PIMA COTTON GROWTH AND YIELD RESPONSESTO MEPIQUAT CHLORIDE (PIX)

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Abstract

Studies were conducted in California's San Joaquin Valley to evaluate the rate and timing responses of mepiquat chloride on Pima cotton. Early data collected in 1991 and 1992 suggest applications made at early bloom are not economical and occasionally result in a yield decline while later applications have tended to have more positive results. The best yield response to date has come from mid- and late-bloom sequential applications of mepiquat chloride (PIX) at a rate of 0.022 lbs ai/acre applied 10 to 14 days following first bloom and again 14 days following first application. The average rate response from this treatment exceeded 50 lbs lint/acre.

Introduction

During the 1980's, it became apparent that the use of PIX (mepiquat chloride) in California would play a critical role in striving for earliness and increasing Acala cotton *Gossypium hirsutum* productivity. Extensive research into the 1990's has allowed University of California researchers and others to identify optimum use rate and timing to develop a predictive model in this end.

Beginning in 1991, the San Joaquin Valley Cotton Board recognized Pima cotton, *Gossypium barbadensa*, as a key cotton type to improve the region's high quality standards and approved for production its first Pima cotton type in the San Joaquin Valley (SJV). Pima S-6, developed out of USDA breeding program in Arizona, was suddenly an important Pima variety with nearly 30,000 acres of production in Fresno County alone. Soon after approval, SJV growers had little information available on best management practices for this new cotton type and began the long process of identifying proper practices necessary to obtain high yields under SJV climatic conditions.

Early guidelines for PIX use in Pima for the SJV were tentative with limited information available for PIX rates in the region. Beginning in 1991, a series of SJV studies were conducted by University of California farm advisors and specialists to identify the potential use of PIX in California Pima cotton production systems.

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Materials and Methods

Beginning in 1991, trials were initiated with numerous San Joaquin Valley growers ranging from Kern County in the south to Merced County in the northernmost SJV cotton production region. Each test plot was replicated four times uding a randomized complete block design on fields ranging from 600 to 1320 feet. At the University research sites, 280-foot plot lengths were used.

Plant parameters, such as plant density and crop developmental characteristics, were collected at the time of the first application of mepiquat chloride and again prior to defoliation. Plant height, fruiting and vegetative node number, first position fruit retention on early map, and fruit retention of all positions on final map were all monitored for each study using the California Cotton Manager Program (CCM) and the California Plant Mapper (CPM) Program.

Yield estimates were taken from four rows running the length of the field for each plot. Gin turnouts estimates from an average of five-pound subsamples taken at the time of harvest. Lint yield estimates for the 1996 season were made based on average turnout information from local gins for Pima S-7. All 30-, 38-, and 40-inch beds were evaluated in this study. Pima S-6 was studied in 1991 and 1992. This industry standard variety was switched and studies thereafter were conducted on S-7 in 1993 through 1996.

A series of five PIX trials were conducted in Fresno, Tulare, and Kern Counties during the 1991 and 1992 production years. The general protocol developed for each trial was aimed at identifying a rate response relationship focused on early bloom applications which had proven effective for SJV Acala types. Application rates of 0.5, 0.75, and 1.0 pint per acre, corresponding to 0.022, 0.033, and 0.044 lbs ai/A, were applied at first bloom on Pima S-6.

Beginning in 1993, a new protocol was developed and another set of trials was established. The new treatments included multiple applications of PIX applied either early season, or later in the season. The early multiple treatment studies evaluated 0.75 and 1.0 pint PIX applications followed by a 0.5 pint application 10 to 14 days later. The later season treatments called for 0.75 and 1.0 pint PIX applications 10 to 14 days following first bloom followed by a second application of 0.5 pint applied two to three weeks following first bloom.

A series of late-season PIX treatments were established in 1994 with treatment rates of 0.5 to 1.5 pints applied at full bloom (defined as two weeks following first bloom), and 0.5 pint applied two weeks following full bloom on all except the 1.5 pint early treatment. In the most recent studies, a total of six trials were conducted during the 1995 and 1996 production years. The treatments were similar to

those used in 1994 and evaluations were continued on Pima S-7 in Fresno, Kern, Merced, and Tulare Counties.

Results

Plant growth and performance results from this series of trials were mixed. As with Acala cotton cultivars tested earlier, reductions in plant height were observed within one to two weeks following an application of PIX. Generally, higher rates of PIX beyond 0.5 pints per acre further decreased plant height. Late season plant mapping dates also showed a trend toward fewer boll numbers on PIX treated plots.

Evaluations of yield data showed no statistically significant yield response using 95 percent confidence levels in each individual trial with the exception of the 1992 Kern County trial which identified all three PIX treatments as reducing yields by an average of 114 lbs lint per acre. In general, there did appear to be trends for lower yields in PIX applied treatments on all 1991 and 1992 study sites.

Again, plant growth responses were similar in this set of trials as observed by reductions of plant height ranging from 1 to 3 inches. Boll count and yield data demonstrated trends in reverse from the previous two years. Yields at the Fresno and West Side Research and Extension Center were consistently improved by the two late season PIX treatments, and, overall PIX treatments improved yields by an average of 70 lbs lint per acre in 1993. Since that time, the focus at PIX Pima work was aimed at late (post-bloom) applications of PIX at rates higher than those recommended for Acala cottons.

Similar to the 1993 trials, all trials showed upward trends on PIX applied treatments while the Fresno County trial observed significantly higher lint yields on all but the 1.5 pint early treatment. Overall, PIX applications increased average productivity by 77 pounds. The treatment having the greatest yield impact over all sites was the 0.5 pint applied at full bloom followed by 0.5 pint applied two weeks later. This treatment yielded a 105 lb lint increase over the untreated check.

Yield results from the 1995 and 1996 trials have been mixed, with only the Tulare County site showing statistically significant yield reductions on the high rate treatment having 0.75 pint at full bloom, plus 0.75 pint at full bloom 10 to 14 days later, and 0.75 pint at cutout.

In an attempt to group these studies into profitable vs. non-profitable applications of PIX, an arbitrary value of 25 lb lint yield response was established. That is, treatments were grouped into those having at least a 25 lb lint yield enhancement, greater than 25 lb lint yield reduction, and those treatments having lint yields within 25 lbs of the untreated check. The remaining 50 percent of the treatments were found to be within 25 lbs of the untreated check. In comparison with an untreated check, 20 percent of the treatments observed a yield increase of at least 25 lbs while 30 percent of the treatments experienced a yield decline of at least 25 lbs per acre.

The most beneficial treatment across all years appears to be the mid- and late-bloom sequential applications of mepiquat chloride (PIX) at a rate of 0.022 lbs ai/acre applied 10 to 14 days following first bloom and again 14 days following the first application. Using a weighted yield averaging technique, yields were improved by 54 lbs over the four-year period from 1993 to 1996.

Summary

In general, PIX applications on SJV Pima cotton consistently showed vegetative growth control from both early and late bloom applications. This can be particularly helpful in managing the crop for high quality and improved defoliation efficacy, resulting in higher grade cotton. Because of the difficulty in defoliating Pima, and the financial grade penalties, this potential benefit should not be overlooked, and greater attention is being placed on these benefits in more recent studies.

Yield responses to early bloom applications of PIX appear to interfere with the normal cycle of fruit development and fruit set causing a yield reduction under some circumstances. This may not be as critical for the more determinant Pima varieties such as the current SJV standard, Pima S-7. Growers should carefully consider delaying the PIX applications as the potential for yield loss in the early stages is readily apparent from two consecutive years of study.

Mid-to-late bloom applications of PIX seem to have the most potential for improving crop yield and reducing late season vegetative growth. Rates that appear to have the most promise are double those applied commonly to SJV Acala cottons with two sequential applications of 0.5 pint showing a benefit at least as great as all other treatments imposed. Higher rates may help control vegetative growth more but do not appear to enhance yields more than the moderate rate sequential application.

Yield benefits with PIX in Pima cotton can be quite substantial in some situations, however, we caution this optimism with the observation that these responses are not yet as predictable as those observed for Acala cotton and under current management practices, PIX applications can occasionally lead to reduced productivity. Linkages between crop growth and development, field agronomic characteristics, and potential plant stressors continue to be explored in the evaluation of PIX responses to Pima. However, no proposals at this time are supported by the data received thus far. It has been suggested that Pima cotton responds to later applications of PIX due to the delayed shifting of the plants, partitioning of vegetative to

reproductive growth. This appears to be a reasonable hypothesis as the proportion of yield set late in the season is much larger in Pima than that set in Acala cotton varieties.

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Table 1. Lint yield from five San Joaquin Valley locations, conducted in 1991 and 1992, expressed in lbs/acre.

		Yield (lbs. lint per Acre)					
Treatment	First Bloom	Fresno 91	Fresno 92	Tulare 91	Tulare 92	Kern 92	Mean
1. UTC	_	1002	1443	1229	1184	1602	1292
2. Pix	.5 pt	968	1345	1237	1178	1482	1242
3. Pix	1.0 pt.	976	1454	1230	1151	1484	1259
4. Pix	1.5 pt.	1086	1347	1180	1147	1499	1252
	LSD .05	*NS*	*NS*		*NS*	*79.4*	
	C.V.	7.32%	5.70%		4.05%	3.30%	

Table 2. Lint yield from three San Joaquin Valley locations, conducted in 1993, expressed in lbs/acre.

		10-14 days after	2-3 weeks after	Yield (lbs. lint per Acre)			
Treatment	First Bloom	First Bloom	First Bloom	Fresno	Merced	WSFS	Mean
1. UTC	_	_	_	1071	1949	1438	1486
2. Pix	.75 pt.	.5 pt	_	1067	2147	1479	1564
3. Pix	_	.75 pt.	.5 pt	1103	2015	1527	1548
4. Pix	1.0 pt.	.5 pt	_	1052	2054	1544	1550
5. Pix		1.0 pt.	.5 pt	1127	2040	1522	1563
			LSD .05	*NS*	*NS*	*NS*	
			C.V.	5.70%	2.90%	5.76%	

Table 3. Lint yield from five San Joaquin Valley locations, conducted in 1994, expressed in lbs/acre.

		2 weeks after	Yield (lbs. lint per Acre)					
Treatment	Full Bloom	Full Bloom	Fresno	Kern	Tulare	Merced	WSFS	Mean
1. UTC	_	_	953	1290	838	1284	1580	1189
2. Pix	.5 pt	.5 pt	1043	1320	902	1528	1678	1294
3. Pix	.75 pt.	.5 pt	1034	1350	884	1360	1693	1264
4. Pix	1.0 pt.	.5 pt	1036	1340	825	1384	1644	1246
5. Pix	1.5 pt.	_	1000	1280	_	1438	1700	1259
		LSD .05	85.3	*NS*	*NS*	*NS*	*NS*	
		C.V.	5.46%	_	7.10%	13.50%	3.90%	

Table 4. Lint yield from 1 San Joaquin Valley location, conducted in 1995, expressed in lbs/acre.

		2 weeks after		Yield (lbs. lint per Acre)
Treatment	First Bloom	First Bloom	2 weeks later	Fresno
1. UTC	_	_	_	1461
2. Pix	.5 pt	.5 pt	_	1427
3. Pix	_	.75 pt.	_	1302
4. Pix	_	.75 pt.	1.0 pt.	1415
5. Pix	_	2.0 pt.		1394
			LSD .05	140.7
			C.V.	6.53%

Table 5. Lint yield from 4 San Joaquin Valley locations, conducted in 1996, expressed in lbs/acre

		2 weeks after		Yield (lbs. lint per Acre)				
Treatment	Full Bloom	Full Bloom	Cutout	Fresno 96	Kern 96	Tulare 95	Merced 95	Mean
1. UTC	_	_	_	1529	1016	809	943	1074
2. Pix	.5 pt	.5 pt	_	1547	985	809	1002	1086
3. Pix	.75 pt.	.5 pt	_	1541	985	781	1022	1082
4. Pix	.75 pt.	.75 pt.	_	1524	1001	765	958	1062
5. Pix	.75 pt.	1.0 pt.	_	1540	1014	822	1066	1111
6. Pix	.75 pt.	.75 pt.	.5 pt	1522	972	701	1036	1058
			LSD .05	*NS*	*NS*	*111*	*NS*	
			C.V.	3.09%	4.82%	9.43%	10.00%	

Table 6. Percentage of PIX treatment averages from each site that were 25 lbs lint above control or 25 lbs lint below treatment.

	91 & 92	93	94	95	95 & 96
Over 25 lbs	7%	83%	85%	25%	20%
Under 25 lbs	67%	0%	0%	75%	30%

Table 7. Average lint yield for 0.022 lb ai/acre sequential application treatment of mepiquat chloride (PIX) obtained over a three-year period from 14 independent studies.

	2 weeks after	4 weeks after	
Treatment	First Bloom	First Bloom	Yield (lbs. lint per Acre)
1. UTC	_	_	1240
2. Pix	.5 pt	.5 pt	1294