INSECTICIDES AND COMBINATIONS OF INSECTICIDES WITH OILS AND SURFACTANTS FOR INSECT CONTROL ON VARIOUS VEGETABLE CROPS [1]

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The cabbage aphid, *Brevicoryne brassicae* (L.), turnip aphid, *Rhopalosiphum pseudobrassicae* (Davis), green peach aphid, *Myzus persicae* (Sulzer), potato aphid, *Macrosiphum euphorbiae* (Thomas), poplar petiole gall aphid, *Pemphigus populitransversus* (Riley), known locally as the cabbage root aphid, cabbage looper, *Trichoplusia ni* (Hubn.), and the leaf miner, *Liriomyza munda* Frick, are pests of cabbages, tomatoes, and turnips in the Lower Rio Grande Valley. Insecticides and combinations of insecticides with oils and surfactants were evaluated as foliar and soil applications on these crops for control of these insects during the 1962-1964 seasons. The objectives were to (1) determine if oils and surfactants increase control when added to chemical and biological insecticides and (2) evaluate various systemic and nonsystemic phosphate and chlorinated hydrocarbon insecticides for control of the above insect pest species.

Littleford and Ditman (1963) found Bayer 44646 to be an effective material for cabbage looper control. Shorey (1963) found Bayer 44646, Monsanto 40294, and Zectran to be effective against the cabbage looper. Shorey and Hall (1963) found DDT to be ineffective for leaf miner and potato aphid control. Shorey (1963) found parathion and mevinphos to be effective for cabbage aphid control on cabbage. He also found that Bayer 44646 was not effective for cabbage aphid control.

Various phosphate insecticides were shown to be effective for leaf miner control (Wolfenbarger and Getzin 1963b). These included dimethoate, Bayer 25141, Bidrin, GC 4072, and Delnav. Carbaryl effectively controlled corn earworm populations on lettuce (Wolfenbarger and Getzin 1962). Endrin, toxaphene, mevinphos, naled, parathion, a toxaphene + parathion combination, and Kepone effectively controlled the cabbage looper (Wolfenbarger and Getzin 1962). Dimethoate, demeton, mevinphos, endrin, Telodrin, and mevinphos-oil combinations were shown to be effective for green peach and cabbage aphid control on peppers and cabbage (Wolfenbarger and Getzin 1963).

METHODS AND MATERIALS

Combinations of oil and surfactants with a cabbage looper virus and various *Bacillus thuringiensis* formulations were evaluated for cabbage looper and cabbage aphid control on cabbage (Tables 2 and 3). Plots 1 row wide and 25 feet long were sprayed at 30 gallons per acre with a carbon dioxide powered sprayer using three nozzles per row.

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[1] Technical contribution number 4799, Texas Agricultural Experiment Station, Lower Rio Grande Valley Experiment Station and Extension Service Center, Weslaco. The studies were supported, in part, by a grant from Humble Oil & Refining, Research & Development, Baytown, Texas.

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Cabbage looper populations were evaluated by counting healthy looper larvae on four plants per plot. The looper counts were separated into small loopers (those up to one-half inch in length) or large loopers (those over one-half inch in length). Cabbage aphid populations in this and all subsequent cabbage plots were evaluated by counting all forms on a designated number of plants per plot. The data are presented as aphids per plant after counting the aphids on four plants per plot.

The data in Table 4 summarize results comparing insecticides on turnips for turnip aphid control. Plots were 1 row wide and 25 feet in length and were sprayed with a hand operated carbon dioxide powered sprayer at the rate of 30 gallons per acre, using three nozzles per row. The control in this and the subsequent experiment was evaluated by counting number of aphids per 13 leaves. The data are presented on a per leaf basis.

Table 5 summarizes results with various insecticides and mevinphos-oil combinations for control of the cabbage aphid on cabbage. Tables 6 and 7 summarize results of various combinations of oil plus DDT or parathion or a *Heliothis* virus for leaf miner and potato aphid control on tomatoes. Plots were 1 row wide, 25 feet in length, and were sprayed with a hand operated carbon-dioxide powered sprayer at 40 gallons per acre, using three nozzles per row and 40 psi. The leaf miner populations were evaluated by counting the mines on each leaflet of 13 leaves and expressing the data on a per leaf basis. The potato aphid populations were determined by counting the aphids on each leaf and the data were placed on a per leaf basis.

During the winter of 1963-1964, various insecticides and oil-insecticide combinations were evaluated on turnip (Table 8) and cabbage (Table 9) plots for turnip and green peach aphid control. The turnip and cabbage plots were sprayed with a Chesterford logarithmic dilution sprayer at 60 gallons per acre and 40 psi on plots 4 rows wide. Plots were 11.2 feet apart and 7 rates were evaluated with each application. The data did not exhibit linear relationship in respect to rate; thus the data are presented as a mean for the range of rates evaluated. The data presented are the mean of 52 leaves per plot on the turnip plots and 91 leaves per plot on the cabbage plots.

Various systemic phosphate insecticides (Table 10) were evaluated on cabbage for cabbage root aphid, green peach aphid, and cabbage looper control. These insecticides were applied at 2.0 lb. active ingredient per acre as a drench and granules to cabbage plants in the 2 leaf stage and furrow irrigated within 24 hours. The granules were applied by hand to a furrow 3-4 inches and 2-4 inches in depth beside the young cabbage plants and covered with a hoe. The drenches were applied to the plants and soil in a band 6-10 inches wide, using 2 gallons of water per 25 feet of row. On a broadcast basis, 1089 gallons of total solution per acre were applied. Plots were 1 row wide and 25 feet in length. Populations were evaluated by counting green peach aphids on 13 leaves per plot, cabbage root aphids on 13 plants per plot, and looper larvae on 4 plants per plot as described previously. The data were then placed on a per leaf or per plant basis.

All plots were arranged in a randomized complete block design replicated four times except for the logarithmic sprayer treated plots which were replicated twice. The looper and *Heliothis* polyhedral viruses were obtained from Carlos M. Ignoffo, USDA-ARS, Entomology Research Division, Pink Bollworm Laboratory, Brownsville, Texas. The cabbage looper virus was standardized at 5.0 x 10^9 polyhedra per milliliter (Tables 2 and 3) and the *Heliothis* virus was standardized at 6.99 x 10^9 polyhedra per milliliter (Tables 6 and 7). The chemical formula for the surfactants used in these evaluations are as follows: B1956 (modified phthalic glycerol alkyl); Plyac^R (the principal functioning agents are emulsifiable A-C^R Polyethylene 629 and emulsifying and dispersing agents); NS139 (ethylene oxylated mercaptan); 50 (fatty acid mixture and ethylene oxylated dinonyl phenol); L775 is the same as 50, except it has a sticking agent added.

The chemical designations of the proprietary insecticides evaluated are as follows:

American Cyanamid 43064 — 2-(diethoxyphosphinothioylimino)-1,3-dithiolane

American Cyanamid 47031—2-(diethoxyphosphinylimino)-1,3-dithiolane

American Cyanamid 47921 — 0,0-diethyl S-2-methyl-1,3-dithiolan-2-yl methyl phosphorodithioate

Bidrin® — 3-(dimethoxyphosphinyloxy)-N,N-dimethyl-cis-crotonamide

Di-Syston®—0,0-diethyl S-2-(ethylthio)ethyl phosphorodithioate

Guthion®—0,0-dimethyl S-(4-oxo-1,2,3-benzotriazin-3-(4-H)-ylmethyl) phosphorodithioate

Monsanto 40273—0-(p-nitrophenyl)-0-propyl methylphosphonothioate

Monsanto 40294 — 0-(p-nitrophenyl)-0-phenyl methylphosphonothioate

Niagara 9203—0,0-dimethyl S-((benzoxazolin-2-on-3yl) methyl) phosphorothiolate

Shell Development 8448 — Phosphoric acid 2-chloro-1-(2,4,5-trichlorophenyl).

The specifications of the oils used in these evaluations are shown in Table 1.

Results and Discussion

The Thuricide® *Bacillus thuringiensis*-oil and Thuricide-surfactant sprays were, in general, superior to the Bacthane® *Bacillus thuringiensis*-oil, virus-oil, and virus-surfactant combinations for control of looper larvae one-half inch or smaller (Tables 2 and 3). The surfactants NS139 and L775 and the high molecular special paraffinic and paraffinic oils when combined with Backthane effectively controlled looper larvae populations larger than one-half inch. Combinations of virus with L775, B1956, isoparaffinic oil, and, in general, the lower two molecular weight paraffinic, special paraffinic, and naphthenic oils did not effectively control cabbage looper larvae.

The virus-oil and *Bacillus*-oil combinations were generally superior in effectiveness regardless of oil fraction and looper size. Cabbage looper larvae one-half inch in length or smaller were, in general, reduced in numbers by the higher molecular weight oil fractions. No trend was noted relative to molecular weight when loopers were larger than one-half inch. The high molecular weight special paraffinic (SP-3) and paraffinic (P-3) oils, when combined with the polyhedral virus, were the most effective virus-oil combinations. The Backthane-isoparaffinic (IP-2), special paraffinic

TABLE 1.—OILS EVALUATED DURING THE 1963-1964 SEASON ON VARIOUS VEGETABLE CROPS, WESLACO AND PROGRESO, TEXAS.

Spray oil fractions	Gravity °API	Viscosity SSU @ 100°F	Average molecular weight	Unsulfonated residue volume %
Paraffinic (P)				
1	38.3	48.2	280	96.0
2	35.1	70.5	322	90.4
3	34.0	101.5	368	94.2
Special Paraffinic (SP)				
1	35.9	51.8	280	92.0
2	35.8	66.9	318	91.0
3	33.6	104.9	370	94.0
Isoparaffinic (IP)				
1	49.5	34.2	203*	99.0
2	42.3	50.8	268*	90.0
Naphthenic (N)				
1	31.1	56.1	275	93.0
2	35.8	83.4	318	94.2
3	29.9	127.4	362	93.8

* Obtained from correlations (Mills et al. 1946).

(SP-3), and paraffinic (P-3) oil combinations were superior to the other Backthane-oil fraction combinations and the Thuricide-oil fraction combinations.

The data show that the *Bacillus*-paraffinic, naphthenic, and special paraffinic oil combinations and the surfactant NS139 had generally smaller cabbage aphid populations than the virus-oil combinations. The isoparaffinic oil-*Bacillus* treated plots had the greatest aphid populations of those evaluated. The data also show that, in general, the lower or the lowest 2 of 3 molecular weight oil fractions were superior to the higher molecular weight fractions.

The data (Table 4) show that all rates of Monsanto 40294 and Monsanto 40273 significantly reduced turnip aphid populations 19 and 26 February compared to the untreated check. Shell Development 8448 was not an effective toxicant for turnip aphid control.

All insecticides and mevinphos-oil combinations significantly reduced cabbage aphid populations in comparison to the untreated check (Table 5). The most effective toxicants were Niagara 9203, mevinphos-IP-2 oil combination, Guthion-oil combination, Monsanto 40273, and endrin. With oil-mevinphos combinations, aphid populations are reduced as molecular weight of the oil increases.

The data in Tables 6 and 7 show that the number of leaf miner mines were reduced with the 15 gallon per acre rate of oil when combined with

TABLE 2.—BIOLOGICAL INSECTICIDES IN COMBINATION WITH VARIOUS OILS AND SURFACTANTS FOR CABBAGE LOOPER AND CABBAGE APHID CONTROL ON CABBAGE, WESLACO, FALL, 1962-63.

Materials*	Actual (ml. or lb.+gal/A)	Mean per plant††		
		Looper larvae		Cabbage aphid
		small	large	4 Jan.
Virus + NS139	136 + 0.25	0.9 ab	0.6 b	2.7 a
Virus + 50	136 + 0.25	1.6 bc	0.4 ab	36.5 ab
Virus + L775	136 + 0.25	1.6 bc	0.6 b	22.0 ab
Virus + B1956	136 + 0.25	3.1 cd	1.1 c	6.4 a
Virus + IP-1	136 + 1.5	1.6 bc	0.4 ab	24.2 ab
Virus + IP-2	136 + 1.5	2.1 bc	0.6 b	11.5 ab
Virus + SP-1	136 + 1.5	1.2 b	0.7 bc	9.9 a
Virus + SP-2	136 + 1.5	1.4 bc	0.7 bc	19.6 ab
Virus + SP-3	136 + 1.5	0.6 a	0.3 ab	10.6 ab
Virus + P-1	136 + 1.5	1.3 b	0.6 b	11.7 ab
Virus + P-2	136 + 1.5	1.7 bc	0.7 bc	11.5 ab
Virus + P-3	136 + 1.5	0.8 ab	0.4 ab	18.8 ab
Virus + N-1	136 + 1.5	0.8 ab	0.5 ab	34.0 ab
Virus + N-2	136 + 1.5	1.9 bc	0.7 bc	3.3 a
Virus + N-3	136 + 1.5	1.2 b	0.5 ab	43.7 abc
Virus + Plyac	136 + 0.25	1.1 b	0.6 b	33.0 ab
*Bacillus thuringiensis*** + IP-1	2.0 + 1.5	1.6 bc	1.1 c	7.5 a
*Bacillus thuringiensis*** + IP-2	2.0 + 1.5	1.4 bc	0.4 ab	6.7 a
*Bacillus thuringiensis*** + SP-1	2.0 + 1.5	1.3 b	0.4 ab	18.7 ab
*Bacillus thuringiensis*** + SP-3	2.0 + 1.5	0.5 ab	0.1 a	1.6 a
*Bacillus thuringiensis*** + N-1	2.0 + 1.5	1.8 bc	0.3 ab	3.6 a
*Bacillus thuringiensis*** + N-3	2.0 + 1.5	0.7 ab	0.4 ab	5.4 a

(TABLE 2 (Continued)

*Bacillus thuringiensis*** + P-3	2.0 + 1.5	1.0 b	0.1 a	2.5 a
*Bacillus thuringiensis*** + NS139	2.0 + 0.25	0.9 ab	0.1 a	0.7 a
*Bacillus thuringiensis*** + L775	2.0 + 0.25	0.7 ab	0.1 a	34.6 ab
Bacillus thuringiensis + IP-1	2.0 + 1.5	0.8 ab	0.5 ab	40.4 ab
Bacillus thuringiensis + IP-2	2.0 + 1.5	0.6 a	0.2 ab	117.8 d
Bacillus thuringiensis + SP-1	2.0 + 1.5	1.0 b	0.2 ab	6.0 a
Bacillus thuringiensis + SP-3	2.0 + 1.5	0.7 ab	0.3 ab	4.7 a
Bacillus thuringiensis + N-1	2.0 + 1.5	0.9 ab	0.2 ab	2.7 a
Bacillus thuringiensis + N-3	2.0 + 1.5	0.6 a	0.3 ab	9.7 a
Bacillus thuringiensis + NS139	2.0 + 0.25	0.1 a	0.2 ab	98.3 cd
Bacillus thuringiensis + 50	2.0 + 0.25	0.5 ab	0.2 ab	9.8 a
Check	—	3.4 d	2.3 d	76.4 bcd

* Applied 21 Sept., 2 Oct., 9 Oct., 22 Oct., 13 Nov.
** Backthane® (contains 7.5 x 10^{10} spores per gram).
† Thuricide® (contains 3.0 x 10^{10} spores per gram).
†† Any two means followed by the same letter are not significantly different from each other by Duncan's Multiple Range Test at the 5% level.

TABLE 3.—SUMMARY OF RESULTS WITH FOUR TYPES OF OIL COMBINED WITH VIRUS OR BACILLUS. (FROM TABLE 2).

	Mean per plant					
	Cabbage looper				Cabbage aphid	
	Virus-oil		Bacillus-oil		Virus-	Bacil-
Oil	small	large	small	large	oil	lus-oil
Naphthenic (N)	1.3	0.6	1.0	0.4	27.0	5.4
Paraffinic (P)	1.2	0.5	1.2	0.4	14.0	3.4
Special paraffinic (SP)	1.1	0.5	0.9	0.3	13.3	7.8
Isoparaffinic (IP)	1.7	0.5	1.1	0.6	17.9	43.1

TABLE 4.—INSECTICIDES FOR TURNIP APHID CONTROL ON TURNIPS, PROGRESO, 1963.

		Aphids per leaf** on dates indicated		
	Actual	February		
Material*	(lb./acre)	7	19	26
Monsanto 40294	0.25	3.4 a	6.6 a	31.8 ab
Monsanto 40294	0.5	4.6 a	9.9 a	23.7 a
Monsanto 40294	1.0	4.4 a	8.1 a	20.9 a
Monsanto 40273	0.25	6.0 a	9.4 a	18.2 a
Monsanto 40273	0.5	9.0 a	9.2 a	29.9 a
Parathion	0.25	1.6 a	44.2 ab	31.4 ab
SD 8448	0.25	11.9 a	31.3 ab	91.5 ab
Check	—	30.1 ab	70.3 abc	139.0 bc

* Applied 15 Jan., 5 Feb.
** See footnote 4, Table 2.

DDT and the *Heliothis* virus. The oils did not increase leaf miner control when added to parathion. The isoparaffinic oils were superior to the paraffinic and naphthenic stocks, and generally the higher isoparaffinic oil rates were superior to the low rates for leaf miner control. As the DDT rate increased, leaf miner control increased.

The smaller two rates of DDT (0.25 and 0.5 lb. per acre) in the DDT-oil combinations had smaller potato aphid populations than the greatest DDT (1.0 lb. per acre) rate. No effects of molecular weights of oils were noted relative to aphid control. The isoparaffinic oil-DDT and -virus combinations had smaller aphid populations than did other oil fractions and DDT alone. The oil-parathion combinations were not superior to parathion alone. The parathion and greater DDT rates were equal in effectiveness for aphid control.

Turnip aphid populations were more effectively reduced by applications of Monsanto 40273 than by the other materials or combinations of other materials evaluated (Table 8). Phosphamidon, naled, Monsanto 40294, and a phosphamidon-naled combination were superior to parathion. Parathion was ineffective. The parathion-naphthenic and -paraffinic oil combinations significantly increased control compared to parathion alone at equal rates.

Green peach aphid populations were reduced by applications of Monsanto 40294, and phosphamidon-naphthenic and -paraffinic oil combinations (Table 9). Both the naphthenic and paraffinic oil-parathion combinations increased control when compared to parathion alone. The naphthenic and paraffinic oils, when combined with phosphamidon, increased cabbage aphid control. Monsanto 40273, naled, parathion, and phosphamidon were ineffective for green peach aphid control.

Cabbage loopers longer than one-half inch were reduced in numbers for 30 days after application by drench applications of American Cyanamid 47031 and American Cyanamid 43064 (Table 10). Drench applications of American Cyanamid 47031 and American Cyanamid 43064 and granule applications of American Cyanamid 43064 gave the best control of green peach aphid populations. All materials except phosphamidon had significantly fewer aphids than the untreated check. Drench applications of American Cyanamid 43064 gave 66% control of cabbage root aphid popu-

TABLE 5.—INSECTICIDES AND INSECTICIDE-OIL COMBINATIONS FOR CABBAGE APHID CONTROL ON CABBAGE, 1963.

Matrial*	Actual (lb. + gal/A)	Mean percnt control 12 March
Shell Development 8448	0.5	72
Monsanto 40273	1.0	77
Guthion + IP-1	0.5 + 1.5	79
Methyl parathion	0.5	74
Methyl parathion + endrin	0.25 + 0.25	76
Endrin	0.5	78
Niagara 9203	2.0	80
Monsanto 40294	0.5	76
Monsanto 40294	1.0	46
Parathion	1.0	41
Mevinphos + IP-1	0.25 + 1.5	68
Mevinphos + IP-2	0.25 + 1.5	81
Mevinphos + SPB-1	0.25 + 1.5	42
Mevinphos + SPB-3	0.25 + 1.5	72
Mevinphos + PB-1	0.25 + 1.5	49
Mevinphos + PB-3	0.25 + 1.5	53
Mevinphos + NB-1	0.25 + 1.5	65
Mevinphos + NB-3	0.25 + 1.5	72
Check	——	1161.6**

* Applied 20 Dec., 11 Jan., 24 Feb., 26 Feb., 6 Mar., 11 Mar.
** Mean apphids per plant.

TABLE 6.—INSECTICIDES AND OIL-INSECTICIDE COMBINATIONS FOR LEAF MINER AND POTATO APHID CONTROL ON TOMATOES, WESLACO, SPRING, 1964.

		Mean percent control on dates indicated	
	Actual	Leaf miner	Potato aphids
Materials*	(lb. + gal/A)	6 June	28 May
IP-2 + DDT	7.5 + 0.25	0	96
IP-2 + DDT	15.0 + 0.25	56	94
N-2 + DDT	7.5 + 0.25	29	90
N-2 + DDT	15.0 + 0.25	57	94
P-2 + DDT	7.5 + 0.25	40	76
P-2 + DDT	15.0 + 0.25	70	54
IP-2 + DDT	7.5 + 0.5	21	94
IP-2 + DDT	15.0 + 0.5	40	96
P-2 + DDT	7.5 + 0.5	36	70
P-2 + DDT	15.0 + 0.5	28	100
N-2 + DDT	7.5 + 0.5	15	90
N-2 + DDT	15.0 + 0.5	39	82
IP-2 + DDT	7.5 + 1.0	17	82
IP-2 + DDT	15.0 + 1.0	50	94
P-2 + DDT	7.5 + 1.0	34	84
P-2 + DDT	15.0 + 1.0	64	49
N-2 + DDT	7.5 + 1.0	11	90
N-2 + DDT	15.0 + 1.0	30	88
IP-2 + *Heliothis* virus	7.5 + 83**	0	84
IP-2 + *Heliothis* virus	15.0 + 83**	50	96
P-2 + *Heliothis* virus	7.5 + 83**	0	64
P-2 + *Heliothis* virus	15.0 + 83**	24	48
N-2 + *Heliothis* virus	7.5 + 83**	19	4
N-2 + *Heliothis* virus	15.0 + 83**	59	10
IP-2 + parathion	7.5 + 0.5	18	0
IP-2 + parathion	15.0 + 0.5	2	84
DDT	0 + 0.5	0	30
DDT	0 + 1.0	4	72
Parathion	0 + 0.5	16	66
Check		4.2†	8.3 ††

* Applied 2 May, 9 May, 24 May, 28 May, 3 June.
** Milliliters per acre.
† Leaf miner mines per leaf.
†† Potato aphids per leaf.

TABLE 7.—SUMMARY OF RESULTS WITH THREE TYPES OF OIL COMBINED WITH DDT OR VIRUS (FROM TABLE 6).

	Mean percent control			
	Leafminer		Potato aphid	
Oil	DDT-oil	Virus-oil	DDT-oil	Virus-oil
Naphthenic (N)	31	39	89	7
Paraffinic (P)	45	12	71	56
Isoparaffinic (IP)	31	25	93	90

TABLE 8.—INSECTICIDES AND INSECTICIDE-OIL COMBINATIONS FOR TURNIP APHID CONTROL ON TURNIPS, PROGRESO, 1963.

		Mean turnip aphids per leaf on dates indicated**	
	Actual	January	
Material*	(lb. + gal/A)	8	20
Parathion	0.25-0.02	102.6 b	127.5 b
Parathion + N-2	0.25-0.03 + 7.5-0.9	17.6 ab	56.9 ab
Parathion + P-2	0.25-0.03 + 7.5-0.9	17.1 ab	48.9 ab
Parathion + IP-2	0.25-0.03 + 7.5-0.9	48.5 b	83.3 b
Monsanto 40294	1.0 -0.13	45.2 b	71.8 b
Monsanto 40273	1.0 -0.13	10.4 a	8.1 a
Naled + Phosphamidon	1.0 -0.13 + 0.5-0.6	29.4 ab	76.6 b
Phosphamidon	1.0 -0.13	54.7 b	61.2 ab
Phosphamidon + N-2	0.5 -0.06 + 7.5-0.9	55.2 b	61.5 ab
Phosphamidon + P-2	0.5 -0.06 + 7.5-0.9	36.0 b	67.9 b
Phosphamidon + IP-2	0.5 -0.06 + 7.5-0.9	63.5 b	93.2 b
Naled	2.0 -0.25	38.5 b	43.3 ab
Naled + N-2	1.0 -0.13 + 7.5-0.9	29.7 ab	44.4 ab
Naled + P-2	1.0 -0.13 + 7.5-0.9	50.0 b	81.5 b
Naled + IP-2	1.0 -0.13 + 7.5-0.9	37.6 b	67.7 b

* Applied 6 Dec., 11 Dec., 3 Jan., 10 Jan.
** See footnote 4, Table 2.

TABLE 9.—INSECTICIDE AND INSECTICIDE-OIL COMBINATIONS FOR GREEN PEACH APHID CONTROL ON CABBAGE, PROGRESO, 1964.

Materials*	Actual (lb. + gal/A)	Mean green peach aphids per leaf on 3 March**
Parathion	0.25-0.03	4.0 b
Parathion + N-2	0.25-0.03 + 7.5-0.9	1.6 ab
Parathion + P-2	0.25-0.03 + 7.5-0.9	0.9 ab
Parathion + IP-2	0.25-0.03 + 7.5-0.9	2.1 b
Phosphamidon + Naled	1.0 -0.13 + 1.0-0.13	1.2 ab
Monsanto 40294	1.5 -0.19	0.5 a
Monsanto 40273	1.5 -0.19	1.9 ab
Naled	2.0 -0.25	1.4 ab
Naled + N-2	1.0 -0.13 + 7.5-0.9	1.3 ab
Naled + P-2	1.0 -0.13 + 7.5-0.9	1.9 b
Naled + IP-2	1.0 -0.13 + 7.5-0.9	3.1 b
Phosphamidon	0.5 -0.06	1.7 ab
Phosphamidon + N-2	0.5 -0.06 + 7.5-0.9	0.5 a
Phosphamidon + P-2	0.5 -0.06 + 7.5-0.9	0.5 a
Phosphamidon + IP-2	0.5 -0.06 + 7.5-0.9	2.1 ab
N-2	7.5 -0.9	0.7 ab
P-2	7.5 -0.9	1.6 ab

* Applied 5 Dec., 2 Jan., 20 Jan.
** See footnote 4, Table 2.

lations on the first sampling date, and 74% control on the second sampling date (115 days after application). Granule applications of American Cyanamid 43064 gave 75 and 72% control 100 and 115 days after application, respectively. Di-Syston gave 57% control 100 days after application, and 50% control after 115 days. Drench application of American Cyanamid 47031 gave 89 and 24% control 100 and 115 days after application. Granule application gave no control. Phosphamidon, at both rates, phorate, and schradan were ineffective for green peach aphid control.

Drench applications of American Cyanamid 47031, American Cyanamid 43064, and American Cyanamid 47921, at equal rates, were generally superior or equal to granule applications of these same materials for cabbage looper, green peach aphid, and the poplar petiole gall aphid.

LITERATURE CITED

Littleford, Michael F., and *L. P. Ditman.* 1963. An evaluation of several insecticides against pests of broccoli. J. Econ. Ent. 56: 766-770.

Mills, I. W., A. E. Hirschler, and *S. S. Kuntz, Jr.* 1946. Molecular weight-physical property correlation for petroleum fraction. Ind. and Eng. Chem. 38: 442-450.

Shorey, H. H. 1963. Differential toxicity of insecticides to the cabbage aphid and two associated entomophogous insect species. J. Econ. Ent. 56: 844-847.

TABLE 10.—SYSTEMIC INSECTICIDES (2.0 LB. PER ACRE) APPLIED AS A DRENCH AND GRANULES TO THE SOIL FOR APHID AND CABBAGE LOOPER CONTROL, PROGRESO, 1963-1964.

		Mean percent control on dates indicated				
		Cabbage looper 10 December		Green peach aphid	Poplar petiole gall aphid	
Materials*	Formulation	Small	Large	6 Jan.	28 Feb.	13 Mar.
AC 43064	Granules	59	0	79	75	72
Di-Syston	Granules	12	56	58	57	50
AC 47921	Granules	71	74	48	0	47
AC 47031	Granules	29	37	55	0	0
Phorate	Granules	12	44	58	62	0
Bidrin	Liquid	0	74	60	0	35
Phosphamidon	Liquid	12	19	39	0	9
Phosphamidon**	Liquid	29	63	52	0	0
AC 43064	Liquid	29	93	78	66	74
AC 47031	Liquid	59	100	80	89	24
AC 47921	Liquid	12	37	62	80	0
Schradan	Liquid	41	56	67	0	0
Check		0.3†	0.5†	22.5‡	20.0†	142.0†

* Applied 8 Nov. 1963.
** Applied at 4.0 lb. per acre.
† Mean per plant.
‡ Mean per leaf.

Shorey, H. H. 1963. Field experiments on insecticidal control of lepidopterous larvae on cabbage and cauliflower. J. Econ. Ent. 56: 877-880.

Shorey, H. H., and *I. M. Hall.* 1963. Toxicity of chemical and microbial insecticides to pest and beneficial insects on poled tomatoes. J. Econ. Ent. 56: 813-817.

Wolfenbarger, Dan A., and *L. W. Getzin.* 1962. Chemical and biological insecticides for cabbage looper and corn earworm control. Texas Agr. Exp. Sta. Progress Rep. 2255.

Wolfenbarger, Dan A., and *L. W. Getzin.* 1963. Insecticides, insecticide-oil and surfactant combinations for cabbage and green peach aphid control. Texas Agr. Exp. Sta. Progress Rep. 2270.

Wolfenbarger, Dan A., and *L. W. Getzin.* 1963b. Selective toxicants and toxicant-surfactant combinations for leafminer, *Liriomyza munda* Frick, control and parasite survival. Fla. Ent. 47: 251-265.