INSECTICIDES AND INSECTICIDE-OIL COMBINATIONS FOR CORN EARWORM, BOLL WEEVIL, AND COWPEA CURCULIO CONTROL [1]

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The cowpea curculio, *Chalcodermus aeneus* (Boh.), boll weevil, *Anthonomus grandis* (Boh.), and corn earworm, *Heliothis zea* (Boddie), are major pests in the Lower Rio Grande Valley. These insects are controlled by frequent applications of highly toxic insecticides. Because it is suspected that a tolerance may exist or develop in the near future, experiments were conducted during the 1963-64 season to determine (1) whether insecticide-oil combinations were more effective against these pests than insecticides alone; (2) whether the methods of applying these insecticides and insecti-side-oil combinations would affect control of these insects and; (3) whether other insecticides would control these insects.

Dogger (1955) showed that isoparaffinic oils do not increase effectiveness of toxaphene + DDT for bollworm and boll weevil control on cotton. Wolfenbarger and Schuster (1963) and Wolfenbarger (1964) found Bidrin, Bayer 25141, and Guthion to be effective against the cowpea curculio.

METHODS AND MATERIALS

Six experiments were conducted during 1963-64. Plots in all experiments were 1 row wide (38 inches between rows) and 30 to 50 feet in length arranged in randomized block design with four replications. An oil-water-insecticide combination and an aerosol were used to apply the insecticides in various experiments. The oil-water-insecticide combinations were applied at 40 to 80 gallons per acre with a carbon dioxide powered sprayer at 40 psi using three nozzles per row. The aerosols (very fine mist) were applied with a Soloport® pack back gasoline powered airblast spray at ½ to 2 gallons per acre through two adjustable nozzles per row.

Two emulsifier systems, designated as unstable and stable emulsion systems, were used with the oil-water-insecticide combinations applied with the CO_2 powered sprayer. The unstable emulsion system had a 1% concentration of B-1956 (modified phthalic glycerol alkyd resin). The stable emulsion system used an amine soap, and was stable during the entire period of the spray application.

Experiments were conducted for control of the cotton boll weevil and cotton bollworm on cotton. In 1963, the plots were established to evaluate toxaphene + DDT, Guthion + DDT, and methyl parathion + DDT alone and in combination with various oil fractions (Tables 2, 3, 4). The oil fractions were naphthenic, paraffinic, and isoparaffinic in structure. The amine soap emulsifier system was used in these evaluations. The specifications of the oils are summarized in Table 1. The oils were applied at the rates at 1.5, 3.0, and 4.5 gallons per acre.

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TABLE 1.—SPECIFICATIONS OF VEGETABLE SPRAY OILS USED IN EXPERIMENTS, WESLACO, 1963-1964.[2]

	Oil		
	IP	N	P
Gravity, API°	42.5	30.2	35.0
Molecular weight	27.0**	32.0**	32.0**
Viscosity @ 100°C	51.1	76.6	76.0
Unsulfonated residue	93.0	95.6	91.6
Distillation 40-50	529–535*	407–415	443–450
5-90	49–59	86–87	76–78

* At 10 mm.
** Approximate.

TABLE 2.—INSECTICIDE-OIL COMBINATIONS FOR BOLL WEEVIL AND CORN EARWORM CONTROL ON COTTON, WESLACO, 1963.

Material*	Actual (Lbs + gals/A)	Percent increase in control		
		Squares		Bolls
		weevil	worm	worm
Toxaphene + DDT	3.0+1.5	16	57	22
Toxaphene + DDT + IP	3.0+1.5+1.5	22	14	33
Toxaphene + DDT + IP	3.0+1.5+3.0	24	0	22
Toxaphene + DDT + IP	3.0+1.5+4.5	16	14	44
Toxaphene + DDT + N	3.0+1.5+1.5	17	43	33
Toxaphene + DDT + N	3.0+1.5+3.0	24	0	33
Toxaphene + DDT + N	3.0+1.5+4.5	21	57	56
Toxaphene + DDT + P	3.0+1.5+1.5	30	43	66
Toxaphene + DDT + P	3.0+1.5+3.0	11	71	44
Guthion + DDT	1.0+1.0	27	29	33
Guthion + DDT + IP	1.0+1.0+1.5	16	14	22
Guthion + DDT + IP	1.0+1.0+3.0	11	43	11
Guthion + DDT + IP	1.0+1.0+4.5	24	29	33
Guthion + DDT + N	1.0+1.0+1.5	30	43	33
Guthion + DDT + N	1.0+1.0+3.0	25	29	44
Guthion + DDT + N	1.0+1.0+4.5	13	57	33
Guthion + DDT + P	1.0+1.0+1.5	19	43	56
Guthion + DDT + P	1.0+1.0+3.0	19	0	22
Guthion + DDT + P	1.0+1.0+4.5	24	43	56
Methyl parathion + DDT	0.5+1.0	14	0	44
Methyl parathion + DDT + N	0.5+1.0+1.5	11	0	44
Methyl parathion + DDT + P	0.5+1.0+1.5	22	43	44
Check**		63	7	9

* Mean of 11 applications.
** Mean % damaged.

TABLE 3.—SUMMARY OF EFFECTS OF INSECTICIDE-OIL COMBINATIONS; COTTON, WESLACO, 1963.

Insecticide	Mean percent damaged squares						Mean percent damaged bolls		
	IP		P		N		IP	P	N
	weevil	worm	weevil	worm	weevil	worm	worm	worm	worm
Toxaphene + DDT	50	6	48	3	50	5	6	4	5
Guthion + DDT	52	5	50	5	49	4	7	5	6
Methyl parathion + DDT	—	—	49	4	57	7	—	5	5
Mean	51	6	49	4	53	5	7	5	5

TABLE 4.—SUMMARY OF EFFECTS OF DIFFERENT RATES OF OILS; COTTON, WESLACO, 1963.

Oil	Mean percent damaged squares						Mean percent damaged bolls		
	1.5 gal./A.		3.0 gal./A.		4.5 gal./A.		1.5 gal./A.	3.0 gal./A.	4.5 gal./A.
	weevil	worm	weevil	worm	weevil	worm	worm	worm	worm
IP	51	6	52	6	51	6	7	8	6
N	51	5	48	6	53	3	6	6	5
P	48	4	47	5	53	3	4	5	5

In 1964, plots were established to evaluate oils representing a naphthenic, paraffinic, and isoparaffinic oil fraction at 3.0 gallons per acre in combination with toxaphene + DDT at 3.0 + 1.5 lbs. active ingredient per acre (Table 5). The insecticide-oil combinations were compared to toxaphene + DDT insecticide combinations of 3.0 + 1.5 and 6.0 + 3.0 lbs. per acre. The data for both rates are summarized because no differences existed between the rates or control of either insect. These treatments were compared to an untreated check and toxaphene + DDT alone in four tests. In three tests, insecticide-oil-water sprays were applied at 56 gallons per acre. All treatments were applied with the CO_2 powered sprayer. The fourth test was designed to evaluate an aerosol application at ¾ gallon per acre. Treatments were evaluated by examining 50 squares or bolls per plot for boll weevil feeding or oviposition scars and bollworm larval feeding damage. Open boll counts on 50 plants per plot were made once as a relative index of yield.

TABLE 5.—SUMMARY OF EFFECTS OF DIFFERENT SPRAY SYSTEMS; COTTON, WESLACO, 1963.

		Percent increase in control					
		Oil-water			Aerosol		
Material	Actual (Gal/A)	- weevil	worm	Open** bolls	weevil	worm	Open** bolls
Oil-Insecticide*							
IP	1.5	7	25	0	41	82	26
N	1.5	0	50	7	24	72	17
P	1.5	9	50	0	29	82	24
Insecticide*		0	25	6	41	91	29
Check†		44	4	182	17	11	257

* Mean of 10 applications.
** Mean open bolls per 50 plants.
† Mean percent damaged squares or bolls.

Sweet corn plots were established in the fall of 1963 and the spring of 1964 for corn earworm control. In the fall 1963, four insecticides and two emulsifier systems for each of 3 oil fraction-DDT combinations, at equal rates, were used. The three fractions represented paraffinic, naphthenic, and isoparaffinic type oils. The 1964 experiments were established to use insecticides, aerosol application of oil-DDT combinations, and oil-water-insecticide combinations. Two oil-water-insecticide emulsifier systems were used as in the fall 1963 experiment. The treatments (Tables 6, 7) were evaluated as described by Wolfenbarger (1964).

TABLE 6.—INSECTICIDES, DDT- AND NALED-EMULSIFIER SYSTEM, AND DDT SPRAY SYSTEMS FOR CORN EARWORM CONTROL ON SWEETCORN, WESLACO, FALL 1963, SPRING 1964.

Material	Emulsion system	Spray system	Actual (Lbs.+ gal./A.)	Percent worm-free ears Fall 1963*	Spring 1964**
DDT			1.0	8	
DDT			2.0		54
DDT			4.0		62
DDT+IP	Unstable	Oil-water	2.0+1.5	5	
DDT+IP	Unstable	Oil-water	1.0+3.0		60
DDT+N	Unstable	Oil-water	2.0+1.5	2	
DDT+N	Unstable	Oil-water	1.0+3.0		41
DDT+P	Unstable	Oil-water	2.0+1.5	12	
DDT+P	Unstable	Oil-water	1.0+3.0		49
DDT+IP	Stable	Oil-water	2.0+1.5	13	
DDT+IP	Stable	Oil-water	1.0+3.0		46
DDT+N	Stable	Oil-water	2.0+1.5	24	
DDT+N	Stable	Oil-water	1.0+3.0		44
DDT+P	Stable	Oil-water	2.0+1.5	25	
DDT+P	Stable	Oil-water	1.0+3.0		59
DDT		Aerosol	2.0		25
DDT		Aerosol	4.0		41
DDT+IP		Aerosol	2.0+1.5		24
DDT+N		Aerosol	2.0+1.5		39
DDT+P		Aerosol	2.0+1.5		39
Monsanto 40294			1.0	30	
Monsanto 40294			2.0		41
Monsanto 40294			4.0		53
Monsanto 40273			1.0	23	
Monsanto 40273			2.0		72
Monsanto 40273			4.0		63
Naled			4.0		48
Naled+N	Stable	Oil-water	4.0+1.5		20
Naled+P	Stable	Oil-water	4.0+1.5		13
Check			——	9	16

* Four applications.
** Three applications.

TABLE 7.—SUMMARY OF EFFECTS OF EMULSION AND SPRAY SYSTEMS AND OF TYPES OF OIL; SWEETCORN, WESLACO, FALL 1963, SPRING 1964.

Emulsion and spray system	Percent worm-free ears	
	Fall 1963	Spring 1964
Oil-water		
stable	21	52
unstable	6	50
Aerosol		
DDT	—	32
oil-DDT	—	31
Oil-fraction		
IP	9	43
N	13	41
P	19	49

In 1963-1964, insecticides and insecticide-oil combinations were used for cowpea curculio control on southernpeas. Two emulsifier systems of the water-oil-toxaphene combinations were evaluated and compared with toxaphene alone in both tests. During the spring of 1964, aerosol applications of toxaphene-oil were made at the rate of 1.5 gallons per acre. Guthion and methyl parathion were applied at 4 different rates and 1 to 4 times. In both experiments, applications were initiated at first blossom. The treatments were evaluated as described in Wolfenbarger & Schuster (1963) and Wolfenbarger (1964), and the data (Tables 8, 9) are presented as larvae per 100 pods.

The chemical formula of the proprietary insecticides used in these evaluations are:

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

Giegy 13005—O,O-dimethyl-S-O (S-methoxy-1,3,4-thiodianzol-2(3H)-on-3-yl-methyl)-dithiophosphate

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

Monsanto 40273—O-(p-nitrophenyl)-O-propyl methylphosphonothionate

Monsanto 40294—O-(p-nitrophenyl)-O-phenyl methyl phosphonothioate

Shell Development 9129—crotanamide, 3-hydroxy-N methyl dimethyl phosphate.

TABLE 8.—RATES AND NUMBER OF APPLICATIONS OF INSECTICIDES, INSECTICIDE-OIL-WATER, AND AEROSOL APPLICATIONS FOR COWPEA CURCULIO CONTROL ON SOUTHERNPEAS, WESLACO, FALL 1963, SPRING 1964.

Materials	Method of application	Number of applications	Actual (Lbs. + gal./A.)	Percent increase in control	
				Fall	Spring
SD 9129		4	1.0		100
Bidrin		4	0.5	29	88
Naled		4	2.0	14	
Naled		4	2.0		0
Phosphamidon		4,4*	1.0	0	0
Phosphamidon		4	2.0		75
Monsanto 40294		4	1.0		50
Monsanto 40273		4	0.75	43	
Monsanto 40273		4	1.0		100
Monsanto 40273		4	2.0	71	
Toxaphene		4,4	3.0	0	0
Toxaphene+IP	Stable	4,4	3.0+1.5	29	0
Toxaphene+N	Stable	4,4	3.0+1.5	14	75
Toxaphene+P	Stable	4,4	3.0+1.5	14	88
Toxaphene+P	Unstable	4	3.0+1.5	43	
Toxaphene+IP	Aerosol	4	3.0+1.5		0
Toxaphene+N	Unstable	4	3.0+1.5	14	
Toxaphene+N	Aerosol	4	3.0+1.5		63
Toxaphene+P	Unstable	4	3.0+1.5	0	
Toxaphene+P	Aerosol	4	3.0+1.5		50
Parathion		4,4	2.0	57	100
Giegy 13005		4	2.0		100
Methyl parathion		2	0.5		50
Methyl parathion		4	0.5		88
Methyl parathion		2	1.0		63
Methyl parathion		4	1.0		88
Methyl parathion		1	1.5		75
Methyl parathion		2	1.5		0
Methyl parathion		3	1.5		100
Methyl parathion		4	1.5		100
Methyl parathion		4	2.0	43	
Guthion		1	1.0		0
Guthion		2	1.0		0
Guthion		3	1.0		75
Guthion		4	1.0		88
Check**			——	7	8

* Number of applications applied in the fall and number of applications applied in the spring.

** Mean larvae per 100 pods.

TABLE 9.—SUMMARY OF EFFECTS OF EMULSION AND SPRAY SYSTEMS AND OF TYPES OF SOIL; SOUTHERNPEAS, WESLACO, FALL 1963, SPRING 1964.

Emulsion and spray system	Larvae per 100 pods	
	Fall	Spring
Oil-water		
stable	6	7
unstable	6	—
Aerosol	—	6
Oil		
IP	5	11
N	7	3
P	7	6

RESULTS AND DISCUSSION

The results in all experiments are expressed as per cent increase in control over the untreated check or as indicated in the summaries in Tables 3, 4, 7, and 9. The data in Table 2 show that the 1.5 and 3.0 gallons per acre rates of paraffinic oil-DDT- + Toxaphene combination gave control of the boll weevil and corn earworm which was superior to the use of DDT + toxaphene alone. This insecticide-oil combination gave better control than all other treatments and the check. The rate of oil (Table 4) in the insecticide-oil combination did not increase insect control. The data (Table 5) show that all aerosol applied insecticide and insecticide-oil combination applications increased corn earworm and boll weevil control over the oil-insecticide-water applied combinations. The oil-water-insecticide combinations or insecticide combinations were ineffective in controlling the boll weevil.

Data in Table 6 show that Monsanto 40273 and Monsanto 40294 gave the best corn earworm control on sweet corn and were equal to or superior to DDT at the 1 lb. per acre rate. Monsanto 40273 was superior to DDT at the 2 lb. rate but equal in effectiveness at the 4 lb. rate. DDT was equal or superior to Monsanto 40294 at 2 and 4 lbs. per acre. DDT-oil-combinations were not as effective as DDT alone at equal rates, when applied as an aerosol spray at the rate of 1 and 2 gallons per acre. The stable emulsion system was generally superior to the unstable emulsion system (Table 7). The water applications of the oil-insecticide combinations were superior to the aerosol applications of oil-insecticide sprays. The oil fraction possessing a predominance of paraffinic type molecules gave the best corn earworm control compared to the naphthenic or isoparaffinic type oils (Wolfenbarger 1964). Naled and the naled-oil combinations were ineffective for corn earworm control.

The data in Table 8 show that parathion, methyl parathion, Monsanto 40273, Giegy 13005, Guthion, SD9129, and Bidrin were the most effective insecticides for cowpea curculio control. Phosphamidon at the highest rate offered promise for curculio control. Three and 4 applications of Guthion

were superior to 1 and 2 applications for cowpea curculio control. Three and 4 applications of methyl parathion at each of 3 rates were superior to 1 or 2 applications. There were no differences between 4 applications of methyl parathion at 0.5, 1.0, or 1.5 pounds per acre. Toxaphene and naled were ineffective for cowpea curculio control. The use of stable and unstable emulsion systems, aerosol applications, and oil had small effects on control (Table 9).

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