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Effects of Harvest-Aid Chemicals on Boll Opening, Yield, and Quality

SUMMARY

Field studies were conducted from 1980 through 1982 to evaluate "early" and "normal" application of the following harvest aids: Prep (ethephon) at 1.5 pound ai (active ingredient) per acre, Prep plus DEF (*S,S,S*-tributylphosphorotrithioate) at 0.5 plus 0.75 pound ai per acre, DEF at 1.2 pound ai per acre, and Dropp (thidiazuron) at 0.1 pound ai per acre. Two cotton varieties Stoneville 825 and Stoneville 213 were planted in the tests. Early application was made when bolls were 40 to 50 percent and 30 to 50 percent open for Stoneville 825 and Stoneville 213, respectively. Normal application was delayed until 65 to 75 percent of bolls were open for both varieties. Prep alone, applied early, increased boll opening at 7 days after treatment for both varieties in 2 of 3 years in the test. Early application of Prep increased percent first harvest for both varieties all years. Seed cotton yields for Stoneville 825 were not affected by application time nor chemical treatments for any year. Early application reduced Stoneville 213 yields only in 1980. Fiber quality was influenced more by application time than chemical treatment. Fiber length, uniformity, strength, and elongation were increased with early application of harvest aids in 1980 for Stoneville 825.

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Effects of Harvest-Aid Chemicals On Boll Opening, Yield, and Quality

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INTRODUCTION

Chemical defoliation of cotton is a standard cultural practice in regions of high rainfall or irrigated production. Benefits of cotton leaf removal include increased harvesting efficiency and reduced boll rot, lint stain, and trash content. Some chemical defoliants also affect vegetative regrowth of cotton, which can affect harvesting efficiency and lint quality (*2,3,4,6,8,10,11,13,14*).

Current recommendations in the Southeast call for delayed application of defoliants until 60 to 75 percent of bolls are open (*2,6,8,10,11,13,14*). Growers may, however, choose to accept potential yield and quality losses and defoliate prematurely to avoid possible late-season weather delays and to facilitate harvest of a large acreage with limited equipment. Brown and Hayer (*5*), and Albert (*1*) reported yield and quality reductions in lint and seed from premature defoliation. Since defoliant timing is critical, it was selected as a variable in these studies.

Chemicals selected for evaluation in these studies included DEF, Prep, and Dropp. DEF is a commonly applied defoliant and is effective. It therefore serves as a standard. Prep was selected on its potential to enhance boll opening. Weir and Gaggero (*12*) reported enhanced boll opening and higher first-picking yields with Prep at rates of 1 and 1.5 pound ai per acre. Cathey et al. (*7*) obtained similar results with Prep and Prep plus DEF mixtures. Dropp was chosen

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for its potential to control cotton regrowth in addition to its defoliant properties.

The cotton varieties selected are high yielding for north Alabama (9). The primary difference between Stoneville 825 and Stoneville 213 is that in years where earliness is a factor, Stoneville 825 has produced higher yields. Since early application of harvest aids could influence boll maturity and yield, a variation in cotton maturity was desired to evaluate variety response to early application of the chemicals.

MATERIALS AND METHODS

Cotton was grown using recommended production practices on an Etowah silt loam at the Tennessee Valley Substation, Belle Mina, Alabama, for crop years 1980 through 1982. Plots four rows (40-inch spacing) by 370 feet were established in adjacent blocks of Stoneville 825 and Stoneville 213 cotton a week prior to defoliation.

Chemical treatments included DEF at 1.2 pound ai per acre, Prep at 1.5 pound ai per acre, Prep + DEF at 0.5 + 0.75 pound ai per acre, and Dropp at 0.1 pound ai per acre. All treatments were applied early and normal. Applications were made according to estimates of percent open bolls as determined by boll counts from 3 feet of row at 20 locations within each plot area. Early application was made about September 15, when bolls were 40 to 50 percent and 30 to 50 percent open for Stoneville 825 and Stoneville 213, respectively. Normal application was made when bolls were 65 to 75 percent open, which occurred 7 to 11 and 11 to 18 days after the early application for the respective varieties. Untreated plots were used as the control. Application dates, percent open bolls at application, and first harvest dates are listed in table 1.

TABLE 1. PERCENT OPEN BOLLS AT TWO DATES OF HARVEST-AID APPLICATION, DATES OF APPLICATION AND DATES OF FIRST HARVEST FOR STONEVILLE 825 AND 213 COTTON, TENNESSEE VALLEY SUBSTATION, 1980-82

Cotton variety and year	Early harvest-aid application			Normal harvest-aid application		
	Pct. open bolls	Application date	Harvest date	Pct. open bolls	Application date	Harvest date
Stoneville 825						
1980	43	9/12	9/19	75	9/19	10/6
1981	49	9/11	9/24	71	9/22	10/1
1982	46	9/13	9/21	74	9/24	10/1
Stoneville 213						
1980	47	9/19	10/6	70	10/7	10/14
1981	30	9/11	9/24	65	9/22	10/1
1982	49	9/13	9/21	77	9/24	10/1

Treatments were applied in a total water volume of 20, 22, and 17 gallons per acre in 1980, 1981, and 1982, respectively, using a high clearance sprayer equipped with three nozzles per row. Nozzle tips were 11002 flat fan in 1980 and TX6 cone in 1981 and 1982.

Percent open bolls was determined 7 days after application by counting all opened and unopened bolls from three, 3-foot sections of row in each plot. Visual rating of crop defoliation was made just prior to first harvest in 1981 and 1982.

The center two rows in each four-row plot were harvested twice with a two-row spindle picker. First harvest dates were different for early and normal treatments, table 1, while second picking date was the same. Seed cotton samples (50 pounds) were collected from each plot at first harvest and analyzed for fiber quality at the USDA Ginning Lab in Stoneville, Mississippi, for 1980 and 1981.

Experimental design was a randomized complete block with four replications. Each experiment consisted of a single variety with a factorial arrangement of harvest-aid treatments. Experiments were analyzed as a factorial arrangement and subjected to analysis of variance with means compared using Fisher's least significant difference at the 5 percent probability level.

RESULTS AND DISCUSSION

Boll Opening

Boll counts 1 week after application showed differences in percent open bolls due to chemical treatments in 1980 and 1982, table 2. For Stoneville 825, early application of Prep alone produced more open bolls than did other harvest-aid chemicals during 1980 and 1982. However, when application was made at normal time to this variety, percent open bolls was no more than the untreated check for any year. For 1981, no differences in percent open bolls due to harvest-aid chemicals or time of application could be detected for Stoneville 825.

Harvest-aid effects on percent open bolls were similar for Stoneville 213. Prep alone applied early produced more open bolls than other chemical treatments but only during 1982. Early application during 1980 produced fewer open bolls for DEF and Dropp and had no effect for Prep and Prep plus DEF. Harvest-aid chemicals applied at normal time to Stoneville 213 did not increase percent open bolls over the untreated check any year. For 1981, no detectable differences in percent open bolls due to harvest-aid chemicals were found for this variety either.

TABLE 2. PERCENT OPEN BOLLS AS INFLUENCED BY HARVEST-AID CHEMICALS APPLIED AT TWO DATES TO STONEVILLE 825 AND 213 COTTON, TENNESSEE VALLEY SUBSTATION, 1980-82

Treatment and rate (ai) per acre	Percent open bolls 7 days after harvest-aid application[1]					
	1980		1981		1982	
	Early	Normal	Early	Normal	Early	Normal
Stoneville 825						
DEF, 1.2 lb.	70	76	65	79	67	89
Prep, 1.5 lb.	91	92	71	89	93	88
Prep + DEF, 0.5 + 0.75 lb.	75	86	71	75	73	87
Dropp, 0.1 lb.	77	86	69	84	64	86
Untreated	75	88	74	77	66	83
FLSD (0.05)	9	9	NS[2]	NS	9	NS
CV (%)	10.3		11.8		8.2	
Stoneville 213						
DEF, 1.2 lb.	72	88	53	--	73	88
Prep, 1.5 lb.	83	89	64	--	95	92
Prep + DEF, 0.5 + 0.75 lb.	83	92	59	--	81	92
Dropp, 0.1 lb.	73	87	52	--	71	94
Untreated	82	91	61	--	73	84
FLSD (0.05)	7	NS	NS		9	9
CV (%)	7.7		19.7		7.2	

[1]Comparisons should be made within columns, within a year, and within a cotton variety.
[2]NS = not significant at 0.05 level of probability.

Failure of harvest-aid chemicals to affect boll opening during 1981 for either variety is believed due to cool night temperatures (59°F average) that followed one week after early application. The later time combined with dry weather in September (1.25 inches total) probably masked Prep's effects when applied at normal defoliation times.

Defoliation

Generally, percent defoliation for both varieties was greater with harvest-aid chemicals than the untreated check, table 3. This was true for both early and normal application. However, exceptions did occur, particularly during 1982. Differences among harvest-aid treatments were few and inconsistent. The newer chemicals, Prep and Dropp, defoliated both varieties as well as and sometimes better than the current standard, DEF; so did the Prep plus DEF mixture.

Percent First Harvest

Percent cotton picked at the first harvest was affected by harvest aids and application times, table 4. Prep alone applied early to Stoneville 825 increased percent first harvest all 3 years. Percent picked ranged from 88 to 90 percent. Delaying the Prep application to the

TABLE 3. PERCENT DEFOLIATION AS INFLUENCED BY HARVEST-AID CHEMICALS APPLIED AT TWO DATES TO STONEVILLE 825 AND 213 COTTON, TENNESSEE VALLEY SUBSTATION, 1981-82

Treatment and rate (ai) per acre	Percent defoliation 7 days after harvest-aid application[1]			
	1981		1982	
	Early	Normal	Early	Normal
Stoneville 825				
DEF, 1.2 lb.	86	84	67	65
Prep, 1.5 lb.	79	89	83	72
Prep + DEF, 0.5 + 0.75 lb.	94	89	74	74
Dropp, 0.1 lb.	91	82	83	68
Untreated	37	51	28	57
FLSD (0.05)	8		19	
CV (%)	7.7		19.8	
Stoneville 213				
DEF, 1.2 lb.	91	96	75	80
Prep, 1.5 lb.	87	98	86	91
Prep + DEF, 0.5 + 0.75 lb.	95	93	78	79
Dropp, 0.1 lb.	88	96	76	63
Untreated	42	64	31	58
FLSD (0.05)	6		NS[2]	
CV (%)	5.8		16.0	

[1]Comparisons should be made within columns, within a year, and within a cotton variety.
[2]NS = not significant at 0.05 level of probability.

TABLE 4. PERCENT FIRST HARVEST AS INFLUENCED BY HARVEST-AID CHEMICALS APPLIED AT TWO DATES TO STONEVILLE 825 AND 213 COTTON, TENNESSEE VALLEY SUBSTATION, 1980-82

Treatment and rate (ai) per acre	Percent first harvest[1] from different application times					
	1980		1981		1982	
	Early	Normal	Early	Normal	Early	Normal
Stoneville 825						
DEF, 1.2 lb.	73	88	79	89	71	86
Prep, 1.5 lb.	88	92	90	96	90	90
Prep + DEF, 0.5 + 0.75 lb.	76	90	81	93	78	87
Dropp, 0.1 lb.	76	89	82	90	69	85
Untreated	72	88	80	90	67	84
FLSD (0.05)	6		4		7	
CV (%)	5.2		3.2		5.7	
Stoneville 213						
DEF, 1.2 lb.	72	85	68	89	76	89
Prep, 1.5 lb.	83	88	85	93	91	92
Prep + DEF, 0.5 + 0.75 lb.	80	87	77	90	82	90
Dropp, 0.1 lb.	77	85	70	85	74	88
Untreated	73	86	70	85	73	87
FLSD (0.05)	4		5		4	
CV (%)	3.7		4.0		3.6	

[1]Comparisons should be made within columns, within a year, and within a cotton variety.

normal time had less effect but did increase percent first harvest 1 of 3 years (1981). The only other treatment that affected percent first harvest of this variety was a mixture containing Prep plus Def. When applied early in 1982, it increased percent cotton picked at the first

harvest over the untreated check. Treatments that received DEF alone or Dropp were no different than the untreated check.

Percent first harvest for Stoneville 213 was also affected by harvest aids and application times, table 4. Prep and Prep plus DEF applied early improved percent first harvest all 3 years. Where Prep was applied alone, 83 to 91 percent of cotton was picked initially. Prep plus DEF provided 77 to 82 percent at the first harvest. When application of harvest aids was delayed to the normal time, Prep alone produced a higher percent first harvest 2 of 3 years when compared to the untreated check. Percent first harvest from treatments receiving DEF alone or Dropp was generally no more than the untreated check.

Seed Cotton Yield

Total seed cotton yield of Stoneville 213 was affected 1 of 3 years by harvest-aid chemicals and time of application, table 5. In 1980, all harvest aids applied early (47 percent open bolls) reduced yield compared to the untreated check. Least reduction (11 percent) was with Dropp and most (22 percent) with Prep. When the application was applied at normal time (75 percent open bolls) during 1980, only DEF reduced (12 percent) total seed cotton yield of Stoneville 213. No reductions for this variety occurred during 1981 or 1982 and no reductions were evident for Stoneville 825 any year.

TABLE 5. TOTAL SEED COTTON YIELD AS INFLUENCED BY HARVEST-AID CHEMICALS APPLIED AT TWO DATES TO STONEVILLE 825 AND 213 COTTON, TENNESSEE VALLEY SUBSTATION, 1980-82

Treatment and rate (ai) per acre	Total seed cotton yield/acre[1], from different application times					
	1980		1981		1982	
	Early	Normal	Early	Normal	Early	Normal
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Stoneville 825						
DEF, 1.2 lb.	2,089	2,133	2,240	2,330	2,704	2,892
Prep, 1.5 lb.	2,044	1,990	2,240	2,392	2,731	2,571
Prep + DEF, 0.5 + 0.75 lb.	2,151	2,124	2,214	2,187	2,553	2,687
Dropp, 0.1 lb.	2,080	2,151	2,330	2,205	2,553	2,883
Untreated	2,089	2,142	2,410	2,231	2,606	2,222
FLSD (0.05)	NS[2]		NS		NS	
CV (%)	4.9		9.8		8.8	
Stoneville 213						
DEF, 1.2 lb.	1,812	1,794	2,562	2,758	2,776	2,731
Prep, 1.5 lb.	1,714	2,017	2,660	2,776	2,544	2,731
Prep + DEF, 0.5 + 0.75 lb.	1,794	2,035	2,517	2,669	2,651	2,535
Dropp, 0.1 lb.	1,964	1,981	2,624	2,624	2,453	2,722
Untreated	2,205	2,035	2,669	2,713	2,713	2,642
FLSD (0.05)	232		NS		NS	
CV (%)	8.3		6.6		8.1	

[1]Comparisons should be made within columns, within a year, and within a cotton variety.
[2]NS = not significant at 0.05 probability level.

Fiber Quality

Effects of harvest-aid chemicals on measured fiber quality indicators were not significant and hence will not be shown. However, time of harvest-aid application did affect fiber quality, table 6. For Stoneville 825, lint turnout was not affected either year by early or normal application time of harvest aids. Fiber length, length uniformity, strength, and elongation were increased when harvest aids were applied early to this variety in 1980. This indicates an advantage for harvesting early before sufficient weathering occurs and deterioates the fiber. Quality of cotton treated early in 1981 was as good as that treated at the normal time, with the exception of a higher micronaire for the early application time.

For Stoneville 213, negative responses to early application of harvest aids were reduced lint turnout and reduced fiber elongation in 1981. Positive responses for the early application were increased fiber strength both years. All other quality measurements for early application were equal to those obtained when harvest aids were applied at normal time.

Early application of harvest-aid chemicals had minimal negative effects during these years of evaluation. Increased percent first harvest without reductions in cotton yield and quality are advantages that should be examined further in order to develop acceptable once-over harvesting systems.

TABLE 6. COTTON FIBER QUALITY AS INFLUENCED BY HARVEST-AID CHEMICALS APPLIED AT TWO DATES TO STONEVILLE 825 AND 213 COTTON, TENNESSEE VALLEY SUBSTATION, 1980-82

Cotton variety and application time	Cotton fiber quality[1]											
	Lint turnout		Micronaire		Length		Length uniformity		Strength[2]		Elongation	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
	Pct.	*Pct.*			*In.*	*In.*	*Pct.*	*Pct.*			*Pct.*	*Pct.*
Stoneville 825												
Early	33.9	37.0	4.51	5.13*	1.12	1.09	81.6*	82.6	23.0*	25.8	5.87*	6.64
Normal	34.5	37.1	4.55	5.02	1.09	1.08	80.9	82.7	22.4	25.2	5.63	6.95
CV (%)	3.3	1.6	3.5	2.7	1.7	2.4	1.3	1.5	3.4	5.0	4.1	7.4
Stoneville 213												
Early	35.1	36.9*	4.77	5.14	1.04	1.11	80.2	83.1	20.3*	26.7*	6.62	7.36*
Normal	34.8	37.5	5.76	5.05	1.01	1.10	80.1	83.2	19.8	25.6	6.54	7.87
CV (%)	2.0	1.6	4.5	4.4	1.6	1.1	.9	1.5	3.9	5.6	5.7	5.4

[1]Comparisons should be made within columns, within a year, and within a variety.
[2]Expressed as grams/tex.
*Significant at the 0.05 level according to ANOVA.

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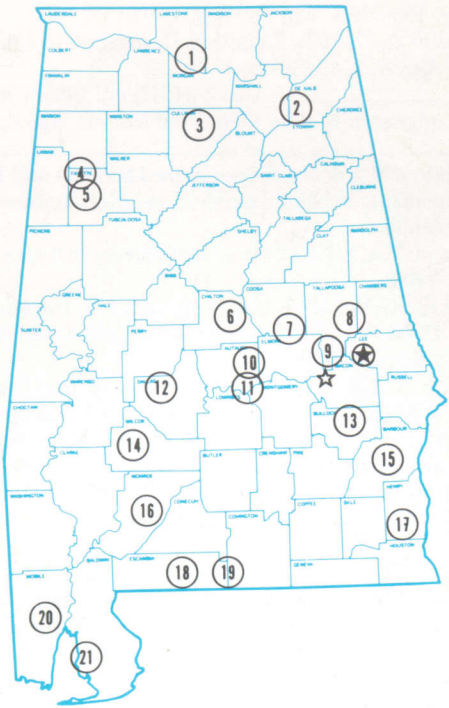

Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.
☆ E. V. Smith Research Center, Shorter.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Chilton Area Horticulture Substation, Clanton.
7. Forestry Unit, Coosa County.
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