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CULTURAL PRACTICES IN RELATION TO MEXICAN BEAN BEETLE CONTROL

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Abstract

The effect of spacing of bean plants on injury caused by the Mexican bean beetle (*Epilachna corrupta*) and on effectiveness of control measures is discussed.

The effect of spacing of plants on yields of string beans has received considerable attention. Bailey (1) recommended that bush beans be grown in drill rows, the plants standing 5 to 10 inches apart in the row. Sevey (2) quotes results of various experiment stations showing that drilled rows yield better than hills and that plants spaced 4½ inches apart gave a maximum yield over 3, 6, 9, 12 and 18 inches. Thompson (3) states that garden beans are usually seeded 2 to 4 inches apart, "but 2 inches is too close for any variety. Spacing 4 to 6 inches apart would give better results with most garden varieties." More recently Gillis (4) has reported results of a long series of experiments on the relation between spacing of plants and yields., He concludes that the size and type of plant, amount of rainfall, and soil fertility greatly influence yields. In spacings from 1 to 4 inches apart in the row he obtained an increased yield in favor of closer planting in every case but one in two-year trials with three common varieties. However, the differences between seeding at the rate of 9 and 12 plants to a foot were generally small. In another report, Gillis (5) concluded that the increases in yield from 1-inch spacing over 1 1/3 inch would not pay for increased cost of seed in all cases. He also called attention to the fact that these rates would apply to very favorable soils.

Nothing definite has been published in regard to the effect of rate of planting on control of the Mexican bean beetle. Howard and English (6) recommended use of varieties producing a small amount of foliage and planting in rows rather than hills in order to aid the effective application of insecticides. Other workers have advised general practices that lead to good growing conditions and quick maturity of the crop.

During the past season the writers have studied the effect of rate of planting string beans in relation to control of the Mexican bean beetle. This report is not complete but gives the results of a single season's study.

Soil. The fertility of the soil influences relative yields from various spacings considerably. These tests were made on the Connecticut Experiment Station farm at Mount Carmel. The soil is Cheshire loam, an upland soil not particularly favorable to bean production. The plot received an application of 5–8–7 fertilizer in April, 1932, at the rate of 2,000 pounds to the acre. The analysis made by the Soils Department of the Connecticut Experiment Station is given in Table 1.

TABLE 1. ANALYSIS OF SOIL FROM BEAN PLOTS

Mechanical	
Colloids	20.5 per cent
Fine sands	40.5
Medium and coarse sands	39.0
Chemical	**Total pounds per acre**
Calcium	10,350
Magnesium	5,196
Potash	23,424
Phosphorus	1,500
Nitrogen	2,010
Available nitrogen	100
Available P_2O_5	200
Reaction pH	7.2

WEATHER. The precipitation for the period of the experiment is given in Table 2. A large deficiency in rainfall accumulated in May, June and July, and the soil was particularly dry during the time the beans were picked.

TABLE 2. PRECIPITATION AT MOUNT CARMEL, 1932

Month	Total precipitation	Deficiency from normal
April	2.825 inches	.695 inches
May	1.700	1.990
June	2.570	.525
July	1.775	2.545
Accumulated deficiency from Jan. 1 to August 1		5.2 inches

EXPERIMENTAL RESULTS. Bountiful and Black Valentine varieties were used in the two series of tests. Bountiful is a common commercial variety and produces a bushy plant with large leaves. Black Valentine is less commonly grown and produces a small compact plant with small leaves. Each variety was planted in 6-row plots, the rows being 10 feet long and 30 inches apart. The spacings were 2, 4, 6, and 8 inches apart in the row. A Latin square arrangement was used, each spacing occurring in four different plots. The seeds were planted by hand and a yardstick was used to insure accurate spacing. All plots were planted May 23, sprouted June 2 and blossomed early in July. Three rows of each plot were sprayed, and three rows left unsprayed. Magnesium arsenate at the rate of three pounds to 100 gallons of water, plus 2 pounds of calcium caseinate, was applied to the under surface of the leaves on June 25 and July 11 for control of larvae. A barrel sprayer and rod with an angle nozzle were used in the application. The amount of spray material used for each series is given in Table 3.

TABLE 3. SPRAY MATERIAL USED—SECOND APPLICATION

Variety	Spacing	Total gallons used
Bountiful	2 inch	10.5
	4 inch	6.0
	6 inch	5.5
	8 inch	6.0
Black Valentine	2 inch	7.0
	4 inch	5.0
	6 inch	3.0
	8 inch	3.0

Black Valentine, being a smaller-leaved variety, required much less spray material, and the 2-inch spacing with each variety required a much larger amount than the other spacings for the same total length of rows.

BEAN BEETLE INJURY. Over-wintering adults appeared on June 6, and some foliage injury was noted June 15. On June 16 a count of the egg-masses present on one row of each of two plots of each spacing was made (Table 4). In the case of Bountiful beans the number of egg-masses on the 2-inch plots was much greater in proportion to the number of plants than on the 4-inch plots, and in the case of the Black Valentine variety slightly greater.

Table 4. Egg-mass Counts—Mexican Bean Beetle

Variety	Spacing	Number egg-masses
Bountiful	2 inch	32
	4 inch	8
	6 inch	7
	8 inch	4
Black Valentine	2 inch	38
	4 inch	16
	6 inch	14
	8 inch	16

On July 13 the unsprayed plots showed considerable larval injury, the 2- and 4-inch plots being more severely damaged than the 6- and 8-inch plots. On July 29 the 2- and 4-inch plots were defoliated, while the 6- and 8-inch plots were much less seriously damaged.

Yield. The pods were picked by rows, the number of pods and total weight being recorded. Beans of marketable size were picked each time. The pods from the thickly planted plots were small when they were picked, but had reached maximum size. The results are given in Tables 5 and 6.

Table 5. Yield of Bountiful Beans

Spacing	No. plants	Total No. pods	Total yield	Acre yield*	No. pods per plant*	Yield per plant*	No. pods per pound*	Per cent uninjured pods†
				Sprayed				
2 inch	628	7558	59 lbs. 4 oz.	8562 lbs.	12	1.5 oz.	127.5	63
4 inch	322	6635	56 lbs. 4 oz.	8127 lbs.	20.2	2.8 oz.	117.9	93
6 inch	217	5886	54 lbs. 4 oz.	7839 lbs.	27.1	4.0 oz.	108.4	95
8 inch	153	4938	52 lbs. 5½ oz.	7557 lbs.	32.2	5.5 oz.	94.6	93
				Unsprayed				
2 inch	644	5451	40 lbs. 7 oz.	5852 lbs.	8.4	1.0 oz.	134.6	18
4 inch	323	5643	46 lbs. 15½ oz.	6791 lbs.	17.5	2.3 oz.	120.0	23
6 inch	219	5569	51 lbs. 2½ oz.	7398 lbs.	25.4	3.8 oz.	108.8	75
8 inch	169	5289	52 lbs. 13½ oz.	7629 lbs.	30.7	5.0 oz.	100.1	72

*Calculated.
†Second picking.

TABLE 6. YIELD OF BLACK VALENTINE BEANS

Spacing	No. plants	Total No. pods	Total yield	Acre yield*	No. pods per plant*	Yield per plant*	No. pods per pound*	Per cent uninjured pods†
				Sprayed				
2 inch	589	6568	45 lbs. 6 oz.	6560 lbs.	11.1	1.2 oz.	144.6	53
4 inch	287	5807	44 lbs. 9 oz.	6444 lbs.	20.2	2.5 oz.	130.3	79
6 inch	198	5960	49 lbs. 14 oz.	7210 lbs.	30.1	4.0 oz.	119.5	92
8 inch	161	5396	45 lbs. 5½ oz.	6555 lbs.	33.5	4.5 oz.	119.0	85
				Unsprayed				
2 inch	591	6307	41 lbs. 3 oz.	5953 lbs.	10.6	1.1 oz.	153.1	46
4 inch	304	5893	44 lbs. 10½ oz.	6457 lbs.	19.3	2.3 oz.	131.9	64
6 inch	200	5581	45 lbs. 9 oz.	6589 lbs.	27.8	3.6 oz.	121.8	78
8 inch	161	4820	40 lbs. 8½ oz.	5865 lbs.	29.9	4.0 oz.	119.0	80

*Calculated.
†Second picking.

These results show some very striking facts. In the case of Bountiful beans, the yield of the sprayed plots increased with the decreased spacing. The differences were not very large in any case, but the trend is very definite. However, the percentage of uninjured pods was very low on the two-inch sprayed plots, and all other spacings yielded a larger amount of clean beans. On the unsprayed series the yields were definitely lower in the case of the 2, 4 and 6-inch plots than in the sprayed series. There was a slight difference in the 8-inch plots in favor of the unsprayed plots, but this was undoubtedly of no significance. The difference may be due to the fact that more plants survived in the unsprayed series. The 8-inch plot produced the highest yield in the unsprayed series, and the yield decreased markedly with closer spacing. This was due to increased beetle injury where the beans were more thickly planted. The 6- and 8-inch unsprayed plots yielded a smaller total amount of pods than the 2-inch sprayed plot, but had a larger percentage of uninjured pods. Figures 7, 8, 9 and 10 show samples from these plots.

It should be noted that the number of pods per plant, total yield per plant and size of pods increased with increased spacing. In the absence of any definite standards for quality in green beans, the writers assume that the appearance and tenderness of the pods govern the quality. The pods from the 2-inch plots were small and tough. The pods from the 4-inch plots were somewhat better, and the pods from the 6- and 8-inch plots were of good quality.

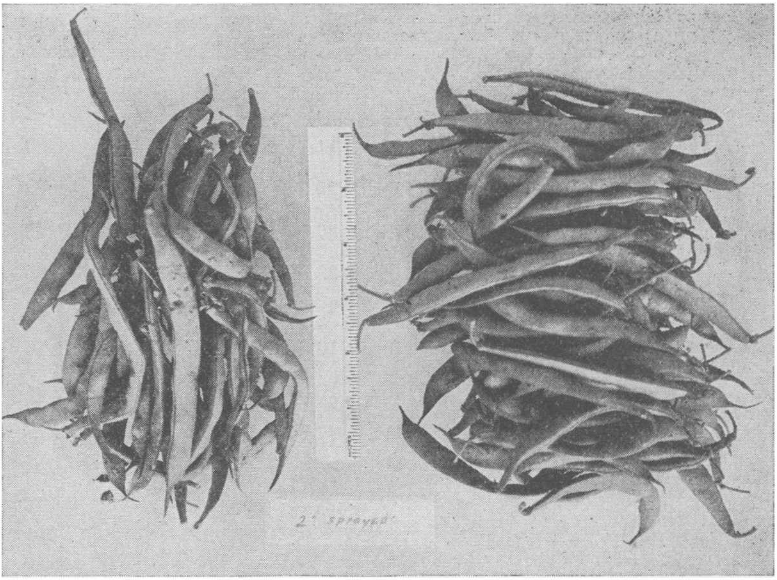

FIG. 7.—Sample of pods from sprayed plants 2 inches apart. Injured pods at left, clean pods at right.

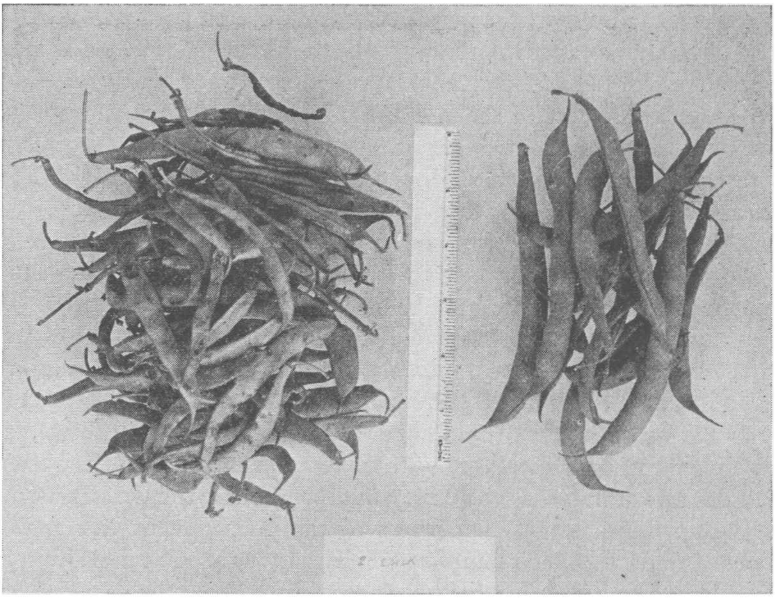

FIG. 8.—Sample of pods from unsprayed plants 2 inches apart. Injured pods at left, clean pods at right.

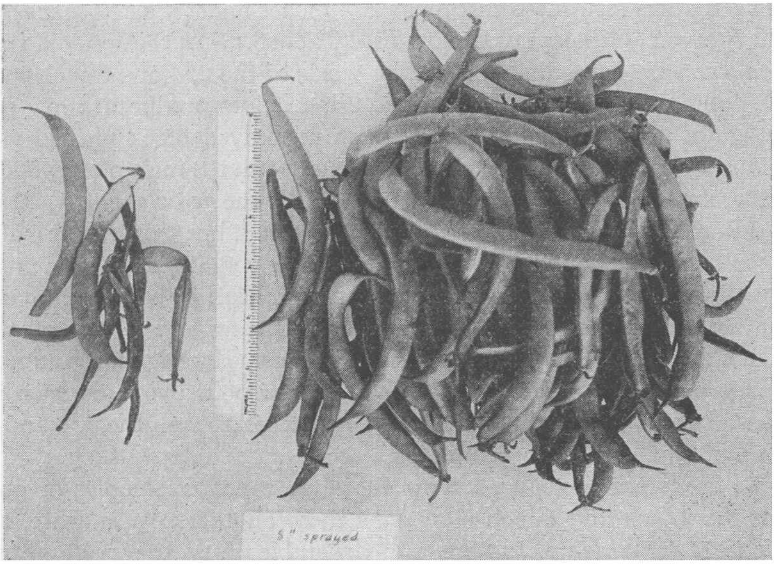

FIG. 9.—Sample of pods from sprayed plants 8 inches apart. Injured pods at left, clean pods at right.

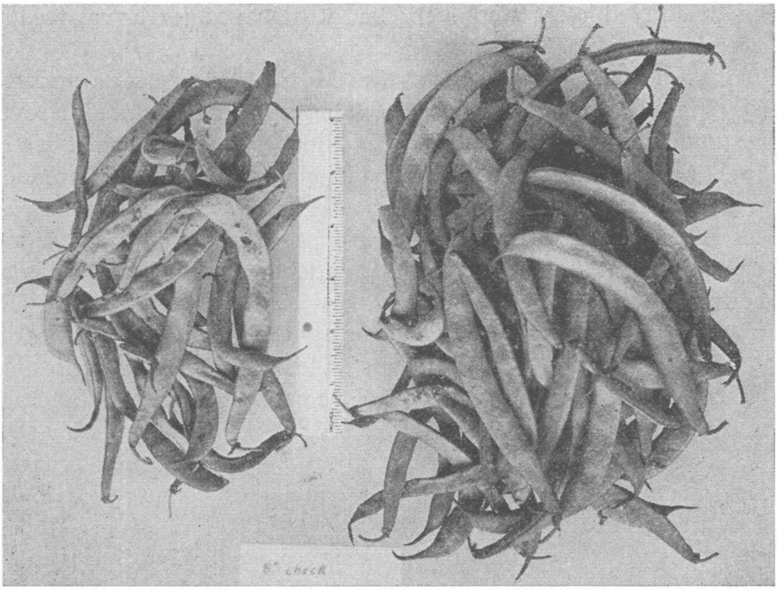

FIG. 10.—Sample of pods from unsprayed plants 8 inches apart. Injured pods at left, clean pods at right.

The Black Valentine beans planted 6 inches apart yielded highest in both sprayed and unsprayed plots (See Table 6.). In the sprayed plots there was very little difference in the yields of the 2, 4 and 8-inch spacings. As in the Bountiful series the 2-inch plots produced a low percentage of uninjured pods. The 6-inch unsprayed block yielded very little more than the 4-inch plot, and the 2- and 8-inch plots yielded smaller amounts. The unsprayed 4-inch plots showed a slightly greater yield than the sprayed plots of the same spacing, but this was probably due to the larger number of plants. The same condition has been noted above in the case of the 8-inch plots of Bountiful. The percentage of uninjured beans decreased with increased spacing and in general was much higher than in the case of Bountiful beans. Here again the number of pods per plant, yield per plant and size of pods increased with increased spacing. The quality of the pods was better on the 4, 6 and 8-inch plots than on the 2-inch plots.

The accompanying plates show the appearance of samples of pods from the 2-inch and 8-inch plots. As these photographs indicate, the pods from the 2-inch plots were not marketable unless they were sorted. There was little difference in appearance between pods from the 4, 6 and 8-inch sprayed plots. The crop from the 6- and 8-inch unsprayed plots was marketable as picked from the vines, but pods from the 2- and 4-inch unsprayed plots were very badly damaged by larval feeding, and were not salable.

Discussion. It is evident that the Mexican bean beetle preferred closely planted beans for oviposition. This preference resulted in severe injury to unsprayed beans planted only 2 inches apart. In spite of very careful hand spraying, this heavy infestation was not sufficiently reduced to protect the pods from feeding injury. It is true that in this study the beetles had a choice of situations for oviposition within a small area, and therefore no statement as to results under commercial conditions can be made. However, the fact that careful hand spraying did not adequately protect beans planted 2 inches apart is sufficient justification for a recommendation to plant beans at least 4 inches apart in areas where the Mexican bean beetle is a serious pest. Under more favorable soil and weather conditions closely planted plants would probably show an increased yield over wider spacings, but there should be no marked differences in relation to bean beetle control as compared with the results obtained in this experiment.

Since this study covers only one growing season, it is hardly justifiable to draw definite conclusions except for the inadvisability of planting beans as close as two inches as mentioned above. The writers expect to continue investigations into the relation of cultural practices to bean beetle injury and control for several seasons.

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INSECTICIDES FOR THE CONTROL OF THE MEXICAN BEAN BEETLE

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Abstract

Field tests over a period of three years indicate that potassium hexafluoaluminate and synthetic cryolite are satisfactory for the control of the Mexican bean beetle (*Epilachna corrupta* Muls.) when used as sprays at the rate of 3 pounds to 50 gallons of water. Barium fluosilicate (80 per cent) must be used at the rate of 5 pounds to 50 gallons of water to give satisfactory control, and is considered too expensive to be recommended. These compounds have not given satisfactory control when used as dusts. There appears to be no advantage in changing current recommendations for the use of magnesium arsenate except that the dosage should be increased from 1 pound to 2 pounds to 50 gallons of water where the infestation is heavy. If fluorine compounds are used, the problem of poisonous residues on green beans is not avoided, and green beans should not be sprayed with any of the above compounds after the pods have set.

The problem of the control of the Mexican bean beetle (*Epilachna corrupta* Muls.) by the use of insecticides has been extensively investigated since the discovery of that insect in the eastern part of the United States in 1920. At the outset it was necessary to find an insecticide which would kill the insect but would not injure the tender foliage of the bean plant. Effort was rewarded in the discovery that magnesium arsenate fulfilled the requirements, but that material is not useful as a general insecticide, and is, therefore, not widely distributed, owing to the fact that it is not in demand in large quantities and for general use.

Since the advent of fluorine compounds[1] many hundreds of tests have

[1]Marcovitch, S., Bul. 131, Tenn. Agr. Exp. Sta. 1924.