PIMA RESPONSES TO MODIFIED GROWTH REGULATOR AND IRRIGATION MANAGEMENT

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Abstract

As with mepiquat chloride recommendations developed for Acala cotton in CA, similar types of growth regulators should be used where field history suggests high vigor problems, or when within-season plant mapping information indicates low to moderate fruit retention combined with moderate to high vigor measured as plant height or growth rates. Results indicate that mepiquat chloride types of materials can be effective in helping manage vegetative growth, but impacts on yield are smaller and less consistent than found with Acala cotton. Results also show that the potential impact of delayed irrigations in combination with growth regulator use depends to a significant extent on fruit retention.

Introduction

Pima cotton has a different general growth habit than most Acala cotton varieties. Pima generally requires a longer growing season, with 3 to 5 more total fruiting branches than Acala varieties grown under similar full-season conditions. In addition, typical Pima varieties make a significant portion of total yield on 2nd, 3rd and even 4th positions out from the main stem and fruit on vegetative branches can also represent as much as 8 to 10% of total yield under some conditions. All of these fruiting pattern characteristics make Pima varieties quite different from Acala varieties grown in California, so there are few reasons to assume that mepiquat chloride growth regulator rate and timing recommendations developed for Acala varieties will "transfer" to Pima grown under similar conditions.

1991 through 1997 Results

Pima studies done by University of CA Specialists, Farm Advisors and other research staff during the 1991 through 1997 period have found little consistent response to mepiquat chloride (PIX, other materials) at the 0.5 pts/acre rate typically used with the 4.2% formulation on Acala cotton (data not shown). Further rate studies in 1993 through 1997 focused on higher PIX rates and on sequential mepiquat chloride (PIX) treatments that combined different rates applied at some combinations of: (1) first or early bloom; (2) 10-14 days after first bloom; and/or (3) 11-17 days after the second application timing (data not shown). Many of these studies were done at 3 to 5 locations per year during the years 1993 through 1997, and some, but not all of the results have been summarized previously (Munk et. Al., 1997, 1998). Summarized across all locations, the best PIX treatments identified in the 1993 through 1997 multi-location field trials were:

(1) 0.5 pts PIX (4.2% formulation) per acre at both full bloom and again 2 weeks later – averaging 104.7% of the untreated control in 1994 through 1997 studies.

(2) 0.75 pts PIX per acre at full bloom, plus 0.5 pts per acre 2 weeks later – averaging 103.5% of the untreated control in 1994 through 1997 trials.

These sequential applications gave the best combination of favorable yield responses and significant control of vegetative growth (plant height and total branch # were reduced - data not shown). It is important to note, however, that even when yield increases with PIX applications did occur, they often only exceeded yields of untreated controls by 50-75 lbs lint/acre or less. None of the earlier studies (1991 through 1993) identified treatments with consistent yield differences from the Untreated Control. Even though the focus of most University of CA PIX evaluations have been on yield response, growers are also interested in effective control of excess vegetative growth, since it helps with preparation for a timely harvest with reduced impact on fiber quality. This report focuses on continuing studies with a range of growth regulator and irrigation management approaches with Pima cotton in the San Joaquin Valley.

Materials and Methods

1993 through 1996 Studies – Clay Loam Soil Site

Several large-scale subsurface drip and furrow irrigation studies were run by Hutmacher and other staff at the USDA-ARS Water Management Research Laboratory (Fresno, CA) in the early through mid-1990's, with the actual field research conducted at the Univ. of CA West Side Research and Extension Center in a deep, clay loam soil. Irrigation water application amounts ranged from 100% of estimated crop evapotranspiration (Etc) during the entire season down to deficit irrigation of 60 or 80% of Etc during the bloom or post-cutout period. Data obtained from these studies with the Pima varieties "S-6" and "S-7" will be used as brief examples of the difference in responses to soil water stress and PIX when early and mid-season fruit retention is low (> 55% early fruit retention). In this and subsequent studies, plant mapping information was collected during the growing season as well as final mapping done during early- to mid-September. Yields were measured in the center two rows within four-row plots using a full-size, commercial-type spindle picker.

1999 and 2000 Studies

Field trials were initiated in 1999 to evaluate plant growth and yield responses to differential irrigation treatments (designed to produce two different levels of water stress) and some specific PIX treatments. Growers have in recent years started to show widespread interest in a broader range of varieties with different growth habits, both more determinate types of Pima (such as the variety "S-7") and more indeterminate types (such as variety "Phytogen-57"). For this reason, the study was also set up to include both of these varieties in order to compare responses to irrigation and growth regulator treatments. The combination of varieties, irrigation treatments, and growth regulator treatments used in 1999 and 2000 studies is shown in Table 1.

In addition to an untreated control (UTC), there were three types of PIX treatments evaluated, as shown in Table 1. All involve PIX Plus, with applications beginning as early as 1st bloom, and following at about 14 day intervals as in previous years. In addition, a BASF experimental (BAS-130-01W) was included as a second application material in one of the sequential treatments (Treatment #4), since other research has shown it to be stronger than PIX in impact on late vegetative growth.

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Results and Discussion

1993, 1995 and 1996 STUDIES

Early and mid-season first-position fruit retention was good in 1993 (>65%) while it was between 38 and 52% through mid-bloom in 1995 and 1996 studies (data not shown). Lint yields are shown in Figure 1 as percent of the untreated (no PIX) control irrigated at the 100/100/100 level (where the three #'s, in order, are the irrigation rate as a percent of crop evapotranspiration (Etc) during the pre-bloom, bloom through cutout, and post-cutout periods, respectively). Yields in 1993 (good retention year) were improved slightly by PIX applications (Figure 1) at the higher irrigation levels (100/100/100 and 100/100/80), while yields were reduced 3 to 5% by PIX applied to plants receiving less irrigation water and therefore subject to more water stress (100/80/60 and 100/60/60). Leaf water potentials were as much as 6 to 8 bars lower in the 100/60/60 treatment than in the fully irrigated treatment during late July and through August all three years (data not shown).

In years with lower fruit retention in the early- to mid-season (1995, 1996 in Figure 1), PIX applications improved yields by several % in the higher irrigation treatments. This correlated well with observations that untreated plants in these treatments were quite tall, with even more vigorous vegetative growth associated with high water availability and lack of early fruit to help hold back vegetative growth (data not shown). Even with the lower fruit retention, plants in the more water-stressed treatments had a slight negative response to PIX applications in 1995 and 1996 (Figure 1).

1999 AND 2000 Studies

As stated in the "Materials and Methods" section, two irrigation treatments and three PIX Plus treatments plus an untreated control were evaluated these years. PIX Plus application rates were always 0.75 pts/acre, while BAS-130-01W applications were at 0.5 pts/acre. These studies were done at the West Side Research and Extension Center, in a deep, clay loam soil. Early and mid-season fruit retention were quite high (1999 data in Table 2; 2000 data not shown), in contrast to the 1995 and 1996 studies just discussed.

In both varieties (S-7 and Phy-57), and in both irrigation treatments, plant height (Figure 2) was quite responsive to PIX applications (although only data for Treatment 3 in 1999 is shown versus untreated controls (UTC) in Figure 2). Similar results were seen in other treatments in both 1999 and 2000 (data not shown). Table 2 also shows the impact of PIX and delayed irrigation (Irrigation Treatment #2) on other growth parameters.

Yields in 1999 and 2000 Studies

Under conditions of high early fruit retention which were observed in both 1999 and 2000 studies, PIX treatment #2 (with an early first PIX PLUS application at first bloom), generally had a modest negative impact on lint yields (1999, Figure 3) or little impact (irrigation treatment # 1 in 2000) (Figure 4). In most other cases, treatments with the more recommended, later timing of first PIX application (10-14 days after first bloom) had little impact on yield except with the more water-stressed plants of Irrigation Treatment #2 in 2000.

In 1999, the delays in irrigation with Irrigation Treatment #2 brought about more severe water stress and reduced yields when compared with the same treatments in 2000 due to the presence of some coarser texture soil within the 1999 plot area. The severity of water stress brought about with the delayed irrigation in 2000 was less severe, and actually had a positive impact on the Phy-57 variety.

Summary and Conclusions

As in earlier studies of Munk et al (1997, 1998), PIX and PIX Plus applications have quite consistent performance in control of vegetative growth parameters with applications made from early bloom through 4 weeks after first bloom. Over numerous years of this and prior studies, the most consistent impacts of mepiquat chloride on lint yield have been with sequential applications made at the 0.75 or 0.5 pts per acre rate starting at about 10-14 days after first bloom, and continuing with one or two additional applications at 10-14 day intervals after the first application. Results indicate that under conditions where fruit retention is high and can help hold down vegetative growth, delayed irrigations and water stress may help manage growth, but can also reduce yields under high yield potential conditions.

Acknowledgements

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Table 1. Varieties, irrigation treatments and growth regulator treatments used in 1999 and 2000 studies at the West Side REC.

VARIETIES

- Pima S-7 (medium-stature under most conditions, moderately determinate for a Pima variety)
- Phytogen-57 (larger plant under most conditions, more indeterminate compared to most Pima)

IRRIGATION TREATMENTS

- IRRIGATION TREATMENT #1:

Irrigations 1st week June, 1st week July, end of July or first week of August (avoids leaf water potentials below -20 bars)

- IRRIGATION TREATMENT #2:

Irrigations 1st week June, mid July, mid August (irrigations delayed to produce stress equivalent to as low as -23 bars)

GROWTH REGULATOR TREATMENTS

- TREATMENT #1: Untreated Control (UTC)
- TREATMENT #2: PIX Plus at 1st bloom, & again 2 more times at14 day intervals
- TREATMENT #3: PIX Plus 14 days after 1st bloom, again once more 14 days later
- TREATMENT #4: PIX Plus 14 days after 1st bloom, BAS 130-01W applied 14 days later

Table 2. Average plant parameters at final plant mapping time (second week of September) as a function of growth regulator, variety and irrigation treatment for select combinations of treatments in 1999 studies at the West Side REC, western Fresno County, CA.

Variety	Irrigation Treatment	Growth Regulator Treatment	Ht. To node ratio (in.)	% fruit retention of 1st position sites: Bot-5 sites	% fruit retention of 1st position sites: 95% zone	# fruiting branches 95% zone all bolls
S-7	Irrig. Trt. # 1 (typical scheduling)	Un-Treated control	1.85	88.0	89.0	11.9
	"	Trt. # 2	1.80	90.7	83.3	11.8
	"	Trt. # 3	1.76	94.7	85.4	11.4
	"	Trt. # 4	1.74	92.0	86.5	11.6
	Irrig. Trt. # 2 (delayed irr.)	Trt. # 3	1.49	88.0	73.8	10.7
Phy-57	Irrig. Trt. # 1 (typical scheduling)	UTC	2.07	94.7	88.2	12.7
	"	Trt. # 3	1.92	88.3	82.9	12.4
	Irrig. Trt. # 2 (delayed irr.)	Trt. # 3	1.65	76.0	75.2	11.1

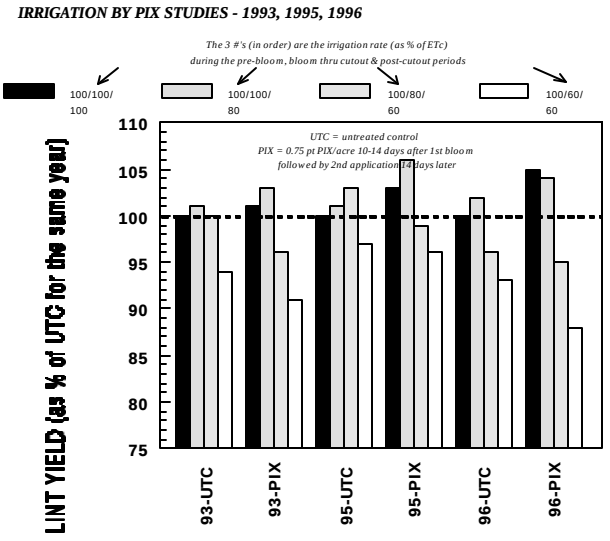

Figure 1. Lint yield as a function of irrigation rate (% of Evapotranspiration – Etc across growth periods) and mepiquat chloride treatment (Untreated control (UTC) versus PIX applications) in 1993, 1995 and 1996 studies at the West Side REC location.

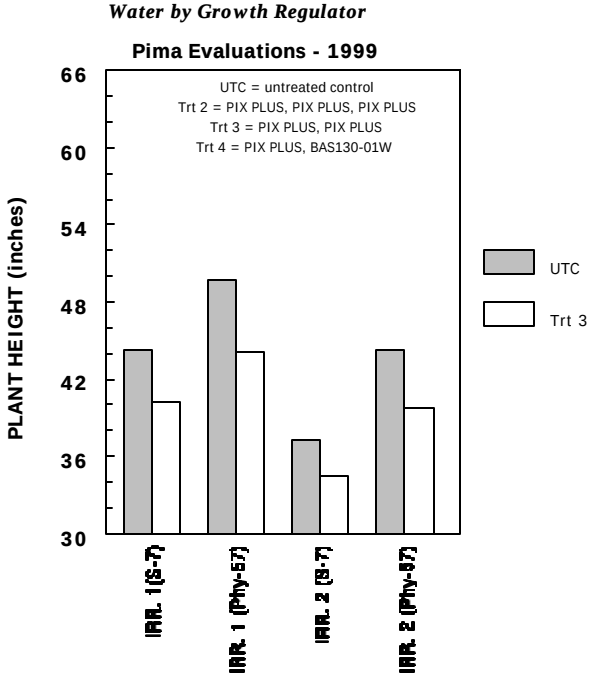

Figure 2. Plant height as a function of irrigation treatment (IRR. #1 or IRR. #2) for the varieties S-7 and Phytogen-57 in untreated controls (UTC) and PIX treatment #3 in 1999 at the West Side REC site.

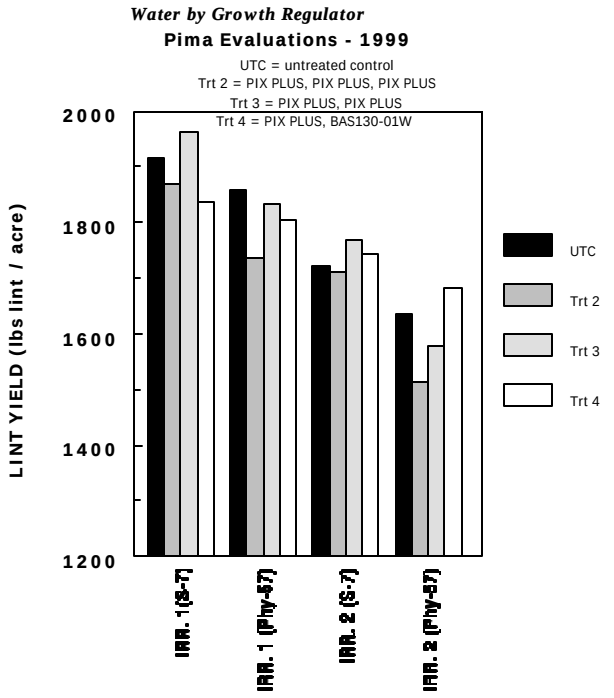

Figure 3. Lint yield as a function of irrigation treatment (IRR. #1 or IRR. #2) for the varieties S-7 and Phytogen-57 in untreated controls (UTC) and PIX treatments in 1999 at the West Side REC site.

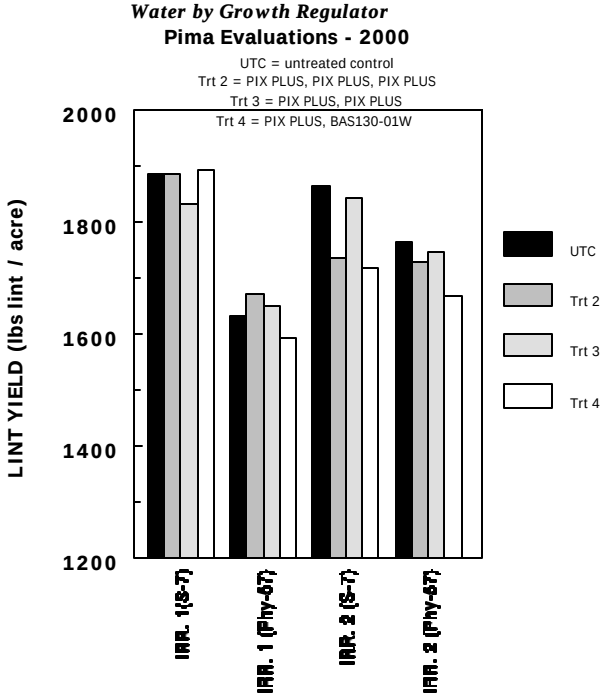

Figure 4. Lint yield as a function of irrigation treatment (IRR. #1 or IRR. #2) for the varieties S-7 and Phytogen-57 in untreated controls (UTC) and PIX treatments in 2000 at the West Side REC site.