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CONTROL OF WEEVILS IN STORED BEANS AND COWPEAS

By
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Injury caused by the bean weevil

KNOXVILLE, TENNESSEE

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CONTROL OF WEEVILS IN STORED BEANS AND COWPEAS

By S. MARCOVITCH

INTRODUCTION

Wherever beans and cowpeas are grown or stored they are subject to infestation by the bean weevil (*Mylabris obtectus*) and the cowpea weevil (*M. quadrimaculatus*). If measures of protection are not adopted against the ravages of these pests, total destruction may follow.

The main reliance for their control is placed on fumigation with carbon disulphide. In 1917, Metcalf[1] found that when cowpeas were stored and mixed with lime they remained free from weevils. Because of the low cost of lime, and the fire hazard connected with the use of carbon disulphide, experiments were planned at the Tennessee Station with a view to finding out more about the possibility of protecting beans and peas by means of dusts. The experiments included different proportions of lime, various clay dusts, fluorine compounds, and other dusts.

FEEDING HABIT OF THE ADULT WEEVIL

Paddock and Reinhard[2] have this to say in regard to the feeding habits of the adult weevil: "The cowpea weevil has not been observed to feed on any solid food in the adult stage, and the cowpea is injured only by the feeding larva. . . . In the field the adults feed almost exclusively upon nectar secreted by nectaries located at the base of the green pods."

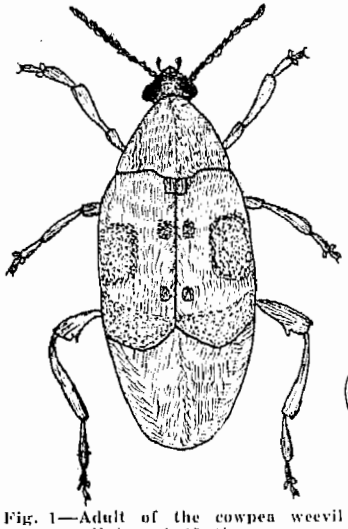


Fig. 1—Adult of the cowpea weevil Enlarged 15 times

It appears, then, that the adults are not equipped to eat solid food. They assiduously avoid all extraneous material. When dusted

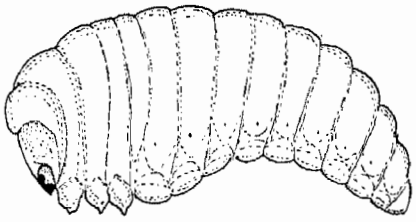


Fig. 2—Larva of the cowpea weevil Enlarged 15 times

with any fine dust they immediately bring into play the "cleaning-up" habit and attempt to remove the dust particles by licking their feet

[1]Metcalf, Z. P. Lime as an insecticide. Jour. Econ. Ent. 10: 74. 1917.
——— The bean and pea weevils. 41st Annual Report. N. C. Agr. Exp. Sta., p. 46. 1918.

[2]Paddock, F. B., and Reinhard, H. J. The cowpea weevil. Texas Agr. Exp. Sta., Bul. 256. 1919.

and antennae. Inert particles of lime or clay thus swallowed cause the death of the weevil. That the adults do not feed on the bean is indicated by the fact that they will die if allowed to crawl over finely ground beans on which the larvae may develop. The "cleaning-up" habit is stimulated by particles of ground beans just as by particles of lime.

It is possible that the dusts have a desiccating action, for weevils dusted with finely divided clay and placed in a moist chamber did not die after 36 hours, while those kept under laboratory conditions did. Weevils dusted with calcium chloride, which has a desiccating action, died within 6 hours, whereas others dusted with hydrated lime were not affected within that time. It is well known that fine clays have a greater absorptive capacity for water than chalk or talcum. Tests also showed that clay is more toxic than lime.

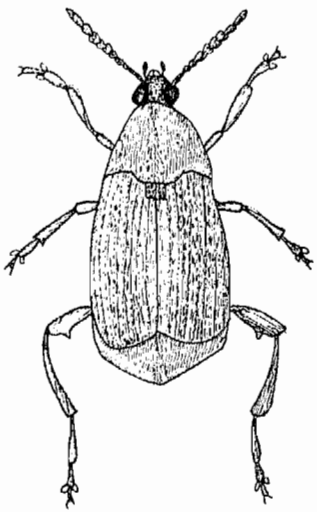


Fig. 3—Adult of the bean weevil Enlarged 15 times

Hockenyos[3], working on the effect of dusts, such as magnesium carbonate, on the Oriental roach (*Blatta orientalis*), also came to the conclusion that death was caused by loss of moisture, which may account for the injurious effect of dusts on some insects.

Mixing Milltown ball clay No. 9, 200-mesh, with beans, Headlee[4] prevented infestation by the bean weevil. Headlee believes that the "inability of the larva to enter the bean which has been coated with a dust is due to its inability to grapple the surface of the bean firmly enough to give it a foothold." Newly hatched larvae, when allowed to crawl over a clay dust, quickly succumb, and it is likely that desiccation affects the larvae as well. Whatever the cause, the fact remains that comparatively inert dusts will protect beans from the ravages of the bean weevil. Toxic materials, such as the fluorine compounds, cause the death of the weevil in a much shorter time.

EXPERIMENTAL

METHODS

Metcalf (1917) states that he protected his cowpeas by "treating" them with lime at the rate of 1 part of lime to 2 parts of peas. From this statement it is difficult to tell just how the peas were handled or

[3]Hockenyos, G. L. Effects of dusts on the Oriental roach. Jour. Econ. Ent. 26: 792. 1933.
[4]Headlee, T. J. Climate and insect investigations. 36th Annual Report N. J. Agr. Exp. Sta., p. 265. 1923.

mixed with the lime. After a few tests it was found that the method and thoroughness with which the peas are mixed are of decided importance. The more thorough the mixing, the less dust is required for protection.

In order to insure uniformity of infestation, a batch of beans were infested with adult weevils (*Mylabris obtectus*). After 38 days, just previous to the time the new brood was ready to emerge, the beans were thoroughly shaken and mixed in a large jar to insure a uniform infestation. Lots of 200 grams of beans were weighed out and placed in 1-quart Mason jars, after which the dusts were added at various rates. The glass covers were then replaced, and the jars were rolled and shaken back and forth for several minutes. After this procedure, the jars were allowed to remain in the laboratory at room temperature, which varied from 65° to 90°F. After the initial emergence of the weevils, all breeding ceased where the dusts were effective. Where no protection was afforded, the beans became badly infested within 2 months and finally decayed. With this method the results were clear-cut, and were recorded, after a period of 3 months, as "infested" or "non-infested."

RESULTS OF DUST PROTECTION

As shown in the table on page 6, hydrated lime, when mixed at the rate of 1 part of lime to 65 parts of beans, gave excellent protection against the bean weevil. Metcalf, on the other hand, recommends 1 part of lime to 2 parts of beans or peas, and for amounts less than a gallon, 4 times as much lime as seed. That Metcalf found it necessary to use such large amounts of lime is strange in view of our results with very much smaller amounts. But, as indicated previously, the thoroughness of the mixing may be an important factor, which is not stressed in Metcalf's recommendations.

Wade[5] obtained protection against the cowpea weevil by using 1 part of lime to 8 parts of seed. Here again the method and the importance of mixing are not discussed, although results were secured with much smaller amounts of lime than were used by Metcalf.

Anderson clay gave no weevil damage at the rate of 1 part to 75 parts of seed.

Copper carbonate was used successfully against grain weevils when mixed at the rate of 2 ounces per bushel[6]. This is approximately 1 to 500. When used at this strength, copper carbonate also gave protection against the bean weevil.

Sodium fluosilicate, when used at the rate of 1 to 1000, was effective in preventing weevil damage. With a fine grade of this material, 1 to 2000 was effective.

Sodium fluoride and barium fluosilicate were likewise effective

[5]Wade, O. T. The four-spotted cowpea weevil. Okla. Agr. Exp. Sta., Bul. 129. 1919.
[6]Mackie, W. W. Prevention of insect attack on stored grain. Col. Agr. Exp. Sta., Cir. 282. 1930.

in strengths of 1 to 1000, while cryolite (natural and synthetic) at the same strength did not give protection.

Flint[7] obtained protection against grain insects by dipping corn ears in 1-10 oil emulsion. This method was tried against the bean weevil, but was not successful in preventing damage.

In a few tests with the grain weevil (*Sitophilus granaria*), hydrated lime 1-10 was of little value. Sodium fluosilicate, however, at the rate of 1 part to 1500 parts of grain, gave protection. There was some indication that this material was of value against the Angoumois grain moth (*Sitotroga cerealella*). It also appears promising as a protection to grain that is to be used for seed purposes.

Effect of various dust treatments on bean-weevil infestation

Treatment	Dosage	Degree of infestation
Copper carbonate	1-1000	Severe
Copper carbonate	1-500	None
Sodium fluosilicate	1-1000	"
Sodium fluoride	1-1000	"
Cryolite (natural)	1-1000	Severe
Cryolite (synthetic)	1-1000	"
Barium fluosilicate	1-1000	None
Wheat flour	1-3	Severe
Road dust	1-100	"
Wood ashes	1-500	"
Anderson clay	1-75	None
Anderson clay	1-100	Severe
Oil emulsion	1-10	"
Lime	1-50	None
Lime	1-65	"
Lime	1-75	Severe
Lime	1-100	"

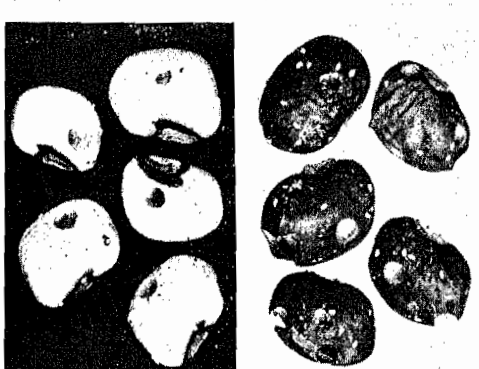


Fig. 4—Infested cowpeas
The small white spots are eggs of the adult weevil

FUMIGATION

Naphthalene

Flaked or powdered naphthalene, when used in air-tight containers at the rate of 1 pound to each 50 cubic feet of space, gave excellent protection. Similar results were secured with paradichlorobenzene. Beans for table use should not be treated in this manner, since the odor is difficult to get rid of.

Carbon Disulphide

Fumigation with carbon disulphide is an effective method of destroying bean weevils. Wade (1919) recommends 5 pounds for

[7]Flint, W. P., and Mohr, C. O. New protection against stored grain insects. Ill. Agr. Exp. Sta., Bul. 359. 1930.

each 1000 cubic feet of space in a tight enclosure. The fumigation should be repeated twice, at intervals of a week, in order to kill all the eggs and larvae within the beans.

For best results, an air-tight container, such as a barrel or can, should be employed on days when the temperature is 75° F. or higher, and the liquid poured over the top of the seeds to be fumigated. Fumigation should continue for 48 hours. One of the drawbacks to the use of carbon disulphide is the danger of explosion when fire is near.

HEAT

The bean weevil readily succumbs to high temperatures. Adults exposed to 131° F. live but 5 minutes. Within the beans it takes 20 minutes to kill the larvae[8]. In actual practice short exposures are not effective because several hours are required for heat to penetrate within the receptacle. For best results, therefore, the beans or peas should be spread out in shallow layers and subjected to a temperature of 130° to 135° for an hour.

COLD

At 50°F. the bean weevil ceases to develop[9]. Beans and peas can therefore be protected from infestation by being kept in cold storage at 32° to 34°.



Fig. 5—Jar of beans protected by lime, 1 part to 50, thoroughly mixed

DIRECTIONS FOR CONTROLLING THE BEAN AND COWPEA WEEVILS

First of all it is essential to remove all breeding places. Weevils are known to breed in storerooms and piles of bean straw left scattered about. Unprotected beans and peas thus breed enough weevils to furnish sources of infestation each summer. The seed should be threshed as soon as possible. Weevily seed should not be used for planting.

As soon as the beans or peas are harvested they should be placed in closely woven sacks or other tight containers in order to prevent infestation from without. Where the seed is known to be free from infestation, a layer of lime about an inch thick placed on top of a container should prevent weevils from entering.

[8]Manter, J. A. Notes on the bean weevil. Journ. Econ. Ent. 10: 190. 1917.
[9]Back, E. A. Weevils in beans and peas. U. S. Dept. of Agr. Far. Bul. No. 1275.

If the beans or peas are to be used for food, and are suspected of being infested, they may be mixed with air-slacked lime at the rate of 1 part to 50, or about 1 pound of lime to a bushel. Thorough mixing is essential. A simple method is to place the lime, with the beans or peas, in a can or drum and rotate it for several minutes. If the mixing is not thorough, a larger amount of lime is necessary—perhaps 6 pounds to a bushel.

Where beans and peas are stored for seed purposes they can be protected by the lime in the same way, or by mixing about 1 ounce of sodium fluosilicate with each bushel of seed. Warehouses may have machinery available for treating large quantities. If beans or peas treated with sodium fluosilicate are to be used for food, they should be thoroughly washed or rinsed.

Placing ground moth balls or flaked naphthalene in an air-tight container with the beans or peas is also a simple method for preventing infestation when they are to be used for seed only. Beans or peas that are to be used as food should not be stored with naphthalene or paradichlorobenzene, since the odor may be detected even after cooking.

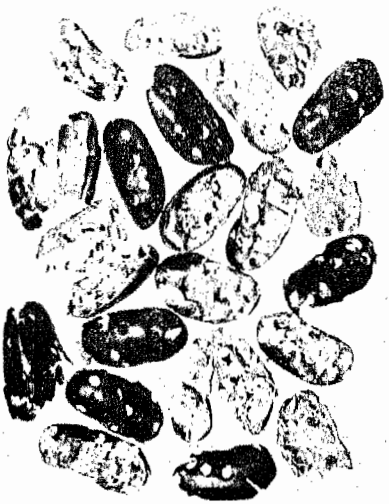


Fig. 6—Beans injured by weevil where no dust protection was given

SUMMARY

1. The bean weevil (*Mylabris obtectus*) and the cowpea weevil (*M. quadrimaculatus*) do not eat any solid food in the adult stage. When allowed to crawl over dust particles, such as hydrated lime or clay, the "cleaning-up" habit is stimulated, resulting in the death of the weevils.

2. Beans or cowpeas to be used for food may be protected by being thoroughly mixed with hydrated lime at the rate of 1 pound of lime to a bushel of seed.

3. Beans or cowpeas stored for seed purposes may be protected by lime, as above, or mixed thoroughly with sodium fluosilicate at the rate of 1 ounce to a bushel of seed. Seed beans may also be stored in air-tight containers with flaked naphthalene or paradichlorobenzene at the rate of 1 pound to 50 cubic feet of space.

4. Grain was protected from the grain weevil (*Sitophilus granaria*) by mixing with sodium fluosilicate at the rate of 1 part to 1500 parts of grain.