Cotton Response to Vetch, Pix, and N Rates

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INTRODUCTION

Cotton is an important economic crop that has potential for expansion in Mississippi and the southern United States. Farmer compliance with the conservation compliance provision of the 1990 Food Security Act, however, may limit its expansion, especially on highly erodible soils. Therefore, the development of profitable productions systems which meet conservation compliance is essential for the future of cotton in Mississippi and the southern United States.

Research (Mutchler and McDowell, 1990) on highly erodible soils indicated that no-tillage and reduced tillage were effective in reducing soil erosion to within tolerance levels only when winter cover crops were included in the production systems. The use of winter cover crops in different cotton-tillage production systems, however, have shown highly variable yield results (Brown et al., 1985; Hoskinson et al., 1988; Hurst, 1989; Williford, 1985; Hutchinson et al., 1990; and Touchton et al., 1984). In the Mississippi Delta (Hurst, 1989). cotton lint yields for the winter fallow (no cover crop), averaged over tillage-herbicide systems, were higher than the wheat cover crop 2 of 5 years. Lint yield following vetch 4 of the 5 years, however, was equal to no cover crop and was more than following a wheat cover crop 2 of 5 years. All treatments (cover crop/tillage) which included herbicides produced from 409 to 1800 lb/acre more seedcotton than treatments with no herbicides. Another delta study (Williford, 1985) on a Bosket silt loam soil indicated that neither cover crops (mustard, subclover, and rye) nor tillage (no-till, minimum and conventional) systems showed a clear advantage as a cotton production system. The subclover cover crop in the check treatment (fall subsoil plus bed and rebed in spring), however, produced 200 lb/acre (3 yr av) more seedcotton than the check treatment with a natural winter cover. In contrast, Hutchinson and Shelton in 1989 reported that cotton in no-tillage and ridge-tillage both with winter wheat as a cover crop were comparable in yield to conventional tillage with no cover crop.

Winter cover crops, to become an acceptable practice in cotton production, must produce some added return (e.g. seed, nitrogen or increased yield) to offset seed and planting costs. Several reports indicated that winter legumes, especially vetch, provided sufficient N for the cotton crop (Hoskinson et al., 1989; Brown et al., 1985; and Touchton et al., 1984). Vetch, however, has been reported (Stevens et al, 1992) to delay maturity.

Pix (mepiquat chloride), a cotton plant growth regulator, has been shown to be effective in controlling cotton plant height and boll retention and increased cotton yield (Cothren et al., 1977 and Gausman et al., 1979). Recently, low rate multiple applications of Pix have been shown to be effective in reducing plant height and increasing earliness (Livingston et *al.,* 1990; McCarthy et al. 1990, Metzer and Wilde, 1990). The effect of Pix and N rates on the maturity, lint yield, and plant height of no-till cotton grown in a killed vetch sod has not been established.

A three-year (1989-91) field study was conducted on the Northeast Branch of the Mississippi Agricultural and Forestry Experiment Station, Verona, MS. The objective of this study was to evaluate cotton growth and yield response to Pix and fertilizer N applied to cotton planted in conventional tillage without vetch and planted no-till in a killed hairy vetch cover crop.

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METHODS AND MATERIALS

The field study was initiated in the fall of 1988 on an Ora fine sandy loam soil. Plots were located on the same site for the duration of the study, The study was conducted as a randomized complete block design with four replications. Plot size was four rows (38 inch wide) x 40 ft long. The Pix treatments were applied across selected N rates (0, 40, 80, and 120 Ib N/acre) applied to no-till cotton planted in killed vetch sod and to conventional tillage cotton (subsoil +disk with no vetch).

In early November of 1988-90, hairy vetch at 30 lb seed/acre was planted no-till in mowed cotton stubble with a no-till grain drill. Vetch biomass samples for dry matter yield and N content analysis were harvested in the no-till cotton (without Pix) N application treatments of 0, 40, 80, and 120 lb N/acre. Vetch samples were harvested from four 1.1 ff randomly selected areas in each plot in mid-April prior to the burndown herbicide application. The samples were dried in an oven dryer at 140 °F for 72 hr before dry weights were determined. A composite sample of each treatment was sent to the MCES soil testing laboratory for N analysis.

The conventional tillage plots were subsoiled 12 to 14 inches deep in March of each year, disked in April and then do-alled prior to cotton planting. Cultivars DES 119 in 1989 and 1990, and DPL 50 in 1991 were planted (5 seed/ft row) no-till into a killed hairy vetch sod and in conventional tillage treatments on 2 May 1989, 24 April 1990, and 24 May 1991 with a four row planter equipped with a coulter and cast iron soil-slit closing wheels. Due to inadequate stands in the vetch treatments, the whole study was replanted on 17 May 1989, 8 May 1990, and 4 June 1991.N rates as ammonium nitrate (Table 4) were applied surface broadcast to both vetch and conventional tillage plots on 16 June 1989, 30 May 1990, and 12 June 1991.

Vetch burndown and cotton weed control during the growing season were accomplished with selected burndown, preemergence and post-directed herbicides. Glufosinate + metolachlor at 0.75 + 2.0 lb ai/acre were applied as a tank mixture on 14 April 1989 followed by fluometuron at 1.0 lb ai/acre applied preemergence at planting on 2 May 1989. Glyphosate at 11.0 lb ai/acre was applied prior to replanting on 17 May 1989. In 1990, paraquat + metolachlor + fluometuron + surfactant at 0.5 + 2.0 + 1.5 lb ai/acre +0.25% v/v in a *tank* mixture were applied as a burndown application to vetch on 12 April 1990. Paraquat + surfactant at 0.5 lb ai/acre + 0.25% v/v also were applied at planting on 24 April 1990 and repeated prior to replanting on 8 May 1990. In 1991 paraquat + surfactant at 0.5 lb ai/acre + 0.25% v/v were applied on 16 April 1991 and repeated on 20 May 1991. Metolachlor + fluometuron at 1.5 + 1.0 lb ai/acre were applied preemergence on 24 May 1991. Glyphosate at 0.75 lb ai/acre was applied prior to replanting on 4 June 1991.

Weeds in all treatments were controlled during the cotton growing season with appropriate herbicides applied preemergence and as post directed sprays. No treatments were cultivated during the growing season. Southern crabgrass [Digitaria scillaria (Retz)] yellow nutsedge Cyperus esculentus), and spiny pigweed (Amaranthus spinosus) were the major weeds present in all plots during the cotton growing seasons of 1989-91. Fluometuron + MSMA at 0.8 + 2.0 lb ai/acre or MSMA + methazole at 2.0 + 0.75 lb ai/acre were applied each year as a post directed spray to cotton plants 4 to 6 inches tall and repeated 2 to 3 wk later. All herbicide treatments were made with water as the carrier and applied at 20 gallons per acre (gpa) volume. Cotton insects were controlled with insecticides applied as needed based on weekly insect scouting reports. Eight to ten insecticide applications were made each year during the growing season.

Pix plant growth regulator applications (4 oz formulated product/acre) were initiated at the match-head (M.H.) square and repeated three times at 2 wk intervals, and the 8 oz/acre application at the mid-bloom cotton fruiting stage of growth (Table 1) was repeated one time

2 wk later. The Pix mid-bloom treatment was initiated when white blooms were present on the 8th to 9th node of the plant. The Pix as-needed treatment (treatment 3) was applied when personal observations indicated above normal soil moisture and rapid plant growth conditions. All Pix treatments were applied with 0.25% (v/v) surfactant in 20 gpa spray volume using SX-12 cone nozzles.

Cotton defoliant, tribufos, was applied at 1.13 lb ai/acre in 1988 and 1990, and tribufos + ethephon at 1.3 + 0.33 lb ai/acre were applied in 1991 when at least 65% of the bolls were open on all treatments. Defoliant application dates were 18 October 1989, 12 September 1990, and 30 September 1991. Ten plants in each treatment replication were mapped about 7 days prior to harvest. Five plants were selected at random from each of the two center rows of a 4-row plot of 4 replications. Each plant was mapped for plant height, number of fruiting branches, total number of bolls/plant, bolls in the first and second fruiting positions, first fruiting branch node, and nodes/plant. Seedcotton was harvested from the two center rows of each 4 row plot with a 2-row cotton picker (modified for plot harvest) on 30 October 1989, 23 September 1990, and 18 October 1991.

Analysis of variance (ANOVA) was conducted to evaluate treatment effects. Least significant difference (LSD) at the 5% probability level was used to separate treatment mean differences.

RESULTS AND DISCUSSION

Hairy vetch average dry matter yield ranged from 2849 lb/acre in 1989 to 1409 lb/acre in 1991 (Table 2). Vetch dry matter production for 2 of the 3 years was not affected by N rates applied to the previous cotton crop. In 1990, however, the 80 Ib N/acre treatment produced less dry matter than the 0 and 120 lb N/acre rate. There is no explanation for the 80 lb N/acre lower dry matter yield than the zero N rate. The N content of the vetch dry matter ranged from 4.30 to 5.28% N (Table 3). Averaged over cotton N application rates, vetch dry matter N ranged from 131 Ib N/acre in 1989 to 73 Ib N/acre in 1991 with a 3 year average of 99 Ib N/acre.

All three years of the study, the first planting in the killed vetch sod resulted in cotton stand failures. This was in contrast to good stands in the conventional tillage (subsoil + disk) treatments. Personal observations indicated that stand failure was not a result of seedling disease, but was possibly due to soil surface compaction from the planter cast iron soil-slit closing wheels. In addition, under the vetch surface mulch, the soil surface was wetter than the conventional tillage treatment. The unfavorable environmental conditions (wet and cool) for good emergence that existed during the seedling emergence period also may have had a more negative influence on emergence in the vetch sod than in conventional tillage. Plant population (data not shown) variability between vetch and conventional tillage and between years was noted with the second planting. Populations ranged from about 20,000 plants/acre in 1989 and 1990 to 50,000 in 1991. Vetch plots had higher populations than conventional tillage in 1989, lower populations than conventional tillage in 1990, and no difference in 1991.

Personal observation indicated that neither vetch nor Pix had any effect on cotton maturity. However, at the 120 lb N rare, the vetch plots had fewer bolls open in mid-September than other treatments and the data indicated a trend for fewer bolls (plant mapping data not shown) and lower seedcotton yield (Table 4).

Cotton planted in vetch and in conventional tillage showed variable yield response to additional N (Table 4). Although multiple low rates of Pix shortened plant height (Table 5), seed cotton yield for both vetch and conventional tillage showed no response to Pix all three years of the study. Cotton planted in vetch with no added N and no Pix produced yield equal to conventional tillage + 80 Ib N/acre each year with a three year average of 2074 Ib seedcotton/acre. These results are in agreement with other reports (Hoskinson et al., 1988; Brown et al., 1985; and Touchton et al., 1984) which indicate that vetch supplied sufficient N for cotton production. Vetch + 80 lb N/acre with Pix (4 oz/acre x 4 times) or without Pix, however, produced higher yield than conventional tillage + 80 lb N/acre in 1991 with no difference in 1989 and 1990. The three year average seedcotton yield for vetch + 80 lb N/acre (no Pix) was 2379 lb/acre. Although not significant, this was 408 lb/acre more than conventional tillage + 80 lb N/acre (no Pix) and 294 lb/acre more than vetch with no N and no Pix, Conventional tillage without Pix showed no yield difference between 80 and 120 lb N/acre. However, both vetch and conventional tillage showed trends for lower yield with the 120 lb N/acre.

Pix usually resulted in shorter plant height at maturity with conventional tillage than vetch treatments (Table 5). Multiple low rate Pix applications (4 oz/acre x 4 times) in both vetch and conventional tillage, however, were more effective in shortening plant height and internode length than the two 8 oz/acre application treatments initiated at mid-bloom or 4 oz/acre applied as needed (data not shown). These results are in agreement with other reports that Pix reduced plant height (Cothren et al., 1977; Livingston et al., 1990; McCarthy et al., 1990; and Metzer et al., 1990). Pix generally reduced the number of nodes/plant in both vetch and conventional tillage (data not shown). Multiple low rate applications of Pix, however, reduced total nodes/plant more in conventional tillage than in vetch.

Pix had no significant effect on total bollslplant (data not shown). Across Pix treatments, total bolls per plant for all vetch/N treatments generally were equal to or more than conventional tillage + 80 lb N/acre. Vetch + 120 lb N/acre (with and without Pix) in 1989, however, had fewer bolls/plant than the conventional tillage (no Pix) with 120 and 80 lb N/acre treatments. The percent of bolls in the first and second fruiting positions were not affected by vetch, Pix and N rate in 1989 and 1991 (data not shown). The first fruiting branch node location was not affected by vetch, Pix, N rate, and conventional tillage all three years (data not shown).

SUMMARY

Vetch planted no-till into cotton stubble in early November of each year produced a biomass of 1978 lb/acre (3 yr av) with N content equivalent to 99 lb N/acre. First planting date (2 to 3 wk after burndown herbicide application) stand failures each year in the killed vetch sod may have been due to soil compaction caused by the planter cast iron soil-slit closing wheels and the surface soil being wetter under the vetch mulch than conventional tillage. Replanted stands were acceptable in both vetch sod and conventional tillage. Multiple low rate Pix applications (4 oz/acre x 4 times) initiated at match head square was more effective in reducing plant height than two 8 oz/acre applications initiated at mid-bloom. Multiple low rate applications also shortened plant height more in conventional tillage than vetch treatments but had no effect on earliness, location of the first fruiting branch node, number of bolls/plant, and seedcotton yield. Yield varied from year to year, but vetch with no N produced yield equal to the conventional tillage + 80 lb N/acre. Although not significant, vetch + 80 lb N/acre with no Pix produced 408 lb/acre (3 yr av) more seedcotton than conventional tillage + 80 lb N/acre and 305 lb/acre more than vetch + no N. In conventional tillage, 40 to 80 lb N/acre was sufficient for maximum yield. Although the vetch cover crop system + 80 lb N/acre produced sufficient increased yield (3 yr av, 408 lb/acre more seedcotton) to more than pay for the vetch seed and the associated planting costs. Further research, however, is needed on the influence the type of planter soil-slit closing wheel system and the length of the delayed planting period following the burndown herbicide application has on cotton seedling emergence planted no-till in a killed vetch sod.

Table 1. Pix application rates and times of application made in 1989-91 to conventional tillage cotton and no tillage cotton planted in a killed vetch cover crop at the MAFES Northeast Branch.

Pix rates and times of application	1989	1990	1991
1. Check (no Pix)			
2. Pix applied at 4 oz/acre x 4 application dates initiated at Match Head (M.H.) square.			
	6/28 & 7/06 at 2 oz/acre	6/27	7/03
	7/28 at 4 oz/acre	7/12	7/17
	8/10 at 8 oz/acre	7/27	7/31
		8/10	8/19
3. Pix applied at 8 oz/acre x 2 applications, initiated at mid-bloom and repeated at 2 wk.			
	6/28 at 4 oz/acre	7/20	8/02
	7/28 at 8 oz/acre	8/08	8/19
	8/10 at 4 oz/acre		
4. Pix at 4 oz/a applied as needed based on soil moisture and plant growth			
	6/28 & 7/06 at 2 oz/acre	7/20	7/17
	7/18 & 7/28 at 8 oz/acre		
	8/10 at 4 oz/acre		

Table 2. Vetch dry matter yield in a no-till cotton study in 1989-91 at the MAFES Northeast Branch, Verona, MS

Cotton Production System	Applied N	-------- Dry matter yield ----------			
	-lb/acre-	1989	1990	1991	AV
		-------------- lb acre --------------			
1. Vetch: NT cotton	0	3072	1892	1361	2109
2. Vetch: NT cotton	40	2578	1614	1356	1849
3. Vetch: NT cotton	80	2936	1282	1547	1922
4. Vetch: NT cotton	120	2810	1910	1372	2031
	AV	2849	1675	1409	1978
	LSD .05	NS	430	NS	
	CV %	19	19	10	

Table 3. Vetch dry matter N content in a no-till cotton study in 1989-91 at the MAFES Northeast Branch, Verona, MS

		%	lb/acre	%	lb/acre	%	lb/acre
1. Vetch: NT cotton	0	4.73	145	5.42	102	5.02	68.3
2. Vetch: NT cotton	40	4.60	119	5.17	83	5.28	71.6
3. Vetch: NT cotton	80	4.30	128	5.61	72	5.20	80.4
4. Vetch: NT cotton	120	4.64	131	5.73	109	5.28	72.4
	AV	4.57	131	5.48	92	5.20	73.2

Table 4. Seed cotton yield response to Pix time and rate of application on cotton grown no-till in a killed vetch sod and conventional tillage in 1989-91 at the MAFES Northeast Branch, Verona, MS.

Pix Rate Tillage/Cover Crop	1989	1990	1991	AV
A. No Pix	---------- Seedcotton Yield lb/acre ----------			
	---- 0 lb N/acre ----			
1. Vetch	2023	1657	2541	2074
	---- 40 lb N/acre ----			
2. SS + Disk	1892	1688	2119	1900
3. Vetch	1997	1662	2596	2085
	---- 80 lb N/acre ----			
4. SS + Disk	2085	1588	2239	1971
5. Vetch	2477	1720	2940	2379
	---- 120 lb N/acre ----			
6. SS + Disk	1713	1461	2102	1759
7. Vetch	2597	1476	2428	2167
B. Pix 4 oz/acre x 4 applications (M.H. square and repeated at 2 wk intervals)				
	---- 0 lb N/acre ----			
1. Vetch	2752	1690	2631	2358
	---- 40 lb N/acre ----			
2. Vetch	2411	1676	2406	2164
	---- 80 lb N/acre ----			
3. SS + Disk	2031	1682	2230	1981
4. Vetch	2364	1608	2901	2291
C. Pix 8 oz/acre x 2 applications (mid-bloom and repeated 2 wks later)				
	---- 0 lb N/acre ----			
1. Vetch	2186	1584	2583	2118
	---- 40 lb N/acre ----			
2. Vetch	1845	1596	2475	1972
	---- 80 lb N/acre ----			
3. SS + Disk	1674	1854	2605	2044
4. Vetch	2008	1562	2469	2013
	---- 120 lb N/acre ----			
5. Vetch	2047	1243	1698	1663
D. Pix 4 oz/acre as needed based on soil moisture and plant growth				
	---- 0 lb N/acre ----			
1. Vetch	1961	1768	2763	2164
	---- 40 lb N/acre ----			
2. Vetch	2488	1493	2463	2148
	---- 80 lb N/acre ----			
3. SS + Disk	2054	1567	2183	1935
4. Vetch	1620	1573	2918	2037
	---- 120 lb N/acre ----			
5. Vetch	1527	1496	2626	1883
AV	2083	1602	2472	
LSD .05	792	379	620	409
CV %	23	21	18	12

Table 5. Effect of Pix and N rates on height at maturity of cotton grown no-till in a killed vetch sod and conventional tillage in 1989-91 at the MAFES Northeast Branch, Verona, MS

Pix Rate Tillage/Cover Crop	1989	1990	1991	AV
A. No Pix		height at maturity (in)		
		0 lb N/acre		
1. Vetch	43	40	33	39
		40 lb N/acre		
2. SS + Disk	46	33	29	36
3. Vetch	42	40	36	39
		80 lb N/acre		
4. SS + Disk	42	36	32	37
5. Vetch	47	39	36	41
		120 lb N/acre		
6. SS + Disk	46	39	34	40
7. Vetch	52	39	33	41
B. Pix 4 oz/acre x 4 applications (M.H. square and repeated at 2 wk intervals)				
		0 lb N/acre		
1. Vetch	--	34	28	31
		40 lb N/acre		
2. Vetch	--	37	29	33
		80 lb N/acre		
3. SS + Disk	--	28	22	25
4. Vetch	--	37	31	34
C. Pix 8 oz/acre x 2 applications (mid-bloom and repeated 2 wks later)				
		0 lb N/acre		
1. Vetch	32	40	34	36
		40 lb N/acre		
2. Vetch	34	38	34	38
		80 lb N/acre		
3. SS + Disk	38	39	33	36
4. Vetch	33	35	36	38
		120 lb N/acre		
5. Vetch	35	35	34	36
D. Pix 4 oz/acre as needed based on soil moisture and plant growth				
		0 lb N/acre		
1. Vetch	33	36	32	33
		40 lb N/acre		
2. Vetch	35	37	32	34
		80 lb N/acre		
3. SS + Disk	37	35	30	34
4. Vetch	42	30	32	32
		120 lb N/acre		
5. Vetch	39	34	32	34
AV	40	36	32	
LSD .05	5	6	5	
CV %	11	12	10	

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