

## COWPEA INSECT CONTROL WITH HIGH-VOLUME AQUEOUS SPRAYS IN SOUTHERN NIGERIA

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### ABSTRACT

Field tests with nineteen insecticides against a complex of insect pests of cowpea in Southern Nigeria resulted in seed yield increases of over four times the unsprayed plots. Treated plants generally reached maturity earlier than untreated plants. Emulsifiable concentrate formulations were phytotoxic to young plants. Repeated applications of Carbaryl WP also were phytotoxic. Chlorophenamide (Galecron (R)) was extremely phytotoxic to plants of all ages.

Insecticides which showed particular promise against each group of the major insect pests were identified. Abate (R) carbaryl, chlorpyrifos dimethoate, fenitrothion, Gardona(R), lindane and methomyl merit further evaluation.

### INTRODUCTION

COWPEA seed yields on West African farms range from 150 to 600 kg/ha (Delassus, 1970 Taylor 1964, 1967, 1971). Yields are easily increased two to ten-fold when cultivars are; partially protected with modest insecticidal spray regimes (Appert, 1964; Ayoade 1959 Booker 1965; Delassus 1970; IITA 1971, 1972; Jerath 1968; Koehler and Mehta 1972 Taylor, 1964, 1967, 1971; Whitney, 1972). Insect attack on determinate cultivars of cowpeas grown in monoculture without plant protection in West Africa is usually so severe that no marketable seeds are produced (IITA 1971, 1972; Whitney, 1972). Although seed yields can be greatly increased by the application of insecticides, the level of insect control and the proportion of undamaged seeds have been unsatisfactory in the trials reported to date. The purpose of this work was to evaluate several commercial insecticides against the major cowpea insect pests under field conditions. Observations on phytotoxic reaction of cowpea plants were also made.

### MATERIALS AND METHODS

#### *1st experiment*

The trial was laid out in randomized complete block design with four replicates using cowpea cultivar Prima, an erect, determinate type. The trials plots were 15m<sup>2</sup> with one meter clear area surrounding each plot. Seeds were sown 2 April, 1972. Sprays were applied at 37, 43, 50, 58, 64 and 71 days after planting. A two-meter-high 16 mesh windbreak screen was used between plots during spraying to minimize drift, and no spraying was done when the wind velocity exceeded 3 km/hr. Insecticides formulations and dosage rates are given in Table 1. Damage to stems by *Maruca testulalis* and to foliage by thrips were estimated at 40 and 45 days after planting, respectively. All ripe pods were harvested from the centre two rows at 70 and 78 days after planting. Random samples of 100 pods per plot were examined for shrivelling (partially related to Hemiptera attack) and for *M. testulalis* damage. A random sample of 100 seeds from each 100 pod sample was examined for damage by Hemiptera and *L. ptychora*. The percentage undamaged seeds was also recorded because some individual seeds had multiple damage. Yields were assessed in terms of kg seeds per ha, g seed per pod, and threshing percentage. The results were subjected to analysis of variance and when significant F-values were found, means were compared by Duncan's multiple range test.

Cowpea plants were examined for signs of injury due to spraying. When phytotoxic symptoms such as burning, chlorosis, leaf distortion and general stunting appeared, these effects were noted. An attempt was made to quantify the total injury by scoring such damage on a 1 to 5 scale where 1 = 0 to 1%; 2 = 1 to 5%, 3 = 5 to 25%, 4 = 25 to 50% and 5 = 50% of the leaf area damaged.

*2nd Experiment:* Nineteen insecticides formulations including eight of those tested in the first season trials, were compared during the second season planting 28 September, 1972. Treatments were made at 15, 22, 29, 36, 42 and 56 days after planting. The growing plants were evaluated at 27, 35, 43 and 48 days after planting for damage to foliage by chewing insects and thrips and for populations of leafhoppers (*Empoasca dolichi* Paoli). Aphid populations (mainly *Aphis craccivora* Koch) were assessed at 43 and 48 days after planting. All ripe pods were harvested and examined for damage at 63 and 70 days after planting.

#### RESULTS AND DISCUSSION

*1st Experiment:* Insect pest populations were unusually low except for Hemiptera. This factor and the high coefficients of variability in the experiment made detection of significant differences difficult. Statistically significant differences in treatment effects on damage from thrips *M. testulalis* and *L. ptychora* and on seed yields are indicated in Table 1. All treatments gave significant reductions in thrips damage to foliage. Best thrips control resulted from the mixture of lindane plus dimethoate, lindane, Gardona WP plus molasses and Gardona E.C. Emulsifiable concentrate formulations of aprocarb, malathion and Gardona appeared to be slightly superior to wettable powders against thrips; however, only Gardona showed statistically significant superiority of the EC over the WP formulation against thrips. All treatments except carbaryl, dimethoate and malathion gave significant reductions in *M. testulalis* damage to pods in comparison to the untreated check. Mehta and Nyiira (1973) reported lindane and carbaryl effective against pod borers (mainly *Maruca testulalis*) but found Dimethoate and Malathion very inferior. Endosulfan EC or WP and Gardona WP were most effective against *Maruca testulalis*. Gardona performed best against both *M. testulalis* and *L. ptychora*., whilst Carbaryl was best against *L. ptychora* only. Seed yields were 7 to 43% larger in treated plots than in the untreated check; however, these increases were not statistically significant (Table 1).

No significant differences were detected for the following measurements (overall mean, range, coefficient of variation): Percentage of plants with *M. testulalis* damage to stems (16.6, 5.0-35.0, 77); percentage of pods totally shrivelled and without seeds (3, 2-6, 78); percentage of pods partially shrivelled (87, 83-90, 5); percentage of seeds with Hemiptera damage (39.7, 32-46, 20); percentage undamaged seeds (53.0, 44-59, 16); g seed per pod (0.56, 0.50-0.62, 11); threshing percentage (68.5, 64-72, 5); and kg seed per ha (1205, 976-1400, 16). Maturity of pods and seeds was earlier in the treated plots than in the untreated control plots (Table 1 percentage of total seed yield in first harvest). This early pod maturity in treated plots may be due to the reduction of flowering period resulting in earlier flowering peak and pod production reported by Booker (1964) in Northern Nigeria. Taylo (1965) reported that spraying did not alter the incidence of the first and main peak of flowering of two cowpea varieties in Southern Nigeria and he attributed these differences to the climatic differences and growing conditions. These two workers used different cowpea varieties in their investigations and that could have accounted partly for the differences observed. However, this apparent interaction between spraying and phenology of the crop needs further investigation.

#### *2nd Experiment:*

Differences in insect damage scores, insect populations and seed yields associated with the various treatments were significant at the 0.01 level except for grains of seed per pod which was significant at the 0.05 level (see Table 4). Excellent control of

TABLE 1.

## Control of insect amage to cowpea by high- volume sprays (1st experiment)

Treatment	Insect damage			Seed yield		
	kg a.i./ha per spray	Thrips	<i>Maruca</i> % damage of pods	<i>Laspyresia</i> % damage of seeds	% of Control <sup>b</sup>	% of total in 1st harvest
procarb EC	0.6	2.00abc	8 de	15	115	71
procarb WP	0.6	2.33 cd	7 cde	13	123	76
carbaryl LD <sup>d</sup>	1.0	2.30cd	10 ef	5	130	66
carbaryl WP	1.0	2.15bcd	10 ef	4	120	71
dimethoate EC	0.3	2.13bcd	16 g	9	116	67
indosulfan EC	0.6	2.40 cd	1 a	14	115	84
indosulfan WP	0.6	2.43 cd	1 a	13	112	79
bardona EC	0.6	1.88 ab	5bcd	7	139	77
bardona WP	0.6	2.50 d	3ab	6	141	81
bardona + Ataplus <sup>e</sup> WP	0.6	2.63a-d	4abc	7	126	78
bardona + Molasses <sup>f</sup> WP	0.6	1.73ab	4abc	6	143	75
bardona + PIB <sup>g</sup> WP	0.6	1.95abc	4abc	5	131	75
bardona + Tenac <sup>h</sup> WP	0.6	2.03a-d	5bcd	4	125	79
bardona + Vatso <sup>i</sup> WP	0.6	1.98bc	6bcd	6	122	72
procarb EC	0.6	1.80 aab	5bcd	11	116	82
procarb WP	0.6	1.75 ab	6bcd	16	107	79
procarb + Dimethoate (0.6)	(0.6)	1.57 a	6bcd	9	143	81
procarb EC	1.0	2.08 bed	13 fg	12	113	72
procarb WP	1.0	2.15 bcd	10 ef	11	124	68
Control	—	3.03 c	12 f	12	100	60
		0.001c	0.001	0.001	NS	

aEC = emulsifiable concentrate; WP = Wettable powder

LD = Liquid dispersible.

b. Untreated check plots averaged 976 kg seed/ha.

c. Level of significance for F-value. Numbers under each heading followed by the same letter do not differ at the 0.05 level according to Duncan's multiple range test

d. Semivol (R), a liquid dispersible formulated with molasses.

e. Wetting agent at 0.6 ml/l of spray.

f. 24 ml/l of spray

g. Staley's Protein Insecticide Bait at 1.9 ml/l of spray.

h. Wetting agent at 1.6 ml/l of spray

i. Wetting agent at 0.4 ml/l of spray.

TABLE 2.

## Efficacy of various insecticidal sprays against pre-flowering pests of prima cowpea (2nd experiment)

Formulations <sup>a</sup>	Treatment	Kg a.i./ha/ spray	Plant damage and Insects			
			Chewing damage <sup>b</sup>	Thrips damage <sup>b</sup>	Aphids <sup>c</sup>	Leaf- hoppers <sup>d</sup>
Abate EC		1.0	1.00 a	1.03 a	0.00 a	0.070 a
Carbaryl LD		1.0	1.00 a	1.15 a	0.00 a	0.000 a
Cabaryl 1 WP		1.0	1.00 a	1.00 a	0.00 a f	0.000 a
Chlorophenamide Sp		0.2	1.23 b	1.90 cd	7.50 bc	0.992 c
Chlorpyrifos EC		0.6	1.03 a	1.05 a	0.00 a	0.000 a
DDTEC		1.0	1.10 ab	1.05 a	7.50 bc	0.20 a
DDTEC + Lindane EC		1.1	1.18 ab	1.08 a	7.50 bc	0.008 a
Diazinon EC		0.6	1.30 b	1.25 ab	0.00 a	0.058 a
Dimethoate EC		0.3	1.25 ab	1.00 a	0.00 a	0.008 a
Endosulfan EC		0.6	1.00 a	1.28 ab	0.00 a	0.013 a
Endosulfan WP		0.6	1.23 ab	1.18 ab	0.00 a	0.015 a
Fenitrothion EC		0.6	1.30 b	1.00 a	0.00 a	0.008 a
Lindane EC	)	0.6	1.18 ab	1.20 ab	2.50 ab	0.985 c
Lindane EC	)	0.6	1.10 ab	1.08 a	0.00 a	0.008 a
(+) Dimethoate EC	)	0.3				
Methomyl Sp		0.6	1.13 ab	1.13 a	0.00 a	0.000 a
Methoxychlor EC		1.0	1.55 c	1.45 n	27.50 d	0.008 a
Trichlorfon Sp		0.6	2.30 e	2.05 d	12.50 c	0.615 b
Vamidothion EC		0.6	1.83 d	1.70 c	0.00 a	0.000 a
Untreated check		—	3.30 f	4.15 e	60.00 e	4.933 d
			0.01 e	0.01	0.01	0.01

<sup>a</sup> EC = Emulsifiable concentrate

LD = Liquid dispersible formulated with molasses

WP = Wettable powder

<sup>b</sup> Scored on 1-5 scale where 1 = 0-1%, 2 = 1-5%, 3 = 5-25%, 4 = 25-50% and 5 = 50% of leaf area damaged.

<sup>c</sup> = % plants infested.

<sup>d</sup> = Number of nymphs per trifoliolate leaf.

<sup>e</sup> = Level of significance in F-test. Numbers (means of 4 replicates) under each heading followed by the same letter do not differ significantly at the 0.05 level according to Duncan's multiple range test.

TABLE 3

Phytotoxicity of high-volume aqueous insecticidal spray to young cowpea plants in field trials  
(1st and 2nd experiments)

Treatments	% a.i.	Kg a.i./ha	Plants reacost
50% EC	0.24	1.0	1.0
carb 20% EC (Baygon (R))	0.14	0.6	-1.0
carb 50% WP ( Baygon (R) )	0.14	0.6	1.0
aryl 40% EC (Sevimol <sup>(1)</sup> ) + Molasses	0.24	1.0	3.3 BC Cu DP
aryl 85% WP (Serin (R) )	0.24	1.0	4.4 BC Cu DP
phenamidine 50% (Galecron (R) )	0.14	0.6	5.0 BC Cu DP
phynfos 40% EC (Dursban (R) )	0.14	0.6	1.8 DP
25% EC	0.24	1.0	1.8 DP
20% EC + Lindane 2% EC (Didigam (R) )	0.26	1.1	2.1 DP
imon 20% EC	0.14	0.6	2.2 DP
ethoate 30% EC (Roger 40(R) )	0.10	0.6	1.0
esulfan 35% EC (Thiodan)	0.14	0.6	1.3 DP
esulfan 50% WP (Thiodan)	0.14	0.6	1.0
methion 50% EC (Sumithion (R) )	0.14	0.6	1.8 B DP
meta (R) 24% EC	0.14	0.6	1.2 DP
meta (R) 75% WP	0.14	0.6	1.0
meta 20% EC (Gammalin (R) )	0.14	0.6	2.5 BDP
meta 50% WP (Gammexane (R) )	0.14	0.6	1.3 DP
meta 20% EC	0.14	0.3	2.9 DP
meta 30% EC	0.07	0.6	
meta 57% EC	0.24	1.0	1.5 DP
meta 50% WP	0.24	1.0	1.7 DP
meta 90% SP (Lannate)	0.14	0.6	1.4 DP
meta 30% EC	0.24	1.0	2.8 BC DP
meta 90% SP (Lannate)			
meta 30% EC	0.24	1.0	2.8 BC DP
meta 94% SP (Dipterex (R) )	0.14	0.6	1.3 DP
meta 40% (Kilval (R) )	0.14	0.6	1.5 DP

<sup>1</sup>Based on a scale where 1 = 0-1%, 2 = 1-5%, 3=5-25%  
4 = 25-50% and 5 = 50% of leaf area damaged.

B = burn, C = Chlorosis, Cu = cupping of leaves, D = distortion,  
mc = Marginal chlorosis of leaves, P = Puckering of leaves,  
S = Stunting.

TABIE 4: Efficacy of various insecticidal sprays against post flowering insect pests of prima Cowpea and effects on seed yield. (2nd experiment)

<i>Treatment</i>	<i>Kg a.i./ha</i> <i>/ spray</i>	<i>% pods</i>		<i>% Seeds damage by</i>		<i>kg/ha</i>	<i>Seed Yield</i>	
<i>Formulation</i>		<i>damaged by</i> <i>M. testulalis</i>	<i>% seeds</i> <i>undamaged</i>	<i>Hemiptera</i>	<i>L. ptychora</i>		<i>G/pod</i>	<i>Threshing %</i>
Abate Ec	1.0	2.25ab	90.75a	7.00a	2.25ab	620abc	0.72b-e	77ab
Carbaryl LD	1.0	22.00bcd	72.00de	23.50de	4.00ab	604abc	0.96ab	72bcd
Carbaryl WP	1.0	11.00bcd	86.75 abc	12.50abc	0.75a	688a	0.88a-d	75abc
Chlorophenamide SP	0.2	8.50abc	74.00cde	23.00cde	3.00ab	463bc	0.70cde	74abc
Chlorpyrifos EC	0.6	0.25a	77.00b-e	22.00b-e	1.00a	651abc	0.70cde	73a-d
DDT EC	1.0	4.75abc	80.00a-e	18.25a-e	1.75ab	709a	0.93abc	74abc
(DDT EC +)	1.0	8.25abc	77.00b-e	19.25a-b	4.25ab	511abc	0.65de	74abc
(Lindane EC)	0.1							
Diazinon	0.6	2.150cd	56.75f	42.25g	1.25ab	473bc	0.74be	70cd
Dimethoate EC	0.3	23.50e	76.00 cde	19.25a-e	4.75b	540abc	1.00a	72bcd
Endosulfan EC	0.6	3.00abc	75.00cde	23.00cde	2.25ab	677a	0.88a-d	73a-d
Endosulfan WP	0.6	2.00ab	73.75de	23.25de	3.50ab	547abc	0.79a-e	75abc
Fenitrothion EC	0.6	9.50a-d	84.00a-d	15.25a-d	0.75a	621abc	0.78a-e	70cd
Lindane EC	0.6	2.75abc	76.25cde	19.25a-e	4.75b	608abc	0.68cde	74abc
Lindane WP	0.6	7.75abc	78.75a-e	18.75a-e	2.50ab	565abc	0.77a-e	72bcd
(Lindane EC +)	0.6	4.50abc	91.25a	7.50a	1.25ab	675a	0.78a-e	77ab
(Dimethoate EC)	0.3							
Methomyl SP	0.6	0.50a	89.25ab	9.00a	0.75a	663ab	0.71cde	78a
Methoxychlor EC	1.0	7.25abc	75.75cde	21.75b-e	3.00ab	592abc	0.72b-e	72bcd
Trichlorfon SP	0.6	8.50abc	67.75e-f	28.75ef	3.50ab	434c	0.82a-e	68de
Vamidothion EC	0.6	36.75f	80.75a-d	10.50ab	9.50c	514abc	0.77a-e	71cd
Untreated check	—	18.25de	58.00f	36.25fg	8.00c	174d	0.63e	63e
		.01b	0.01	0.01	0.01	0.01	0.05	0.01

WP = Wettable power, SP Soluble

by the same letter

leaf-chewing insects and foliage thrips resulted from all treatments, however; methoxychlor, trichlorfon and vamidothion were less effective than the other treatments. Aphids were completely controlled by all treatments except chlorophenamide (=Chordimeform or Galecron (R.) DDT, DDT plus lindane, lindane, methoxychlor and trichlorfon. Chlorophenamide, lindane and trichlorfon were also inferior against leafhopper. The best control of *M. testulalis* damage to pods was obtained with chlorpyrifos and methomyl. Damage by *M. testulalis* was significantly higher with Vamidothion than in the untreated check. Satisfactory control of Hemiptera was obtained with Abate, lindane plus dimethoate, and methomyl. Carbaryl WP, chlorpyrifos, diazinon, fenitrothion, lindane plus dimethoate and methomyl gave very good control of *L. ptychora*. All treatments gave significant seed yield increase. Highest yields were associated with carbaryl, DDT, endosulfan EC and lindane plus dimethoate.

Emulsifiable concentrate and wettable power formulations appeared to be equal in efficacy except for carbaryl where the liquid dispersible with molasses (sevimol) was inferior to the wettable powder (Table 4).

**Phytotoxicity:** The results are summarised in Table 3. Several emulsifiable concentrates caused severe distortion and puckering of foliage when plants were sprayed before the trifoliolate leaves had expanded. Except for carbaryl, the WP formulations were not toxic to the plants. The phytotoxicity of carbaryl to cowpeas, pigeon peas and Soybeans in Tropical Africa has been reported by IITA (1972), Koehler and Rachie (1971) and Taylor (1968). Older plants (from flowering onwards) showed little phytotoxic reactions to any formulations except to chlorophenamide which was very toxic to Prima cowpeas at all growth stages.

#### SUMMARY AND CONCLUSION

Field tests with 19 insecticides (25 formulations) at dosage rates of 0.3 to 1.0 kg a.i./ha/ha against a complex of insect pests on cowpea in Southern Nigeria resulted in seed yield increases ranging from 7-30%. Treated plants generally matured one to three weeks earlier than untreated plants.

All insecticides except trichlorfon and vamidothion gave satisfactory control of leaf-chewing insects. Compounds which showed particular promise against major insect pests are categorised below.

**Leaf-chewers:** Lindane + dimethoate, lindane, Gardona WP + molasses and Gardona EC.

**Hemiptera:** Abate, Lindane + dimethoate and methomyl.

***M. testulalis*:** Chlorpyrifos, Endosulfan EC or WP, Gardona WP and methomyl.

***Lycopersia ptychora*:** Carbaryl, Chlorpyrifos, Diazinon, Endosulfan EC or WP, Fenitrothion, Gardona WP, lindane + dimethoate and Methomyl.

No consistent differences were detected when comparing emulsifiable concentrate and wettable powder formulations. Addition of wetting agents, molasses, cane syrup or molasses bait to Gardona WP made very little difference to performance.

Emulsifiable concentrate formulations were, however, phytotoxic to expanding trifoliolate leaves and leaf buds but not to fully expanded leaves. Carbaryl was phytotoxic, especially with repeated applications to young plants. Chlorophenamide was extremely phytotoxic to plants of all ages. Based on performances in these field tests and lack of residue persistence the following insecticides merit further evaluation: Abate, Carbaryl (older plants only), Chlorpyrifos, dimethoate, fenitrothion, Gardona, lindane and methomyl.

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