Effect of Fungicides, Insecticides, and Their Combinations on Stand Establishment and Yield of Cotton

A. J. KAPPELMAN, Jr., Research Plant Pathologist, Agricultural Research, Science and Education Administration, U.S. Department of Agriculture, and Adjunct Associate Professor, Department of Agronomy and Soils, Auburn University (Alabama) Agricultural Experiment Station, Auburn, AL 36830

ABSTRACT

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The effects of pesticides individually and in combination on cotton growth were evaluated in fields in Alabama during 1977 and 1978. Under favorable environmental conditions following the 1977 planting, no treatment increased early growth, but 11 reduced emergence and nine reduced seedling survival to less than that in check plots. The May-July drought, followed by extensive worm damage, wet weather in August and September, and resultant boll rot affected yields; only plots receiving three treatments had increased seed cotton yields. Six treatments tested in 1978 increased emergence or seedling survival under the adverse growing conditions after planting. Metalaxyl/pentachloronitrobenzene (1:8) plus aldicarb significantly increased yields in 1977, and metalaxyl plus aldicarb emergence and seedling survival in 1978.

Establishment of a good stand of vigorously growing plants is a major problem in producing satisfactory cotton yields. Although many factors affect stand establishment, proper use of fungicides and insecticides at planting is extremely important. Several pesticides have been effective in reducing disease, insect damage, or both (1,2,4–8). Although specific fungicides and insecticides have been recommended for obtaining stand establishment in most cotton-producing states, the availability of pesticides constantly changes. In addition, performance of these materials is difficult to assess because the occurrence and intensity of seedling diseases and insects cannot be predicted and because seasonal environmental conditions influence control effectiveness. Therefore, results from evaluations of available materials tested in diverse environments are continually needed.

The objective of this study was to evaluate the effects of chemicals applied at the time of planting on cotton growth in northern Alabama in 1977 and 1978.

MATERIALS AND METHODS

Tests were conducted in northern Alabama at the Tennessee Valley Substation with cotton planted 12 April 1977 and 5 and 6 April 1978. Treatments were applied to acid-delinted cv. Stoneville 213 cottonseed treated with seed fungicides. In 1977 the seed treatment consisted of 340 g of 4:1 pentachloronitrobenzene (PCNB) and 5-ethoxy-3-(trichloromethyl)-1,2,4-thiadiazole (ETMT) per 45.4 kg of seed. In 1978 the seed treatment was a combination of two fungicides (PCNB and ETMT) and carboxin plus the insecticide disulfoton. The latter was applied at 283, 113, and 227 g/45.4 kg of seed.

In 1977 plots were single rows 17.3 m long, spaced 1.07 m apart, but data were taken from only the center 15.2 m of each

Table 1. Results of cotton field trials with pesticides applied at planting time in Belle Mina, AL

			1977					1978	
			Plants (no.)/15.2-m row					Plants (no.)/15.2-m row	
Treatment	Application[a]	Rate (kg[a.i.]/ha)[b]	Emergence 15 days	Survival 35 days	Vigor[c]	% 1st pick (maturity)	Total seed cotton (kg/ha)	Emergence 21 days	Survival 34 days
Check	ST	...	85	120	2.2	55.1	1,650	86	32
aldicarb	IFG	0.67	76	117	3.2	55.1	1,929	120	33
	IFG	0.45	...	...	...	...	...	108	32
aldicarb	IFG	0.67							
metalaxyl	IFG	0.07	...	...	...	...	...	117	64[+d]
metalaxyl + PCNB[e]	IFG	(0.6 + 1.24)	...	...	...	...	...	122	58
metalaxyl + PCNB	IFG	(0.08 + 1.32)	...	...	...	...	...	118	53
metalaxyl + PCNB	IFG	(0.16 + 1.24)	48*[f]	110	2.9	54.4	2,004[+]	...	...
metalaxyl + PCNB	IFG	(0.22 + 1.74)	50	112	2.7	58.1	1,707	...	...
Na salt of hexachlorophene	IFS	0.08	54	94	2.8	50.4	2,052[+]	...	...
Na salt of hexachlorophene (10)	PES	0.08	45*	88*	2.8	57.3	1,823	...	...
Na salt of hexachlorophene (20)	PES	0.08	38**	87**	2.2	51.1	1,992	...	...
PCNB	IFG	1.12	...	...	...	...	...	114	42
carboxin	IFG	1.12	...	...	...	...	...	106	45
aldicarb	IFG	0.67	...	...	...	...	...	98	31
phenamiphos	IFG	1.12	...	...	...	...	...	118	36
carboxin + captan	HB	(0.56 + 0.56)	83	98	1.4	55.8	1,632	96	31
aldicarb	IFG	0.67	54	106	3.1	56.6	1,812	...	...
terbufos	IFG	1.01	...	...	...	...	...	92	34
disulfoton	IFG	1.12	41*	82**	2.2	42.9**	1,759	...	...
metalaxyl	IFG	0.07	...	...	...	...	...	124	70[++]
metalaxyl	IFG	0.28	74	116	2.6	59.6	1,725	...	...
aldicarb	IFG	0.67	52	100	3.3	53.1	2,020[+]	...	...
metalaxyl + PCNB	IFG	(0.08 + 1.32)	...	...	...	...	...	106	62[+]
	IFG	(0.12 + 1.85)	...	...	...	...	...	108	58
	IFG	(0.16 + 1.24)	46*	102	2.2	45.6*	1,725	...	...
	IFG	(0.16 + 1.24)	...	...	...	...	...	122	60[+]
	IFG	(0.22 + 1.74)	53	106	1.8	51.2	1,708	...	...
metalaxyl + PCNB	IFG	(0.08 + 1.32)							
phenamiphos	IFG	1.12	...	...	...	...	...	102	50
Na salt of hexachlorophene (10)	IFS	0.08	73	103	2.9	59.4	1,889	77	25
(20)	IFS	0.08	42*	94*	1.8	46.5	1,748	...	...
	IFS	0.16	...	...	...	...	...	92	37
	PES	0.16	...	...	...	...	...	73	28
PCNB + ETMT[g]	IFG	(1.12 + 0.28)	...	...	...	...	...	132[+]	67[++]
PCNB + ETMT	IFG	(1.12 + 0.28)	80	117	2.4	49.4	1,789	...	...
aldicarb	IFG	0.67	79	113	3.6[++]	59.2	1,899	101	47
phenamiphos	IFG	1.12	...	...	...	...	...	117	56
terbufos	IFG	1.01	...	...	...	...	...	134[+]	70[++]
PCNB + ETMT + disulfoton	IFG	(1.12 + 0.28 + 1.12)	50	94	2.1	40.9**	1,714	...	...
PCNB + ETMT + pyorate	IFG	(1.12 + 0.28 + 1.12)	28**	87**	1.9	31.7**	1,690	...	...
PCNB + ETMT xylene	GF	(1.12 + 0.28)	18**	83*	1.1	40.0**	1,481	...	...
aldicarb	IFG	0.67	12**	76**	1.6	39.5**	1,783	...	...
phenamiphos	IFG	1.12	50	96	2.5	40.1**	1,794	77	34
	IFS	1.12	42	93*	2.4	30.9**	1,864	...	...
	IFG[h]	1.12	64	111	2.8	39.4**	1,852	...	...
phorate	IFG	0.84	40*	86**	2.6	33.4**	1,701	...	...
potassium *N*-hydroxymethyl-*N*-methyldithio-carbamate	IFS	4.48	38**	109	2.2	45.3*	1,759	102	36
aldicarb	IFG	0.67	50	107	3.3	55.5	1,922	...	...
TCMTB[i]	IFS	1.12	...	...	...	...	...	70	35
terbufos	IFG	1.01	...	...	...	...	...	79	27
Na salt of hexachlorophene	IFS	0.16	...	...	...	...	...	86	39
Na salt of hexachlorophene	PES	0.16	...	...	...	...	...	65	20

[a] ST = seed treatment only, GF = gravity flow, HB = hopperbox, IFG = in-furrow granules, IFS = in-furrow spray, PES = preemergence spray over to top in a 12- to 14-in. band.

[b] Numbers in parentheses indicate rate of chemical applied to same granule.

[c] Scale of 0–5, where 0 = poor, 5 = excellent.

[d] + and ++ = significantly better than the check at the 0.05 and 0.01 levels of probability, respectively, according to Dunnett's test.

[e] PCNB = pentachloronitrobenzene.

[f] * and ** = significantly worse than the check at the 0.05 and 0.01 levels of probability, respectively, according to Dunnett's test.

[g] ETMT = 5-ethoxy-3-(trichloromethyl)-1,2,4-thiadiazole.

[h] In-furrow granules dispersed in a 6-in. band.

[i] TCMTB = 2-[(thiocyanamethyl)thio]benzothiazole.

row. During 1978, row length and spacing were the same as in 1977, but plots consisted of three rows and data were taken only from the interior 15.2 m of the center row of each plot. Each year the test was designed as a randomized complete block with four replications.

During the 2-yr test, 11 chemicals and combinations of chemicals were evaluated, but not all chemicals were evaluated each year. Eleven treatments were the same both years; the chemicals involved in an additional treatment were also tested both years but at varying rates.

Chemicals were applied by six different methods or combinations of them. In-furrow granules and liquid gravity flow materials were applied directly over the seed; in one test, in-furrow granules were applied in a 6-in. band over the seed. Hopperbox chemicals were mixed with the seed immediately before planting, then dispersed with the seed into the furrow. In-furrow spray chemicals were applied with two nozzles. Spray from the first nozzle was directed on the seed in the furrow; that from the second nozzle was directed at and incorporated into the covering soil. Spray from these nozzles was applied in a 1:4 ratio (v/v). Preemergence spray treatments were applied over the top of the covered furrow in a 12- to 14-in. band.

Each year state recommendations were followed to maintain plot fertility and to control weeds and late season insects. Emerged seedlings were counted 15 days and surviving seedlings 35 days after planting in 1977. In 1978 similar counts were made 21 and 34 days after planting. Vigor ratings of each plot, on a scale of 0–5 (0 = poor, 5 = excellent), were made in 1977 35 days after planting. Two harvests were made in 1977. Data were analyzed and compared with that of the check by using Dunnett's test.

RESULTS AND DISCUSSION

During 1977 no treatment significantly increased emergence or seedling survival or affected maturity (Table 1). In contrast, 11 treatments reduced emergence and nine treatments reduced seedling survival below that of check plots. Plants in plots that received five of the above treatments also matured later than those in the check plots. Although plants in plots that received one treatment were more vigorous than those on check plots, they neither matured earlier nor had higher yields.

Environmental conditions after planting during 1977 favored cotton growth, and early season insect damage was minimal. Drought May through July, however, followed by heavy infestations and damage from worms (*Heliothus* spp.) and then wet weather in August and September, resulted in abnormal growth and boll development. Eleven treatments retarded maturity as evidenced by percent of cotton harvested at the first picking, although plots receiving these treatments were not lower yielding (Table 1). Mean yields of plots that received three treatments of combinations of fungicides and the insecticide aldicarb were greater than the yield of the check.

In the 1978 test two treatments significantly increased mean seedling emergence and survival (Table 1). Seedling survival of plots that received four other treatments was also greater than that in check plots. Weather conditions after emergence were extremely adverse and caused early termination of this test; insects thus had little effect on the results. Therefore, results from plots that received fungicide-insecticide combinations should have been similar to those from plots that received only a comparable fungicide, unless antagonistic effects between chemicals occurred. All possible comparisons (18 for each trait) were made and no significant differences were evident. Only two treatment combinations, 1:8 metalaxyl/PCNB plus aldicarb and metalaxyl plus aldicarb, increased yield during 1977 and also increased emergence and survival during 1978.

LITERATURE CITED

1. BIRD, L. S., C. D. RANNEY, and G. M. WATKINS. 1957. Fungicide treatments at planting to control the cotton seedling disease complex. Tex. Agric. Exp. Stn. Prog. Rep. 1930.
2. CHAMBERS, A. Y., W. G. RUSSELL, J. R. OVERTON, and H. ANDREWS. 1969. Interactions of recommended pre-emergence herbicides, systemic insecticides and soil fungicides on cotton: Two years results. Proc. South. Weed Sci. Soc. pp. 83-92.
3. DAVIS R. G. 1978. The influence of seed quality and fungicide treatment on cotton seedling stand. Proc. Beltwide Cotton Prod. Res. Conf. pp. 18-19.
4. FARRAR, L. L. 1973. Report of Multiple Soil Treatments Committee of the Cotton Disease Council. Proc. Beltwide Cotton Prod. Res. Conf. pp. 10-14.
5. KAPPELMAN, A. J., Jr. 1969. Fungicidal control of diseases in cotton. Plant Dis. Rep. 53:161-163.
6. KAPPELMAN, A. J., Jr. 1977. Effect of fungicides and insecticides applied at planting on cotton emergence, seedling survival, and vigor. Plant Dis. Rep. 61:703-706.
7. McCARTER, S. M. 1973. Report of the Soil Fungicides Committee of the Cotton Disease Council. Proc. Beltwide Cotton Prod. Res. Conf. pp. 14-17.
8. McCARTER, S. M. 1974. Report of the Soil Fungicides and Multiple Pesticides Committee of the Cotton Disease Council. Proc. Beltwide Cotton Prod. Res. Conf. pp. 8-9.