



Effect of paraquat on immature bolls is illustrated by this comparison. Bolls in the two upper rows were treated with DEF + paraquat, 1 pint of each per acre. Those in the lower row are from cotton treated with  $1\frac{1}{2}$  pints per acre DEF alone.

## DEFOLIATION, DESICCATION, AND REGROWTH INHIBITION OF COTTON

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USE OF HARVEST-AID chemicals for cotton has increased steadily in Alabama during the past few years. Some 30 to 40 per cent of the State's crop was treated with defoliant in 1967. Much of this increase came about because of almost complete mechanization of harvesting and use of higher levels of nitrogen fertilization.

Despite widespread use of defoliant as preharvest chemicals, there is much confusion as to what they should do. Growers often expect too much and are disappointed in the results. Defoliant

do not hasten maturity, rather they stop the process. Thus, they are more effective when applied to matured cotton that is 60 to 80 per cent open, and when temperatures are high and moisture is low at time of application. If new growth is slight, temperature high, and available soil moisture low, a defoliant such as DEF (S,S,S-tributyl-phosphorotrithioate) or Folex (tributyl-phosphorotrithioate) does a satisfactory job and facilitates harvest.

Late plantings, excessive or late nitrogen application (or both), low tempera-

tures, and excessive rainfall result in delayed maturity and slow opening. Under such conditions in 1966 and 1967, cotton continued to grow vigorously until frost. This situation increases interest in harvest-aid chemicals that will desiccate the new growth and prevent regrowth, as well as defoliate the plants.

Early work by Hall<sup>1</sup> indicated that amitrole (3-amino-1,2,4-triazole) was an effective defoliant and had some regrowth inhibiting properties. Hogue and Frans<sup>2</sup> later reported that both amitrole and pyriclor inhibited regrowth of cotton for 5 to 6 weeks after application. In mixtures with DEF, both pyriclor and amitrole reduced regrowth when compared to DEF alone.

Hogue and Frans also reported that addition of endothall (7-oxabicyclo 2.2.1 heptane-2, 3-dicarboxylic acid) to DEF increased desiccation over DEF alone. When endothall was added to Folex, however, defoliation was increased over that of Folex alone but there was no increase in desiccation. Paraquat (1,1'-dimethyl-4, 4-bipyridinium salt) added to DEF significantly increased desiccation, but regrowth was not inhibited.

Studies were begun by Auburn University Agricultural Experiment Station in 1967 to determine the effect of endothall, paraquat, and pyriclor on defoliation, desiccation, regrowth inhibition, and injury to cotton when applied in combination with DEF.

#### DESCRIPTION OF EXPERIMENTS

Field studies during 1967 at the Agricultural Engineering Research Unit at Marvyn, Alabama, were made to evaluate combinations of paraquat or pyriclor

<sup>1</sup> HALL, W. C., S. P. JOHNSON, AND C. L. LEINWEBER. 1954. Amino Triazole—A New Abscission Chemical and Growth Inhibitor. Tex. Agr. Exp. Sta. Bull. 789.

<sup>2</sup> HOGUE, CHARLES W. AND R. E. FRANS. 1967. Use of Chemical Combinations for Defoliation, Desiccation, and Regrowth Inhibition Prior to Cotton Harvest. Proc. Annual Cotton Defoliation and Physiology Conferences 21:84-87.

with DEF. One experiment consisted of five treatments in plots 8 rows wide and 100 feet long. Treatments were replicated three times in a randomized complete block design.

The plots were planted to Auburn 56 variety on April 26 and subjected to standard production practices during the growing season. All chemicals were applied September 21, using a high-clearance sprayer with one K-5 flooding nozzle mounted on the spray boom directly above each row, in 20 gallons of water per acre. The cotton was approximately

TABLE 1. DAILY RAINFALL FOR JULY-OCTOBER 1967, MARVYN RESEARCH UNIT

Date	Rainfall by days			
	July	Aug.	Sept.	Oct.
	In.	In.	In.	In.
1	0.70			
2			0.30	
3	2.00		2.40	
4				
5				
6	0.75			
7	2.20	0.17	0.85	
8			0.15	0.10
9				0.20
10				
11		1.20		
12				
13	0.40			
14	0.25			
15				
16				
17				0.10
18				
19		0.50		
20				
21		0.35		
22		0.40		
23		0.40		
24	0.28	1.15		
25	0.30			0.95
26	1.15			
27				
28		0.05		
29				
30				
31				2.00

3 feet tall and 60 to 70 per cent open at time of application. Rainfall during the study period is recorded in Table 1.

Leaf drop, regrowth, and immature boll injury estimates were made October 2, 6, and 10. On October 24, seed cotton yield and harvesting efficiency were determined for each treatment. At harvest, regrowth from a portion of one row in each plot was harvested, dried, and weighed. Unopened bolls were also harvested and the amount of cotton remaining in these bolls determined.

In a second experiment at the Marvyn Research Unit, application was made when only 40 to 50 per cent of the cotton bolls had opened. Treatments were applied as described in the previous experiment on October 2.

An additional experiment was begun September 11, 1967, at the Agronomy Farm, Auburn. Experimental methods were the same as previously described, except endohall was included as a treatment.

### RESULTS OF MARVYN EXPERIMENTS

Fifteen days after treating (October 6), cotton treated with 1½ pints per

TABLE 2. EFFECT OF PARAQUAT AND PYRICLOR IN COMBINATION WITH DEF ON LEAF DROP OF COTTON, MARVYN RESEARCH UNIT, 1967

Chemical and per acre rate	Leaf drop <sup>1</sup>		
	Oct. 2	Oct. 6	Oct. 10
	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>
DEF, 1½ pt.....	83 a	93 a	90 ab
DEF, 1 pt. + paraquat, ½ pt.....	78 a	80 b	82 b
DEF, 1 pt. + paraquat, 1 pt.....	72 a	73 b	70 b
DEF, 1 pt. + pyriclor, 2 pt.....	87 a	90 a	95 a
DEF, 1 pt. + pyriclor, 3 pt.....	77 a	85 ab	93 a

<sup>1</sup>When values within columns are followed by the same letter there is no difference because of treatment, as figured by standard statistical methods; those followed by different letters differ significantly.

acre of DEF had dropped 93 per cent of its leaves, Table 2.

When either 2 or 3 pints per acre of pyriclor was applied with DEF, defoliation remained about the same. With paraquat in the spray solution there was a slight reduction in leaf drop at the ½ pint per acre rate and a substantial reduction when 1 pint per acre was used. The reduced leaf drop at the higher rate of paraquat was caused by "leaf freezing."

TABLE 3. EFFECT OF PARAQUAT AND PYRICLOR IN COMBINATION WITH DEF ON BURN OF UNOPENED BOLLS, MARVYN RESEARCH UNIT, 1967

Chemical and per acre rate	Unopened bolls having some burn <sup>1</sup>	
	Oct. 2	Oct. 10
	<i>Pct.</i>	<i>Pct.</i>
DEF, 1½ pt.....	0 a	0 a
DEF, 1 pt. + paraquat, ½ pt.....	80 b	80 b
DEF, 1 pt. + paraquat, 1 pt.....	83 b	82 b
DEF, 1 pt. + pyriclor, 2 pt.....	0 a	4 a
DEF, 1 pt. + pyriclor, 3 pt.....	0 a	4 a

<sup>1</sup>When values within columns are followed by the same letter there is no difference because of treatment, as figured by standard statistical methods; those followed by different letters differ significantly.

No injury to immature unopened bolls was observed in plots treated with DEF alone at 1½ pints per acre, Table 3. Addition of pyriclor at rates up to 3 pints per acre caused no significant injury. Few of the immature bolls showed any detectable burn. The addition of paraquat at ½ pint per acre to DEF caused severe burn to as high as 80 per cent of the unopened bolls. Type of burn observed on unopened bolls is shown in the title photograph.

The number of cotton plants initiating regrowth was not affected by addition of paraquat to the spray solution, Table 4. However, regrowth on plots treated with 1 pint DEF and 2 or 3 pints pyri-

TABLE 4. EFFECT OF PARAQUAT AND PYRICLOR IN COMBINATION WITH DEF ON REGROWTH OF COTTON, MARVYN RESEARCH UNIT, 1967

Chemical and per acre rate	Plants initiating regrowth <sup>1</sup>		Regrowth
			per acre, <sup>1</sup>
	Oct. 2	Oct. 10	Oct. 24
	<i>Pct.</i>	<i>Pct.</i>	<i>Lb.</i>
DEF, 1½ pt. ....	15 a	18 a	29 a
DEF, 1 pt. + paraquat, ½ pt. ...	8 ab	13 a	25 a
DEF, 1 pt. + paraquat, 1 pt. ....	6 ab	18 a	28 a
DEF, 1 pt. + pyriclor, 2 pt. ....	0 b	2 b	6 b
DEF, 1 pt. + pyriclor, 3 pt. ....	0 b	2 b	6 b

<sup>1</sup> When values within columns are followed by the same letter there is no difference because of treatment, as figured by standard statistical methods; those followed by different letters differ significantly.

TABLE 5. EFFECT OF PARAQUAT AND PYRICLOR IN COMBINATION WITH DEF ON YIELD OF PICKER-HARVESTED COTTON, UNOPENED BOLLS, AND PICKER EFFICIENCY, MARVYN RESEARCH UNIT, 1967

Chemical and per acre rate	Seed cotton per acre harvested by picker <sup>1</sup>	Cotton per acre left in unopened bolls <sup>1</sup>	Harvesting efficiency
	<i>Pounds</i>	<i>Pounds</i>	<i>Per cent</i>
	DEF, 1½ pt. ....	2,456 a	119 a
DEF, 1 pt. + paraquat, ½ pt. ....	2,442 a	204 a	93.7
DEF, 1 pt. + paraquat, 1 pt. ....	1,933 a	349 b	92.0
DEF, 1 pt. + pyriclor, 2 pt. ....	2,398 a	90 a	94.8
DEF, 1 pt. + pyriclor, 3 pt. ....	2,224 a	125 a	95.1

<sup>1</sup> When values within columns are followed by the same letter there is no difference because of treatment, as figured by standard statistical methods; those followed by different letters differ significantly.

TABLE 6. EFFECT OF PARAQUAT AND PYRICLOR IN COMBINATION WITH DEF ON LEAF DROP AND BOLL BURN OF COTTON, MARVYN RESEARCH UNIT, 1967

Chemical and per acre rate	Boll burn <sup>1</sup>		Leaf drop, October 10 <sup>1</sup>
	October 6	October 10	
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
DEF, 1½ pt. ....	0 a	0 a	76 a
DEF, 1 pt. + paraquat, ¼ pt. ....	16 a	53 b	78 a
DEF, 1 pt. + paraquat, ½ pt. ....	65 b	92 b	55 b
DEF, 1 pt. + pyriclor, 2 pt. ....	0 a	3 a	85 a
DEF, 1 pt. + pyriclor, 3 pt. ....	0 a	5 a	80 a

<sup>1</sup> When values within columns are followed by the same letter there is no difference because of treatment, as figured by standard statistical methods; those followed by different letters differ significantly.

clor per acre made only approximately 25 per cent as much regrowth as did cotton treated with 1½ pints per acre DEF. Although only slight regrowth occurred in this experiment, the potential was evident and could be substantial under high moisture and fertility conditions.

Yield of cotton was not significantly reduced in any treatment, Table 5. There was, however, a significant increase in amount of cotton remaining in unopened bolls when treated with DEF + paraquat (1 pint each per acre). Picking efficiency was reduced slightly. Adding pyriclor to the spray solution did not reduce yields or decrease picking efficiency when compared with DEF treatment alone. Amount of cotton remaining in unopened bolls when treated with pyriclor was comparable to that in cotton treated with DEF alone.

TABLE 7. EFFECT OF PARAQUAT, PYRICLOR, AND ENDOTHALL IN COMBINATION WITH DEF ON LEAF DROP OF COTTON, AGRONOMY FARM, AUBURN, 1967

Chemical and per acre rate	Leaf drop <sup>1</sup>			Regrowth, <sup>1</sup>
	Sept. 21	Sept. 27	Oct. 11	Oct. 11
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
DEF, 1 pt. + paraquat, ½ pt. ....	75 a	88 a	95 a	80 b
DEF, 1 pt. + pyriclor, 2 pt. ....	70 a	95 a	95 a	20 c
DEF, 1 pt. + endothall, 1½ pt. ....	65 a	95 a	95 a	85 b
Untreated check. ....	0 b	30 b	40 b	90 a

<sup>1</sup> When values within columns are followed by the same letter there is no difference because of treatment, as figured by standard statistical methods; those followed by different letters differ significantly.

In the second experiment at the Marvin Research Unit treatments were applied when only 40 to 50 per cent of bolls were open. Boll burn occurred on 53 and 92 per cent of unopened bolls when ¼ and ½ pint per acre paraquat was applied with DEF. Leaf drop was not delayed by ¼ pint paraquat, but was decreased slightly by the ½ pint per acre rate, Table 6. No significant boll burn was observed on plots treated with pyriclor. Leaf drop was the same as with DEF alone.

#### RESULTS AT AGRONOMY FARM

The addition of either ½ pint paraquat, 2 pints pyriclor, or 1½ pints endothall to 1 pint DEF per acre gave com-

parable leaf drop. Practically all cotton plants in all treatments except DEF + pyriclor initiated regrowth, Table 7.

#### SUMMARY AND CONCLUSIONS

Addition of ½ pint paraquat or more to 1 pint per acre of DEF caused substantial burn to unopened bolls. Observations of field scale application of paraquat revealed that severity of burn was decreased as level of maturity increased. Immature bolls that received substantial burn did not open sufficiently to be harvested with a mechanical picker. Pyriclor caused slight boll burn even at the highest rate. Regrowth was inhibited by pyriclor at rate of 2 pints per acre or more. Endothall and paraquat did not prevent regrowth.

