Bulletin 432 August 1936

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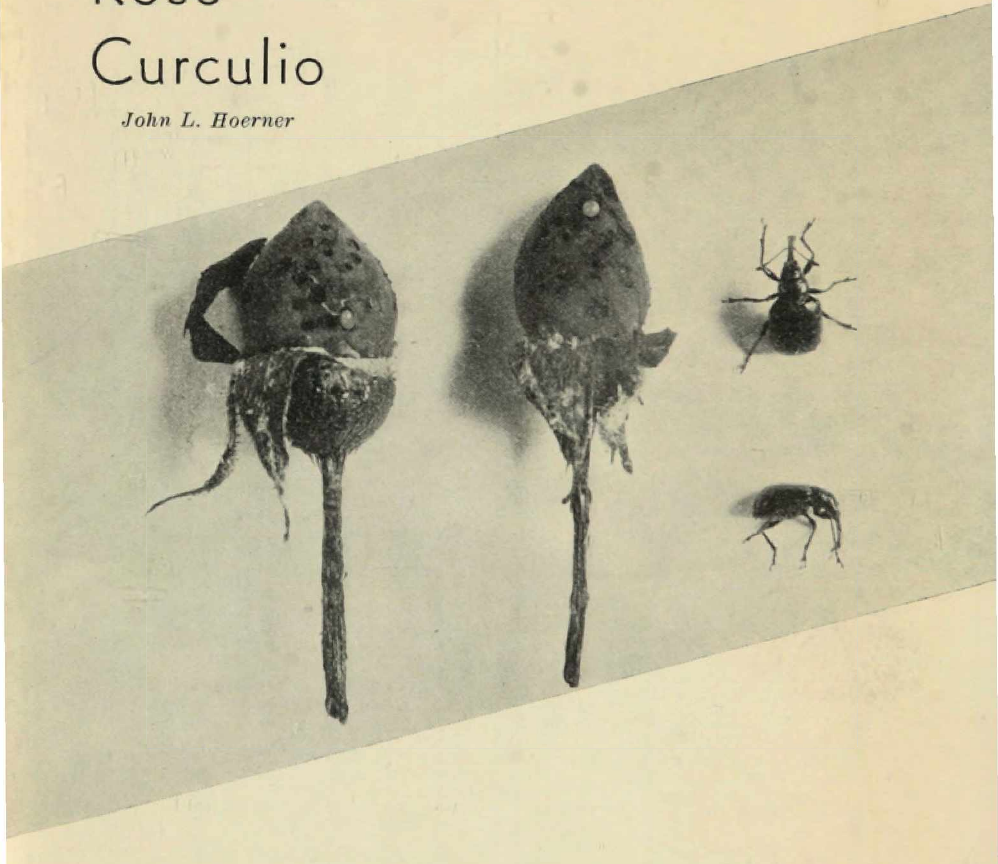

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WESTERN ROSE CURCULIO*

Rhynchites bicolor wickhami Ckl.

JOHN L. HOERNER

THE WESTERN ROSE CURCULIO is one of the most destructive enemies of the rose in Colorado. A few beetles are capable of destroying the entire crop of roses on small bushes. On large clumps of roses the injury ranges from about 10 percent to almost 100 percent. For a number of years the injury from this beetle has been severe, in some sections to the extent that it is almost impossible to grow roses out of doors. James Cassidy (1) in 1888 reported it as injuring raspberries. The writer has never observed it feeding on this plant, although in rearing cages the adults feed readily on raspberry buds when no rosebuds are available.

Distribution

The distribution in the United States is shown by states on the map, figure 1. Undoubtedly it occurs in Nevada, although it is not recorded as occurring there. The four specimens recorded by Pierce from North Carolina, as he suggests, are probably in error.

The distribution for the state of Colorado is shown on the map, figure 2. Pierce (2) records it as occurring in this state at Ouray,

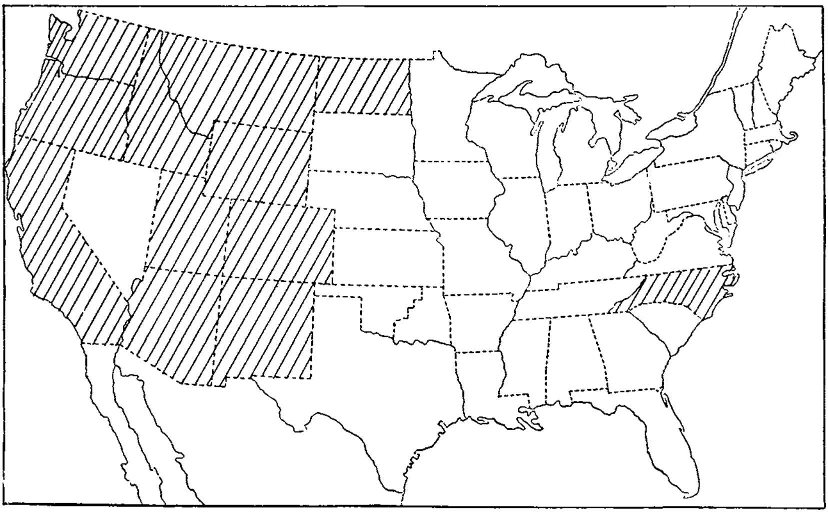

Figure 1—Distribution of western rose curculio in the United States

*The material in this paper was partly prepared for a part requirement for a degree of Master of Science. During the past 3 years additional observations and methods of control have been added.

Berkeley (this is evidently in error, as no town or station is listed in the state by this name), Colorado Springs, Breckenridge, and Leadville. The writer has taken specimens at various points over the state. These, with records of specimens in the collection of Colorado State College, give the additional distribution in the state as Rist Canon, Sapinero, Fort Collins, Cherokee Park, Poudre Canon, Greeley, Chambers Lake, Paonia, Delta, Littleton, Denver, Kutch, and Boulder. In this distribution the elevation ranges from 4,664 feet at Greeley to 10,185 feet at Leadville. The writer has found this insect quite abundant on wild roses in all elevations from the foothills west of Fort Collins to almost timber line in Pingree Park.

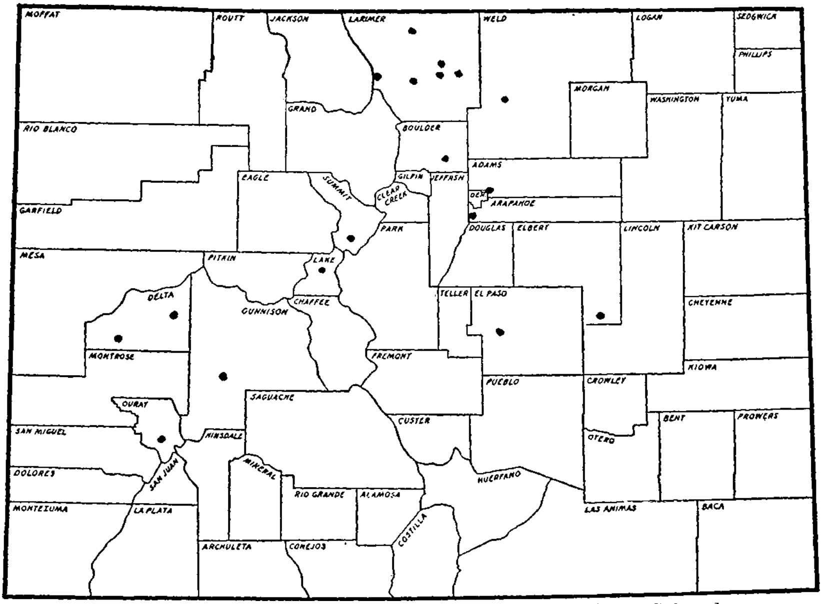

Figure 2—Known distribution of western rose curculio in Colorado

Allied Varieties

According to literature there are seven varieties of this species separated on color phases, all of which feed on wild and cultivated roses. Separating these varieties or races on a color base is not entirely satisfactory, as there appear to be intermediate forms which will fit about as well under one variety as another. In the college collection of eight specimens of *bicolor*, one was found with a red tip on the beak; one had traces of red on the legs, especially the tarsal joints; and one had the base of the antennae red. One beetle taken at Fort Collins will fit about equally well into *erythrosoma* or *cockerelli*. This specimen has the beak darkened at the base and tip. The ocular sclerites, club of the antennae, venter of the thorax, abdomen, and legs are darkened. Another specimen taken at Fort Collins appears to be typically *erythrosoma*, except that the beak and antennae are almost black.

Host Plants

This insect has been observed to feed readily on all forms of wild and cultivated roses. It does not go so readily to the climbers and ramblers, but feeds readily on these and on raspberry buds in rearing cages when no other food is available. Teas and hydrid-teas are favorites.

Character of Injury

The feeding punctures of the adult beetle are seen as small holes in the buds. Most of these punctures are made in the petals, sometimes through the sepal into the petal or in the base of the bud. Occasionally they are made in the stem below the bud. When buds are not plentiful the young tips of shoots may be eaten off or the stem punctured so that the tip will curl and dry. Some of the buds that are punctured from feeding will open, and the petals will be riddled with holes, giving the flower a ragged, unsightly appearance. It is difficult to distinguish the feeding punctures from those in which eggs are deposited. In addition to the egg punctures the female will puncture the stem of the bud so that it will wilt and usually bend over and dry, leaving the mummified bud in which the larva develops. A pair of beetles in rearing cages have made as high as 99 punctures in rosebuds in 24 hours. The maximum number of eggs obtained from one caged female was eight. This means as many as eight buds may be destroyed daily by one female in egg deposition; and in addition she may make a large number of feeding punctures, which disposes of rosebuds rather rapidly. All sizes of buds, from very small to those about ready to open, are destroyed.

Description of Stages

Eggs

The eggs are about one-twentieth of an inch long by 1.25 inch wide, being easily seen with the naked eye. They are elliptical in shape and pearly white in color. Under the microscope the surface is pitted or reticulated. Twenty-five eggs measured under a microscope averaged 1.24 mm by 1.1 mm—the largest 1.5 mm by 1.3 mm and the smallest 1.0 mm by .9 mm.

Larvae

When first hatched the larvae are rather robust and tough, measuring about one-twelfth by one-twenty-fifth inch coiled, and are white.

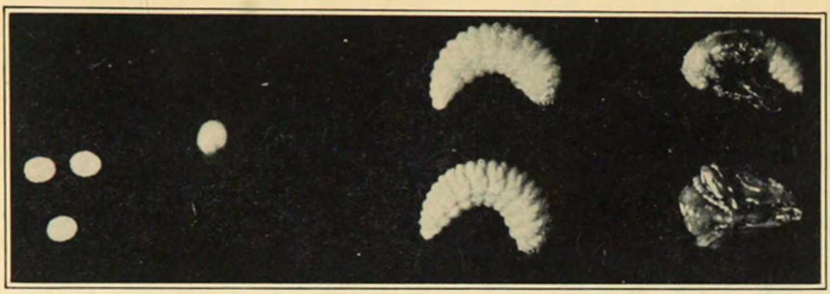

Figure 3—Eggs, small larva, mature larvae, and pupae; enlarged

The full-grown larva is about one-fourth inch long and one-eighth inch wide. The larva is a legless grub, sub-cylindrical in shape. The widest part is back of the head through the third, fourth, and fifth segments, tapering bluntly to the head and gradually to the posterior end. The dorsum, sides, and sternum are strongly wrinkled. The general color is pale yellow or straw-colored. The head is much narrower than the body, and sub-ovate, with the anterior third brown. The mandibles are dark brown, and maxillae and labium light brown. The labrum is almost transparent, showing a double line of brown on the meson. The head is retractile, so that only the tip and mouth parts show. The antennae are located at the lateral angle of the frons. The thoracic shield shows as a pale yellow spot on the anterior half of the dorsal part of the first segment. The thoracic segments have the legs represented by enlarged tubercles, each bearing a number of setae. The abdominal segments are well defined and about equal in length. Each segment of the thorax and abdomen bears a few scattered dorsal, lateral, and ventral hairs which are visible only under the microscope. Spiracles occur on all segments except 2, 3, and 12.

Pupae

The pupae are uniformly white in color when first transformed. Their length is about one-fifth inch, and the width across the mesothorax is about one-seventh inch. The head is bent downward with the beak along the sternum. The antennae are exposed, and the tarsi of pro and mesothoracic legs are partly concealed beneath the beak. The metathoracic legs largely are concealed beneath the wings. The end segment of the abdomen bears a pair of curved appendages.

Adults

The adults are robust, convex, and pyriform. The elytra and thorax are bright red; the under surface, femora, beak, tibiae, tarsi, and antennae are black. The beak is almost as long as the head and thorax and rather sparsely marked with elongate punctures; the antennae are inserted at its middle, with their grooves distinct. The front in both sexes is strongly rugosely punctate to the vertex. The thorax is subcylindrical, about as long as wide, with sides strongly rounded and converging toward the base and the apex, and rather densely and finely punctate. The elytral strial punctures are not easily separable from the interstitial punctures. The entire animal is sparsely covered with short setae. The measurements of the beaks of 12 males averaged 1.82 mm, and of 15 females 1.95 mm, indicating that the beak of the female is typically longer than that of the male. The sex of these beetles was determined by squeezing out the genitalia.

Dissemination

The adults are strong flyers, and this is probably the most important means of spreading.

LIFE HISTORY AND DEVELOPMENT

Summary of Life Cycle

The winter is passed as full-grown larvae in the soil. About April or early May the larvae pupate in the soil and in about 9 days transform to adults, emerging from the ground about 2 weeks later. The adults feed on the young rose shoots and buds; they mate and deposit eggs in the rosebuds, puncturing the stem beneath so that it withers and dries, sometimes falling to the ground. About 40 eggs are deposited by each female.

The eggs hatch in about 10 days, and the larvae feed inside the dry rosebud, leaving it in the fall to enter the ground, where the winter is passed. There is one generation a year.

Eggs

The eggs are deposited in punctures in the rosebuds at depths varying from just beneath the surface of the bud to about 2 mm below the surface. These punctures are invariably plugged and can seldom be detected except as a slight scar on the bud, or sometimes as a small protuberance on the side of the wilted rosebud. In 3 years' observations only two eggs were found in the base of buds; all the rest were desposited in the folded petals. In the few cases where females were observed in the act of oviposition, the stem of the bud was punctured before making the egg puncture in the bud. One female when first seen had already eaten holes through the stem and was on the bud with the beak about half buried in the petals. She spent about 8 minutes more on this puncture, inserting the beak up to the eyes and twisting the head on the flexible neck joint as if enlarging the hole on the sides and bottom. Turning around, about

50 seconds were consumed in inserting the ovipositor and depositing the egg. The opening was then plugged with the beak by chewing off bits of petal along the edge of the puncture and placing them in the opening. This operation took about 2½ minutes more and when finished left a slight scar on the rosebud.

Occasionally an egg is found upon the petals of an open rose, but in these cases the female may have been disturbed, or perhaps instinct varies sometimes so that the bud stem would not be punctured as is the usual custom. A few buds were found which were wilted with the stem punctured, but no egg or larva inside. Rarely more than one egg is found deposited in a bud under field conditions, and here the second egg was probably deposited by a second female. In the rearing cages, where the available buds are limited, several eggs may be placed in one bud.

Examining a large number of buds containing eggs, there appears to be no definite position in the bud preferred for deposition. Eggs are placed anywhere in the petals of the bud from the tip to the base, rarely in the base. Sometimes removing one of the petals will expose the whole egg; then again four or five thicknesses of petal may be removed and expose only the tip of the egg. A few eggs have been observed that were placed inside the petal, so that the egg was detected only by a protuberance or bulge in the petal that appeared somewhat clearer in color than the surrounding parts. In wild roses or in buds with a few petals the eggs may be placed directly among the stamens.

NUMBER OF EGGS—The number of eggs deposited by females varies considerably. The average number of eggs deposited by 64 females was 37. The maximum for one female was 143, and the minimum 16. The largest number deposited by one female in 24 hours was eight.

Most of the eggs are deposited from the latter part of May to the middle or latter part of July. One record shows eggs deposited as late as August 21, but this is unusual.

INFLUENCE OF TEMPERATURE—Temperature is an important factor in the incubation of the eggs. In the latter part of May the eggs hatched in about 11 or 12 days; in July, when the temperature was considerably higher, they hatched in 8 or 9 days. The average period of egg incubation was 10.47 days, the minimum 8 days, and the maximum 15 days. Eggs deposited on the same day varied as much as 4 days in the hatching time.

The eggs when first laid are almost pearly white in color, turning a pale yellow in about 6 or 8 days. The mouth parts, especially the mandibles, can be seen through the egg shell about 36 hours before hatching.

Figure 4—Feeding punctures on rose flowers and injured buds

Larvae

Although considerable time was spent attempting to see a larva emerging from an egg, that event was never observed. The larvae can be seen moving inside the eggs about 36 hours before hatching. The remaining eggshells have a small cut in them as though the larvae used the mandibles in cutting the hole through the shell. The empty shells keep their shape and are somewhat transparent.

The newly hatched larvae are about 2 mm long by .7 mm wide, and coiled. The mouth parts are somewhat darkened. Transferring the newly hatched larvae to rosebuds was seldom successful. The small larvae, under natural conditions in the dried buds, are found among the stamens in most cases. Probably the pollen is their main food when first hatched. Later, when the larvae become two-thirds grown or almost full grown, they are practically always found in the base of the dried bud. The buds may remain attached to the plant or fall to the ground. With some varieties the injured buds drop readily.

When fully grown the larvae leave the buds and enter the ground, where they pass the winter in small earthen cells about 6 mm in diameter and about ½ to 2 inches below the surface. Larvae were dug up from the soil beneath rosebushes in October, November, February, March, April, and early May. From other observations made, this period may extend from July to May. A few larvae dug up in April did not pupate but remained all summer and winter as larvae. This would indicate that a few larvae may not transform to pupae the following spring but remain over for two winters as a safety factor against unfavorable conditions. When about ready to transform, the larvae become somewhat thickened and less coiled.

A few larvae periods were obtained by exposing buds to laying females for a day and keeping these buds until the larvae emerged from them. This gave larvae periods of 93 and 142 days. From field material collected in early summer, larvae emerged from the buds July 16 to October 6. This would indicate that the larvae period may be as short as 45 or 50 days.

Pupae

When first transformed the pupae are about the size of the adult, and they are white. In a day or two the facets of the compound eye show as brown spots. In 5 or 6 days more the eyes, mandibles, tarsi, and caudal spines become light brown. These gradually darken until the pupae transform to adults.

Pupation takes place in the earthen cells. The pupae habitually lie on their backs and can move around quite readily in their cells by means of abdominal movements, aided by the caudal spines.

Adults

EMERGENCE FROM PUPAL CELL—To determine the age of the adult beetle before it works its way to the surface of the ground, pupae that were about ready to transform into adults were placed in the bottom of a small glass vial covered with a pupal cell and then covered with an inch of dirt. The glass bottom permitted observations.

It takes the adult 4 or 5 days to become fully colored and hardened, and a day or 2 to work its way to the surface. In the dry soil the adult was apparently unable to work its way to the surface, but when the soil was moistened it reached the surface in a day and started feeding soon after. In the rearing cages, where the pupae were not covered with earth, feeding took place in 4 days. This is probably a shorter time than it would take under natural conditions. (Cover illustration shows adult beetles.)

FEEDING HABITS—The beetles after emerging soon begin feeding, usually on the young growing tip of the rose shoots, eating the young leaves or stems, or on the rosebuds. The tip of a shoot may be killed. Feeding punctures may be numerous in buds and flowers,

Figure 5—Typical injury to buds

giving them a riddled and ragged appearance when fully open. The adult beetles emerge the latter part of May and the first part of June, and at that time they feed largely on the early varieties of roses such as the yellow Persian. Later, as the buds on these become scarce, they feed on the later varieties such as the hybrid-teas and wild roses.

When making the puncture for egg deposition, the female removes the material by eating it. Females in rearing cages have deposited as many as eight eggs in 24 hours, which would destroy as many buds. Feeding punctures may be made at the rate of four or five per minute and as many as 40 to 50 a day in the cages.

When disturbed the beetles draw in the feet and depress the beak, usually dropping off the plant and remaining motionless for some time. When falling at the base of a rose plant among the prickly stems, they are well protected and difficult to find. Rarely the beetles fly when disturbed.

MATING—Mating was observed to take place at all times of the day, both in the rearing cages and under natural conditions. Each female and male may mate several times with different individuals.

On several occasions, both in cages and out of doors, males were seen fighting, using their beaks raised above their opponents and bringing them down with considerable force.

LENGTH OF LIFE—The average length of life of the adults after emerging is about 7 weeks. The average length of life of 109 beetles was 41.78 days. The males averaged 43.06 days and the females 40.72 days. Two females lived 97 days, but this is unusual. There is one brood annually.

Natural Enemies

In studying this insect only one larval parasite was found associated with it, but it evidently is not numerous enough to check the development to any great extent. About 200 larvae were dug up from natural conditions in the soil, and only six were parasitized. Of this number four parasites spun cocoons, and only one adult was secured. This parasite was determined by R. A. Cushman, specialist on Ichneumonidae, U. S. D. A. Bureau of Entomology, as *Temelucha* sp.

Prevention and Control Measures

In working out control measures for this pest two methods showed promise of being practical. First, the destruction of the adults as they appeared on the plants before injury was done; and second, the destruction of the overwintering larvae in the soil.

According to the available published accounts on *Rhynchites bicolor* Fab., hand picking of adults and use of arsenical sprays have been recommended as control measures.

Hand picking of the adults cannot be relied upon to control a pest of this kind. At best it reduces slightly the number of adults; some beetles will escape by dropping to the ground, and others will be overlooked. If clumps of roses are near the plants to be protected, they will furnish an almost continuous supply of beetles which will sooner or later find the prized plants and destroy many of the buds. If the picking is carried out daily, the beetles may find their way to the plants shortly after the operation has been carried out and destroy many buds before the next picking time.

A number of materials were tried out for control of the adults in cages where a definite check-up on results could be obtained. The results are shown in table 1. In numbers 2 and 3 the poisons were used at the rate of 1 pound to 40 gallons of water. Number 3 contained calcium caseinate at the rate of 4 ounces to 40 gallons. Some

Cage number	Material used	Amount used	Date	Number beetles	1
1	Paris green	1 lb.-100	June 4	10	....
		Feeding punctures			9
2	Lead arsenate	1 lb. to 40	June 4	10	....
		Feeding punctures			68
3	Lead arsenate	1 lb. to 40	June 4	10	....
		Feeding punctures			90
4	Calcium arsenate dust	Undiluted	June 4	10	9
		Feeding punctures			9
5	Sodium fluosilicate dust	1 lb. to 9 lbs. lime	June 4	10	....
		Feeding punctures			21
6	Sodium fluoride dust	1 lb. to 9	June 4	10	....
		Feeding punctures			74
7	Check		June 4	10	....
		Feeding punctures			178
8	Calcium fluosilicate dust	1 lb. to 9	June 4	10	1
		Feeding punctures			61
9	Calcium arsenate dust	1 lb. to 9	June 12	10	1
		Feeding punctures			7
10	Calcium arsenate dust	Straight	June 12	10	7
		Feeding punctures			0
11	Check		June 12	10	....
		Feeding punctures			190
12	Sodium fluosilicate	Straight	June 16	....	2
		Feeding punctures			3
13	Calcium fluosilicate	Straight	June 16	9	1
		Feeding punctures			....
14	Calcium arsenate	Straight	June 16	7	4
		Feeding punctures			0
15	Calcium arsenate	Straight	June 29	15	6
		Feeding punctures			3
16	Calcium arsenate	Straight	June 29	15	9
		Feeding punctures			0

Length of life in days								Beetles	Total punc-	Per- cent	Number days
2	3	4	5	6	7	8	9	alive	tures	kill	in test
2	....	1	....	2	3	....	1	1	....	90	9
129	140	34	40	36	42	7	12	....	449	....	....
1	1	1	2	....	3	....	....	2	....	80	9
140	126	49	52	60	50	48	42	....	635	....	....
1	....	....	....	5	1	....	1	2	....	80	9
174	75	49	35	40	49	30	15	....	557	....	....
1	....	....	....	....	....	....	....	....	....	100	2
....	....	....	....	....	....	....	....	....	9	....	....
2	7	1	....	....	....	....	....	....	....	100	4
129	29	....	....	....	....	....	....	....	179	....	....
3	6	1	....	....	....	....	....	....	....	100	4
54	64	....	....	....	....	....	....	....	192	....	....
....	....	2	....	....	....	....	....	8	....	20	9
176	66	57	120	129	235	147	151	....	1259	....	....
2	1	3	....	2	1	....	....	....	....	100	7
97	69	50	16	6	....	....	....	....	299	....	....
3	2	2	2	....	....	....	....	....	....	100	5
3	10	7	....	....	....	....	....	....	27	....	....
2	1	....	....	....	....	....	....	....	....	100	3
0	0	....	....	....	....	....	....	....	0	....	....
....	....	1	....	....	....	....	....	9	....	10	9
120	59	244	86	....	....	....	....	....	699	....	....
3	4	....	....	....	....	....	....	....	....	100	3
2	....	....	....	....	....	....	....	....	5	....	....
2	3	1	1	1	....	....	....	....	....	100	6
12	11	2	....	....	....	....	....	....	25	....	....
2	1	....	....	....	....	....	....	....	....	100	3
0	0	....	....	....	....	....	....	....	0	....	....
6	3	....	....	....	....	....	....	....	....	100	3
3	3	....	....	....	....	....	....	....	9	....	....
6	....	....	....	....	....	....	....	....	....	100	2
0	....	....	....	....	....	....	....	....	0	....	....

of the dust materials were used straight; others were mixed 1 part to 9 parts of hydrated lime. The liquid materials were applied to the rosebuds by means of a bucket pump, and the dust materials with a hand duster.

It will be noticed that, while the liquid sprays of paris green and lead arsenate gave some protection, it was much less than that given by the materials applied as dust. Both the paris green and lead arsenate appeared to repel the beetles from feeding for a time. Of the poisons applied as dusts, the calcium arsenate gave the quickest kill and the least number of punctures. Several tests gave a 100-percent kill without a single puncture. This fact led to special observations to see how the beetles obtained the poison without feeding on the foliage. It was found that the beetles crawling over the dusted material soon became covered with dust; and the dust, sticking on their feet, prevented their crawling up the sides of the glass cage, a practice which is easily done when no dust is present. The beetles also had difficulty in crawling over the dusted rosebuds. Within a few minutes' time some of the beetles began cleaning their feet and legs by rubbing them together and over the body. The antennae were cleaned by pulling them through the mouth parts by the aid of the front legs. When the antennae passed through the mouthparts,the mandibles were held open and the maxillae worked rapidly, scraping the dust from the surface. It appears that in cleaning the antennae in this manner the beetles obtain a lethal dose of poison and are killed in 24 to 72 hours.

Several field tests with calcium arsenate showed very promising results. Here, as in the cages, the beetles were seen cleaning themselves soon after encountering the dusted material. One beetle was unable to crawl up the dusted surface of a leaf which was at an angle of about 85°. This beetle was able to keep from falling off the leaf only by using the tarsal claw, which caught over the edge of the leaf. Another beetle was observed having great difficulty in crawling over the surface of a dusted bud.

On July 1, which is past the period of heaviest injury, seven Teplet bushes were dusted with calcium arsenate after removing 27 injured buds. On July 6 one adult was seen feeding on this plot, and the plants were again dusted. On July 12 beetles were again seen feeding on the buds. This time three injured buds were removed before dusting. No more beetles or injured buds were noticed on this plot. Other tests on small plots showed similarly promising results.

Table 2 shows the results of treating the larvae with carbon disulphide emulsion. In preparing carbon-disulphide emulsion for larval control, several methods were tried. Leach (3) gives two methods of making it. The ingredients of his emulsion number 1 are: 10 parts by volume of carbon disulphide, 1 part by volume of cold water soluable rosin fish oil soap, and 3 parts by volume of water. The emulsion is prepared by placing the soap and water in a churn or ice cream freezer and turning the handle until an even mixture is obtained. The carbon disulphate is then added to the mixture of soap and water in the churn, and the handle turned for about 2 minutes, or until the mixture emulsifies as indicated by a change in color and a cream-like consistency of the liquid. The writer used a bucket pump and obtained a good, even emulsion. This emulsion has the disadvantage that, if left standing in containers for any length of time, it has a tendency to separate or stratify and must be thoroughly shaken before being used.

Leach's emulsion number 2 is made up containing 135 cc of 7 percent sodium hydroxide solution and 50 grams of powdered rosin. Four hundred forty cc of water are added and the mixture thoroughly agitated. To this 50 cc of oleic acid are added and again mixed. Only the best grades of sodium hydroxide, rosin, and oleic acid should be used. Thirty parts of this mixture are added to 70 parts of carbon disulphide and the mixture agitated in a churn or with a bucket pump until emulsification occurs. This emulsion will separate or stratify but very little on standing or when stored.

The most satisfactory emulsion was obtained by following the recommendations of Fleming (4). This emulsion is made containing 13.5 grams of potassium hydroxide, 193 cc of 95 percent ethyl alcohol, 77 cc of oleic acid, 700 cc of carbon disulphide, and 30 cc of cottonseed oil. Prepare the emulsion by first dissolving the potassium hydroxide in alcohol and filtering off the unsoluble carbonate. The concentration is then determined and enough added to produce 13.5 gms in 193 cc of alcohol. To this add 77 cc of oleic acid. Then add 700 cc of carbon disulphide and 30 cc of cottonseed oil to each 270 cc. This emulsion is homogeneous and does not separate when standing for long periods. It is designated as number 3 in table 2.

The easiest way found to make an emulsion of carbon disulphide is to mix 30 parts by volume of a commercial oxidized gas oil product with 70 parts of carbon disulphide. This mixture will readily make an emulsion when mixed with water.

All these emulsions appear equally effective against the larvae. In diluting the stock emulsion with water it is best to mix the emulsion with an equal amount of water and thoroughly agitate before mixing with large volumes of water.

In the first test of the emulsion on larvae only small numbers were used, as the material was saved for life-history work. In these tests the emulsion was diluted 4.5 cc to 8 liters, as recommended by Leach and Johnson (5) for control of the larvae of the Japanese beetle. This strength, which is about .075 percent carbon disulphide, was found to be too weak to kill the larvae. After 48 hours in the soil moistened with this solution the larvae appeared to be killed but recovered soon after. The second strength used was one part stock emulsion to 199 parts of water, making a carbon disulphide content of .35 percent which was applied at the rate of 1 quart to a square foot of soil surface. This gave satisfactory killing, as is shown in table 2.

TABLE 2—*Results of carbon disulphide emulsion on larvae*

Experiment number	Emulsion number	Percent CS_2 in emulsion	Date treated	Number larvae	Larvae dead at end of 3 days	Larvae missing	Percent larvae killed
			1926				
1	2	.075	May 15	4	0	—	0
2	2	.35	May 18	4	4	—	100
3	2	.35	Nov. 15	3	—	3	—
4	2	.35	Nov. 16	5	4	1	80
5	2	.35	Nov. 24	10	10	—	100
6	2	.35	Nov. 24	10	9	1	90
7	Check	—	Nov. 24	10	0	1	0
8	Check	—	Dec. 29	10	1	1	10
9	2	.35	Dec. 29	10	9	—	90
10	2	.35	Dec. 29	10	7	1	70
			1927				
11	3	.35	Feb. 15	15	14	1	93

To see if this strength of .35 percent would injure lawn or rosebushes, four tests were made on lawn and four on rosebushes, applying it at the usual rate of 1 quart to 1 square foot. No injury was noticed on either lawn or rose bushes. Testing double this strength of emulsion (.7 percent) showed that the lawn was readily killed in 48 hours, and the leaves of a baby rambler rose showed drooping. The leaves fell off a few days later, but in 3 weeks new growth was appearing. This same strength did not injure Teplet roses when treated in a similar manner.

The ideal procedure for control of this insect would be a combination of carbon disulphide emulsion treatment on the larvae, dusting with calcium arsenate for the adults, and hand picking the injured buds and any beetles noticed.

Treatment of the soil around rose bushes, on which no previous control had been used, would prevent most of the adults from appearing. This would probably not be practical on bushes treated the season before. Probably 50 to 95 percent of the larvae could be killed, but this could not be relied on to prevent beetles coming in from surrounding bushes.

Dusting with calcium arsenate could be carried out very effectively alone or in combination with the carbon disulphide treatment.

Hand picking and destruction of injured buds would eliminate the possibility of development of a few beetles that would be missed by the other two methods.

Summary of Control Measures

1. Hand picking of the beetles as they appear on the rosebuds does not prevent serious injury.
2. Hand picking the injured buds and destroying them prevents the development of the larvae and gives protection for the following year.
3. The adults are controlled best by the use of calcium arsenate applied as dust to the foliage of the plants.
4. Carbon disulphide emulsion, .35 percent strength, applied at the rate of 1 quart to a square foot, gave good control on the overwintering larvae.

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