16.5, 17, and 18.5 pounds per acre. The plants were not injured by the insecticide. The infestation was 12 per cent on August 30, and 22 per cent on September 17. The yield in beans was 60 pounds.

Lead Arsenate 1 Pound, Water 40 Gallons. The beans in this plot were given three sprayings at the rate of 80 to 120 gallons per acre. They were sprayed on August 5, August 23 and August 30. The infestation by the beetles was only 5 per cent on August 30 and 12 per cent on September 17. The injury by the spray itself was very easily seen, many of the

leaves being injured, in all 29 per cent. The yield of beans was 34 pounds.

Zinc Arsenate 1 Pound, Water 40 Gallons. The beans in this plot were sprayed three times, the first on August 5, second on August 23 and third August 30. The spray was used at the rate of 80, 118 and 122 gallons per acre. No apparent injury resulted from the use of the spray. The infestation on August 30 was 6 per cent and on September 17, 9 per cent. The yield in beans was 48 pounds.

Magnesium Arsenate 1 Pound, Water 50 Gallons. The beans in this plot were sprayed on August 5, August 25 and August 30, at the rate of 90, 115 and 112 gallons per acre. The beans were not injured by the spray. The infestation on September 17 was 16 per cent. The yield of beans was 57 pounds.

Calcium Arsenate ¾ Pound, Lime 1½ Pounds, Water 50 Gallons. The spray was applied on August 5, August 25 and August 30 at the rate of 95, 120 and 123 gallons per acre. The beans were not injured by the spray. The infestation was 4 per cent on August 30 and 7 per cent on September 17. The yield of beans was 73 pounds.

BEETLE INJURY ON CHECKS

The beetles began to collect on the check plots on August 3 and there was a gradual increase of infestation and beetle injury. All the plants were infested by August 30 and on September 17 the injury was very severe, a great deal of the foliage being completely destroyed. The three check plots yielded 22, 29 and 24 pounds, respectively.

RESULT OF TESTS 1926

The experiments in 1926 showed that the fluosilicates dusts were not as efficient in protecting the beans as the arsenical insecticides. Some foliage injury resulted in two tests where sodium fluosilicate dusts were used. The lead arsenate dust and spray gave practically as good protection as the more effective insecticides, but there was decided foliage injury in at least two tests. Zinc arsenate did not injure bean foliage, at least there

was no spotting or burning of the foliage. The dust made of calcium arsenate 1 pound and hydrated lime 9 pounds and the spray made of calcium arsenate ¾ pound and lime 1½ pounds in 50 gallons gave in general slightly better protection than the other insecticides that were used. The yields were correspondingly good.

GENERAL METHODS OF CONTROL

Cultural Practices. The beans should be planted in good soil and should be stimulated by fertilizers if necessary to make a rapid and vigorous growth. The beans should be planted as early in the spring as good practice permits. The early beans are more likely to escape serious injury than later plantings because of later rapid multiplication of the beetles. Plant bush beans because they generally mature more quickly and are easier to treat. After the crop has been gathered, plow under the remnants of the crop. This will destroy large numbers of all stages of the insect.

Sprays and Dusts Recommended. Bean foliage is tender and susceptible to arsenical injury but some of the arsenicals may be used with a reasonable degree of safety and at the same time protect the plants sufficiently for maturing a crop. The liquids should be used at the rate of about 100 gallons per acre and the dust at about 15 pounds per acre, when the beans are drilled in rows three feet apart. There may be some variation of these amounts according to the size of the beans and distance between rows. The dusts should be applied if possible when no wind is blowing. The calcium arsenate should be of high grade and have a low water-soluble arsenic content. Some of the liquid sprays give slightly better control than the dusts.

The spray made of calcium arsenate ¾ pound and lime 1½ pounds in 50 gallons of water gave a little better protection than any of the other sprays and magnesium arsenate 1 pound in 50 gallons of water gave good protection to the plants. From the standpoint of protection from the beetles, there was very little difference between these two sprays.

Three dust insecticides were found to give good protection from the beetles. These were (1) calcium arsenate 1 pound and hydrated lime 9 pounds, (2) calcium arsenate 1 pound, sulfur 1 pound, and hydrated line 4 pounds, (3) magnesium arsenate 1 pound and lime 3 pounds or the hydrated lime may be increased to 4 or 5 pounds when the infestation is lighter. The dust made of calcium arsenate 1 pound and hydrated lime 9 pounds gave a little better protection than the other two. The magnesium arsenate dust was more difficult to prepare. It required more time in the mixing and did not cover as well as the other dusts.

Directions for Applying the Insecticides. The spray or dust should be directed to the under surfaces of the leaves. Where liquid sprays are used, angle nozzles should be used to give proper direction to the spray. Small compressed-air sprayers or foot-pumps can be used for gardens and tractor sprayers for large plantings. For dusts, there are several types of bellows and plunger dusters for gardens, and fan and tractor dusters for field work.

Number of Treatments. The number of treatments depends upon the amount of infestation. Usually one to five treatments are sufficient to protect a crop. The treatments should be given at intervals of a week to ten days. The insecticides act in a measure as repellants so that if the first treatment is made when the beetles begin collecting on the beans and before many eggs are laid better protection is generally secured. The last treatment may be made when green snap beans are two to three inches long. Analysis has shown that there is no danger from the use of treated beans, but they should always be washed two or three times with clear water before being eaten or sent to the markets. Where beans are grown in a locality where the beetle is present, the beans should be examined frequently in order to observe the degree of infestation if any. A crop can be destroyed in two or three weeks.

SUMMARY

The Mexican bean beetle is our most destructive bean pest. It prefers as food the common varieties of garden bean but it

will also attack cowpeas and soybeans, sometimes other legumes and a few non-leguminous plants.

The adult insect is about one-fourth of an inch long by one-fifth of an inch wide. The back is arched. It is brownish or copper-colored with eight black spots on each wing-cover.

The beetles begin to collect on the beans at about the middle of May or the first of June and the females commence to lay in a few days after feeding. The time necessary for development from egg-laying to the adult stage is about 30 days. Three broods may develop during a season.

The larvae and adults feed on the under surface of the leaves. The larvae are responsible for the greater part of the injury to the beans. A crop may be destroyed in two or three weeks when the infestation is severe, if no remedial measures are used.

The bean foliage is tender and susceptible to arsenical insecticides. Some of the arsenical insecticides, however, may be used with a reasonable degree of safety to the foliage and give enough protection to the plants for maturing a crop.

Dust insecticides or liquid insecticides may be used. In either case, the insecticide should be applied to the under surface of the leaves. Calcium arsenate 1 pound mixed with 9 pounds of hydrated lime or magnesium arsenate 1 pound mixed with 3 to 5 pounds of hydrated lime or calcium arsenate 1 pound and sulfur 1 pound mixed with 4 pounds of hydrated lime may be used as dust insecticides. Liquid sprays made of calcium arsenate ¾ pound and 1½ pounds of lime in 50 gallons of water or magnesium arsenate 1 pound in 50 gallons of water may be used.

The number of treatments varies according to the degree of infestation. Generally, one to five treatments at intervals of seven to ten days are sufficient.

Where the infestation is severe, the remnants of the crop should be plowed under as soon as the beans have been gathered. Bush beans should be planted because of convenience in giving treatments.