Table 1.—Effect of different nitrogen sidedress rates on boll weevil, bollworm, and aphid infestation and yield of cotton. Experiment, Ga. 1964–66.

Lb nitrogen/acre	1964	1965	1966	3-year avg
Seasonal avg % boll weevil punctured squares[a]				
0	5.1	3.8	4.4 ab	4.4
30	6.5	6.2	2.4 d	5.0
60	5.9	5.4	5.4 a	5.6
90	5.2	4.2	4.3 abc	4.6
120	5.6	5.0	2.9 bcd	4.5
Avg % bollworm damaged bolls				
0	0.2	0	3.2	1.1
30	.5	0	2.0	0.8
60	.8	2.0	2.0	1.6
90	.8	0	2.8	1.2
120	.2	1.0	1.8	1.0
Seasonal avg no. aphids/in.^{2} [b]				
0	4.0 b	9.6	25.0	12.9
30	7.2 a	11.2	30.2	16.2
60	7.8 a	9.2	33.9	17.0
90	7.5 a	9.5	38.0	18.3
120	9.9 a	10.8	43.3	21.3
Lb seed cotton/acre[a]				
0	1752	1560	1252 c	1521
30	1702	1500	1592 a	1598
60	1804	1560	1360 abc	1575
90	1812	1720	1388 abc	1640
120	1610	1640	1510 ab	1587

[a] Means followed by the same letter are not significantly different at the 1% level.
[b] Means followed by the same letter are not significantly different at the 5% level.
Absence of letters indicates no significant differences.

counts were averaged over the 3 years. Table 1 presents percent bolls damaged by bollworm. Under conditions of effective bollworm control, as a result of the seasonal insecticidal spray schedules, significant differences among nitrogen treatment did not occur during any of the 3 years.

Table 1 shows cotton aphid counts. Although there was a strong indication that more aphids occurred on leaves as the rate of nitrogen was increased, significant differences among treatments resulted only in 1964 when populations were higher in all plots receiving nitrogen than in plots receiving no nitrogen. Aphid infestation was considerably higher in 1966. Methyl parathion was included in the last 2 spray applications in 1964 to control aphids after the infestation counts were made.

Table 1 presents yields of seed cotton per acre. During 1964 and 1965 there was an indication that nitrogen rates up to 90 lb as a sidedress increased yields of seed cotton; however, these differences were not significant. In 1966, the yield was significantly higher in all plots receiving nitrogen than in those not receiving nitrogen. The higher rates did not significantly increase yields. Consistent differences in yield caused by increased rates of nitrogen sidedress were not obtained under the conditions of these tests. The recorded rainfall in inches during the 5-month cotton-growing season, May through September, was 16.08, 16.63, and 23.93 for the 3 years. The normal rainfall for this period is 20.26 in.

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In-Furrow Applications of Systemic Insecticides for Control of Mexican Bean Beetle[1,2,3]

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ABSTRACT

The duration of toxicity in snap beans produced by several systemic insecticides applied at a rate of ½–4 lb/acre in the soil at planting time was determined by bioassaying larvae of *Epilachna varivestis* Mulsant on new growth removed from treated plants at weekly intervals. The persistance of test insecticides appeared to be: carbofuran > phorate > aldicarb > disulfoton > dimethoate. Other tests with foliage from beans planted at the time of application of the insecticides and 1, 2, or 3 weeks later showed that some loss in toxicity occurred because of plant growth and reduced adsorption by roots, but the breakdown of the compounds in the soil caused the greater loss.

It has been reported (Webster and Smith 1962) that phorate and disulfoton granules applied in the furrow at the time beans were planted resulted in increased yields and reduced damage by the Mexican bean beetle, *Epilachna varivestris* Mulsant. In those tests, the furrow was filled with loose soil without the compaction that is the usual practice in commercial operations. The field tests reported here were made

[1] Coleoptera: Coccinellidae.
[2] Received for publication Dec. 18, 1969.
[3] Mention of a pesticide or a proprietary product does not constitute endorsement by the USDA.

Table 1.—Percentage mortality of 2nd- and 3rd-instar Mexican bean beetle larvae fed 4 days on detached snap bean leaflets from plants grown in plots treated with phorate (10G) (4 replicates unless otherwise specified). Spring 1965.

			% mortality on indicated days after planting[a]					
			23	30	37	44	51	58
	Soil compacted above		Position of leaf sampled (trifoliate)					
Lb AI/acre	Granules	Seed	1st	2nd	3rd	4th	5th	6th
			Phorate placed below seed					
2	X	X	84	100	100	76	16	8
	X	—		100	100	76	32	13
	—	X	100	100	100	53	26	3
	—	—		100	100	82	26	8
4	X	X	100	94	100	65	32	18
	X	—		88	100	94	16	28
	—	X	100	100	100	59	11	33
	—	—		88	100	59	11	33
			Phorate placed beside seed					
2	X	X	89	100	100	35	39	18
	—	—		100	94	88	37	3
4	X	X	100	100	89	88	53	3
	—	—		100	100	71	45	13
Control[b]			5	15	10	15	5	25

[a] Mortality of treatments adjusted for mortality of checks.
[b] Based on 8 replicates.

at Beltsville Md., to compare the residual effectiveness of systemic insecticides in compacted and loose soil against the Mexican bean beetle and the duration of uptake of the insecticides.

MATERIALS AND METHODS.—Phorate, disulfoton, dimethoate, aldicarb, and carbofuran (Furadan) were applied as 10% granules, and phorate also was applied as 15% granules. 'Top Crop' variety snap bean was used in all tests. Leaves were collected once a week beginning 2–3 weeks after planting and continuing until the pods were nearly ready for harvest as green snap beans. The continuing movement of the systemics into the new leaves on the growing bean plants was measured by feeding 2nd- or 3rd-stage Mexican bean beetle larvae on a succession of newly expanded trifoliate leaves.

Test 1 was made in spring 1965 to determine what effect the placement of the phorate and the compaction of the soil had on the duration of uptake (and control) in the field. Thus, rows were furrowed out with tractor cultivator shoes, and fertilizer (5–10–5) was applied at the rate of 200 lb/acre (187.2 g to

Table 2.—Percentage mortality of 2nd- and 3rd-stage Mexican bean beetle larvae fed 4 days on detached snap bean leaflets grown in plots treated with insecticides (4 replicates). Summer 1965.

		% mortality at indicated days after planting[a]				
		24	31	38	45	52
		Position of leaf sampled (trifoliate)				
Test material	Dose (lb/acre)	1st	2nd	3rd	4th	5th
Disulfoton 10G	1	100	22	28	0	25
	2	87	44	22	44	40
Phorate 10G	1	100	50	33	19	19
	2	94	61	83	44	40
Phorate 15G	1	100	56	28	25	6
	2	100	67	100	13	19
Aldicarb 10G	1	94	44	39	0	13
	2	81	67	17	31	25
Dimethoate 10G	1	100	67	22	25	25
Check	–	20	10	10	20	0

[a] Mortality of treatments adjusted for mortality of checks.

Table 3.—Percentage mortality of 2nd- and 3rd-stage Mexican bean beetle larvae fed 2 days on detached snap bean leaflets grown in plots treated with insecticides (4 replicates unless otherwise specified). Spring 1966.

		% mortality on indicated days after planting[a]				
		19	26	32	34	40
		Position of leaves sampled				
Material	Lb/acre	Primary leaf	1st trifoliate	3rd	4th	5th
Carbofuran 10G	½	100	87	100	94	30
	1	100	80	100	83	10
	2	100	100	100	100	60
Aldicarb 10G	½	84	67	50	11	0
	1	95	73	55	11	25
	2	95	87	95	61	50
Dimethoate 10G	1	100	53	5	0	10
	2	95	80	35	0	10
Disulfoton 10G	1	95	7	30	22	5
	2	100	40	65	28	5
Phorate 10G	1	100	53	95	17	15
	2	100	80	100	72	20
Phorate 15G	1	100	73	65	28	35
	2	100	87	100	83	30
Check[b]		5	25	0	10	0

[a] Mortality of treatments adjusted for mortality of checks.
[b] Based on 8 replicates.

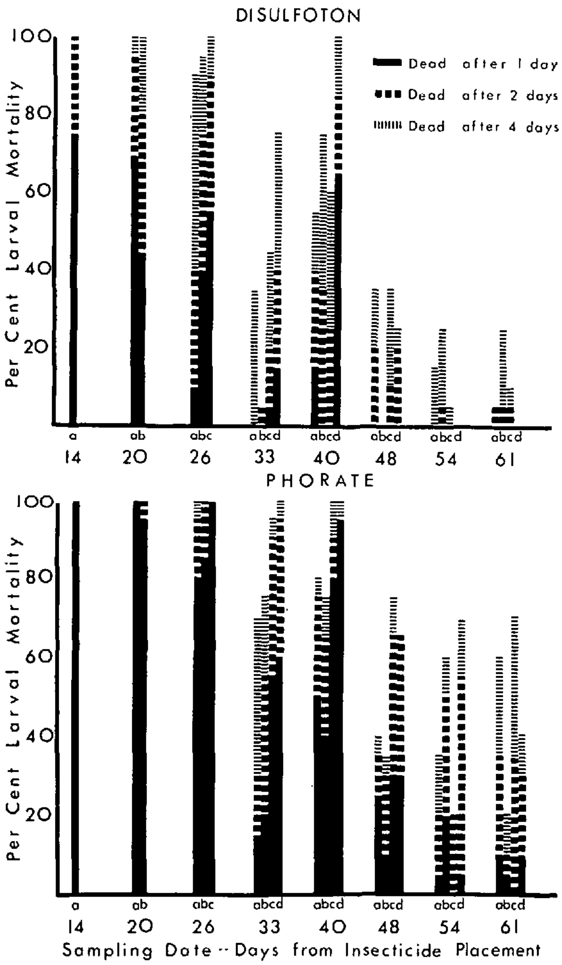

FIG. 1.—Mortality of Mexican bean beetle larvae fed on snap bean leaves sampled on indicated dates from plots treated with disulfoton (top) or phorate (bottom). Section A seeded at time of application of insecticide; Sections B, C, and D seeded 1, 2, or 3 weeks, respectively, after application.

30-ft rows spaced 3 ft apart) at the same time the 10% phorate granules (applied at rates of 2 or 4 lb AI/acre) were placed 1 in. below the seed in the furrow with an Alan distributor. The soil above the phorate granules was then compacted with a rubber-tired wheelbarrow carrying an 80-lb load; the seeds were placed 1 in. above, or 2 in. beside and 1 in. above, the phorate with a Planet Jr. seeder; and ½ of each row was covered with 1 in. of loose soil which was compacted again with the weighted wheelbarrow; the other half was not. Finally the furrow was filled and ridged slightly with loose soil with a tractor cultivator. Successive trifoliate leaves of the growing plants were sampled 6 times, between 23 and 58 days after planting.

Test 2, made in summer 1966, included disulfoton (10G), phorate (10G and 15G), and aldicarb (10G), all applied at rates of 1 or 2 lb/acre, and dimethoate applied at a rate of 2 lb/acre. Test 3, also made in 1966, included dimethoate (10G), disulfoton (10G), and phorate (10G and 15G), all applied at 1 or 2 lb/acre and aldicarb (10G) and carbofuran (10G), both applied at ½, 1, or 2 lb/acre. In both Tests 2 and 3, the fertilizer and the systemic insecticides were applied with an Alan distributor below the seed without compacting the soil.

In Test 4, made in 1967, disulfoton, dimethoate, carbofuran, phorate, and aldicarb were all used as 10% granules, and all were applied at a rate of 2 lb/acre to 30-ft row-plots. However, each plot was divided into four 7½-ft sections–A, B, C, and D. Top Crop snap beans were planted in Section A at the time the insecticides were applied. Section B was planted after the insecticides had been in the ground 1 week; Section C after 2 weeks, and Section D after 3 weeks. In Section A, the rows were leveled without compaction after planting and then opened with a hoe when Sections B, C, and D were planted. Thus, Section D was seeded 3 weeks after Section A, when the insecticide had been in the ground for 3 weeks.

In all 4 tests, center leaflets of newly expanded trifoliate leaves from 3 randomly selected plants were taken from each plot (4 replicates of each treatment)

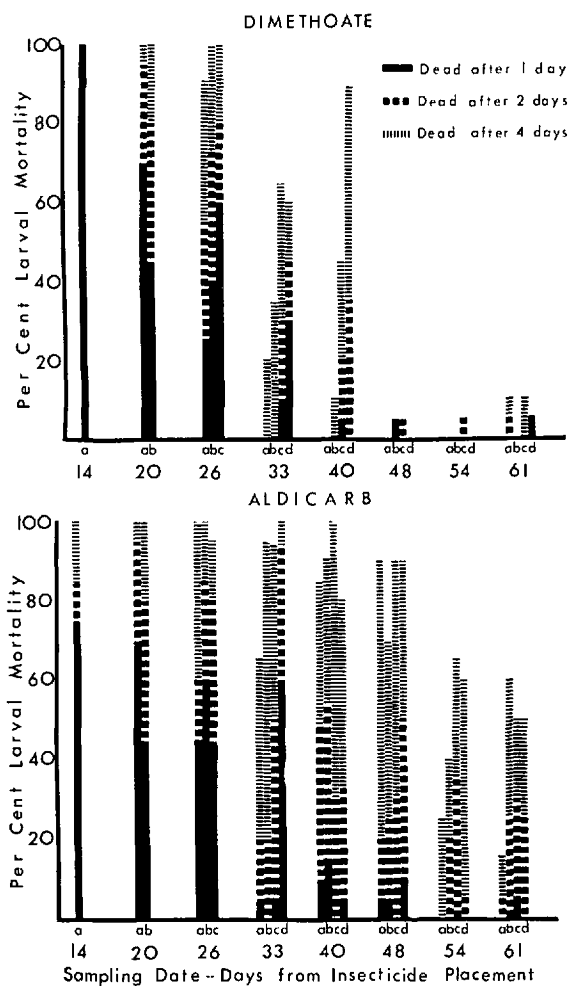

FIG. 2.—Mortality of Mexican bean beetle larvae fed on snap bean leaves sampled on indicated dates from plots treated with dimethoate (top) or aldicarb (bottom). Section A seeded at time of application of insecticide. Sections B, C, and D seeded 1, 2, or 3 weeks, respectively, after application.

and placed underside up in an 85-mm-diam Lab Tek® plastic petri dish. Then five 2nd- or 3rd-stage larvae were placed in each dish and allowed to feed for either 4 days (Tests 1, 2 and 4) or 2 days (Test 3). Mortality counts were made the 4th day (Test 1 and 2), the 2nd day (Test 3), or the 1st, 2nd, and 4th days (Test 4).

RESULTS AND DISCUSSION.—*Test 1.*—Virtually complete mortality was obtained with all treatments when the larvae were fed 3rd trifoliate leaflets sampled 37 days after planting (Table 1). Mortality obtained with 4th trifoliate leaves sampled 44 days after planting ranged from 35 to 94%, an indication that the uptake of phorate was declining by this date. Thereafter, the decrease in mortality was accelerated. Thus, by the time the 5th trifoliate leaves were sampled, mortality caused by uptake of phorate was below the level of effective control in all plots. However, the crop was mature by this time, so that, for all practical purposes, complete protection was provided for the entire growing period.

Compaction of the soil over the granules or seed had little effect on retention of toxicity. Also, phorate offset beside and below the seed was just as effective as phorate placed directly below the seed. In this test, phorate applied at a rate of 2 lb/acre gave control equal to that obtained with phorate applied at a rate of 4 lb/acre.

Test 2.—All insecticides were effective after 24 days (Table 2), when the plants were in the 1st-trifoliate stage. After 31 days (plants had 2–3 trifoliates), the insecticides showed signs of a substantial breakdown which continued to increase, based on the later tests of younger leaves.

Test 3.—As in Test 2, the 1st trifoliate leaves from plants treated with all test materials were highly toxic (Table 3). However, at the next sampling (2nd trifoliate leaves), the toxicity of disulfoton had decreased greatly, and that of dimethoate, phorate, and aldicarb had decreased moderately, but that of furadan still persisted. After 34 days, all compounds except carbofuran were present, but at low levels. However, leaves from plots treated with carbofuran continued to cause high mortality.

In this test, the persistence of the insecticides appeared to be as follows: carbofuran > phorate 15G = phorate 10G = aldicarb > disulfoton > dimethoate.

Test 4.—The purpose of Test 4 was to determine whether the insecticides were breaking down in the soil or whether the decrease in mortality noted in 1966 was caused by changes in absorption and translocation in the plant or by roots growing beyond the zone of the insecticides. Fig. 1–3 indicates that part of the loss of systemic activity was the result of plant growth. However, the differences between the uptake of the compounds by younger or older plants were slight at a given date, an indication that the greater proportion of activity had been lost because of actual breakdown of the compounds in the soil.

The persistence of the materials in Test 4 was carbofuran > phorate = aldicarb > disulfoton > dimethoate.

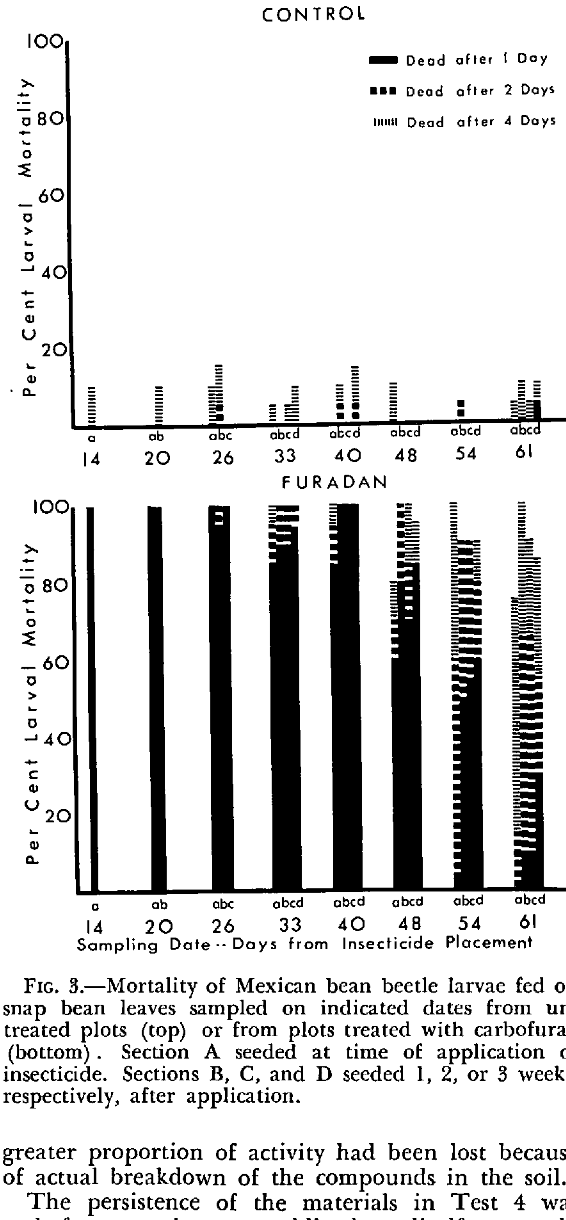

FIG. 3.—Mortality of Mexican bean beetle larvae fed on snap bean leaves sampled on indicated dates from untreated plots (top) or from plots treated with carbofuran (bottom). Section A seeded at time of application of insecticide. Sections B, C, and D seeded 1, 2, or 3 weeks, respectively, after application.

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