Agronomics of Cotton Production Systems

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Objectives: Develop crop management guidelines which optimize production and quality of Acala and Pima cottons.

Procedure: Seven individual replicated trials were conducted at Shafter. Most trials had companion trials at the UC West Side Field Station, and many in similar trials in cooperation with Farm Advisors in grower fields. Eight approved Acala varieties were evaluated for yield performance; Pima S-6 and five other advanced lines from the USDA Pima program were tested; 19 experimental USDA Pima lines were tested in screening trials; Acala response to low dose multiple applications of the growth regulator Pix was measured; tests were initiated to develop plant map guidelines for scheduling defoliation; and the influence of canopy architecture on growth and development, yield, and fiber quality by position on the plant were under initiated.

Results:

Acala Varieties: Eight approved Acala varieties were tested at Shafter and five other locations in the SJV (Table 1). The Shafter location had the highest mean yield of all six locations which indicates we have been successful in refining our 30-inch production system at Shafter. Maxxa averaged 1825 lbs/A which was very similar to SJ-2 even though *Verticillium wilt* level was very low. New varieties are shorter, have a lower vigor index, and retain a larger percentage of early fruit than Acala SJ-2. Increased earliness and improved harvest index continues to account for yield improvement of varieties which are equally tolerant to *Verticillium wilt*.

Table 1. Lint yield (lbs/A) for approved Acala varieties tested at six locations in the San Joaquin Valley in 1990.

Variety	Shafter	WSFS	Madera	Kern	Kings	Merced (D-6)	Avg.
SJ-2	1830	1477	1317	1622	998	1109	1392
C-37	1566	1385	1238	1575	921	--	1303
Prema	1498	1345	1148	1604	914	1081	1265
Maxxa	1825	1577	1341	1673	962	1073	1409
Royale	1714	1395	1187	1729	971	1193	1365
GC-510	1663	1448	1214	1728	928	1102	1347
GC-356	1500	1309	1239	1560	977	1055	1273
DP-6166	1525	1290	1142	1491	856	1162	1244
Avg.	1640	1403	1228	1623	941	1112	1325
LSD 0.05	177	131	N.S.	88	N.S.	N.S.	72
CV%	7.4	6.3	13.0	3.7	7.0	6.2	4.6
p	0.001	0.003	>0.50	0.000	0.13	0.14	0.000
% wilt	7	21	22	56	0	0	
Row spacing	30	40	38	38	38	30	

Advanced USDA Pima Lines: Pima yields averaged 1179 lbs/A lint in 1990 compared to 947 lbs/A in 1989 (Table 2). Low soil saturation percentage continues to be associated with low yield of Pima S-6 across the SJV. Application of gypsum and ability to apply irrigation water uniformly to level basins is believed to be the major reason for yield improvement at Shafter. Drip irrigation of Pima on these sandy loam soils may improve yield levels to the level noted for clay loam soils at the UC WSFS (Table 2). P-74 has a larger leaf more typical of Acala cottons. It had the highest mean yield at Shafter.

Table 2. 1990 San Joaquin Valley Pima Variety Tests

Variety	Shafter	WSFS	Average
S-6	1140	1531	1336
P-67	1078	1508	1293
P-69	1189	1490	1340
P-71	1240	1629	1435
P-73	1121	1598	1360
P-74	1305	1520	1413
Average	1179	1546	1363
LSD 0.05	118	N.S.	80
CV %	8.4	8.4	7.0
V*L = N.S.			

Pima Screening: Pima S-6, two lines from Chaney Ranch, and 18 USDA Pima lines were tested on the South 40. Lint yield averaged 962 lbs/A. This was substantially lower than yields in North D. We believe much of the difference was related to irrigation management. Five of the USDA entries yielded at least 10 percent more than Pima S-6, with 89-394 (16.6 percent) and 89-220 (14.9 percent) yielding significantly more than Pima S-6 (table of data not presented).

Low Dose Multiple Applications of Pix: One test was conducted at Shafter and seven additional tests in the SJV. Use of Pix increased yield at Shafter and three additional locations (Table 3). Low dose multiple applications did not show an advantage over the single application of 0.5 pts/A applied at early bloom. The 1990 results were in agreement with the results obtained from 34 trials conducted from 1987 through 1990.

Table 3. Comparison of multiple low application rates of Pix to control or standard 0.5 pts/A single application in 1990.

	Pts/A Pix applied at						Orthogonal
Early square:	0	0.13	0.25	0.25	0		Contrast
First bloom:	0	0.13	0.25	0.5	0.5	LSD	Control vs. Pix
10 days later:	0	0.13	0.25	0	0	0.05	(p)
In 1990:							
Shafter	1512	1639	1685	1639	1629	N.S.	0.06
WSFS	1721	1718	1705	1719	1728	N.S.	>0.50
Madera	1256	1332	1326	1404	1361	N.S.	0.16
Merced 19	1588	1609	1558	1554	1704	N.S.	0.04
Merced 20	1219	1309	1342	1313	1309	N.S.	0.14
Merced 21	1282	1384	1379	1405	1394	42	0.01
Kern	1408	1449	1359	1361	1459	59	0.01
Kings	1095	1115	1074	1088	1043	N.S.	>0.50
1990 Avg.	1385	1444	1429	1435	1453	42	0.01
34 tests 1987-1990	1330	1377	1378	1369	1386	--	--

Nodes Above Cracked Boll (NACB) as a Management Tool To Schedule Defoliation: Defoliation is recommended when 95 percent of the bolls are mature. Currently, this is estimated by one of three techniques: Cutting bolls with a sharp knife; cutting bolls and looking at the seed coat color; and percent of bolls that have opened. California cotton producers are beginning to use plant mapping in management decisions. All bolls on the same plant are related to each other in age according to their position on the plant. First positions on fruiting branches (FB-1) are the last bolls to be set at the top of the plant. Our goal was to related NACB with boll size and fiber quality loss due to premature defoliation. Acala SJ-2 plants with a FB-1 cracking boll were tagged on August 31 when the FB-1 number with a cracking boll averaged 3.25. There were three main treatment groups: All FB-1 bolls harvested on the day of defoliation beginning at the cracked boll (zero) up to 8 NACB (trt A); tagged plants defoliated and bolls allowed to develop as much as possible and harvested by NACB when all bolls were open (trt B); and tagged plants which were never defoliated and where all FB-1 bolls were harvested according to NACB (trt C).

Boll size for control plots (C) declined beginning at 6 NACB (Table 4). This corresponds to approximately FB# 9. Minimal reduction in boll size (5 percent) began at 4 NACB and increased steadily to a maximum value of 27 percent reduction at 8 NACB. When bolls were harvested on the day of defoliation (trt A), boll size was reduced 5 percent at 3 NACB. This treatment should have a similar effect as a killing frost or desiccation. The average differential between A as a percent of C, and B as a percent of C reaches a maximum at 5 NACB with an average difference of 14.5 percent for 5 to 8 NACB. This suggests when bolls are immature and defoliated versus desiccated, up to 14.5 percent of the normal boll dry weight accumulation can come from redistribution of assimilates. Using the regression line for rate of boll dry weight accumulation reported by Kerby et al. 1987 in UC Bulletin 1921 Fig. 19, this corresponds to 99 HU worth of boll growth during the linear phase of growth.

Table 4. Boll size and fiber quality as influenced by maturity at time of defoliation.

Nodes above cracked boll	Boll size (g)			Micronaire			Elongation %		
	A	B	C	A	B	C	A	B	C
0	7.58	7.37	7.47	4.6	4.8	4.8	6.40	6.35	6.30
1	6.95	7.30	7.10	4.5	4.3	4.8	6.30	6.35	6.30
2	7.15	7.21	7.03	4.4	4.6	4.8	6.15	6.35	6.60
3	6.65	6.94	7.00	4.2	4.2	4.6	6.35	6.50	6.60
4	6.07	6.74	7.09	3.7	4.4	4.4	6.20	6.35	6.50
5	5.53	6.44	7.14	3.3	3.8	4.8	5.95	6.40	6.40
6	4.85	5.85	6.39	3.0	3.9	4.5	5.70	6.20	6.30
7	4.34	5.29	6.02	2.7	3.3	4.2	5.70	5.95	6.20
8	3.75	4.57	6.27	2.3	2.9	4.3	5.70	5.85	6.30

A = harvested the day of defoliation; B = defoliated, same bolls allowed to develop as much as possible; C = never defoliated, opened on their own.
Fruiting branch no. of cracked boll at defoliation = 3.3
Date of defoliation = Aug. 31 % open bolls = 12%

Premature defoliation did not appear to influence fiber length, length uniformity, fiber strength, or reflectance. Micronaire values were slightly erratic and suggests even though we had at least 100 bolls in each category, some variation sample variation still remained (Table 4). It is possible this was a blending problem. We will have additional micronaire estimates from the same samples which were sent to New Orleans for spinning and knitting. At 5 NACB micronaire is reduced by defoliation and/or harvesting of bolls on the day of defoliation. Prior to this date there seems to be no consistent decrease in micronaire by premature defoliation. Fiber elongation appeared to have a small effect as early as 2 NACB. Differences were only about 0.15 percent prior to 5 NACB and would not be considered a problem.

Canopy Architecture and Fiber Quality: We have identified that fiber quality limiting factors are associated with a general carbohydrate deficit during the latter part of the season. The results also demonstrate that localized carbohydrate deficits exist even early in the season. We believe this is the result of shading of lower leaves which nourish these early set bolls. FB-1 bolls are always higher in quality that any other position. FB>2 and bolls on vegetative branches are always the lowest in quality. These positions have less leaf area to support boll growth and what leaf area they do have is deeper in the canopy (more shading) at the time of bloom than FB-1 bolls. These poor quality positions represent roughly 20 percent of the total crop.

Results suggest that average fiber quality, for the variety being grown, could be improved by eliminating long branches. This would allow greater light penetration into the canopy which should help leaves important to lower bolls remain more photosynthetically active. We have made selections within the germplasm of the late Dr. Hyer for such "columnar" type cottons. Likewise, some are available in commercial company germplasm.

Five treatments which varied in plant type were as follows: Acala SJ-2 modified, SJ-2, GC-510, columnar 2 (Shafter germplasm), and DP-895 (a columnar cotton). Acala SJ-2 was modified by pruning the fruiting branch after the first position on June 28, July 19, and August 13. Plant height, number of main stem nodes, leaf area ration, leaf area index, and biomass production and distribution were monitored by destructive sampling from row 7 of plots on June 14, July 9, July 30, and August 22. Solar radiation (PAR) penetration into the canopy was monitored at ground level, or at fruiting branch number 3, 7, and 11 on 11 July, 30 July, and 22 August. Seed cotton from 10 different was hand harvested. Zone 1 (vegetative branches) and zone 9 (FB position >2 on FB# 1-4) did not have sufficient size samples to obtain fiber analysis by replications.

This is such a large test with many tables it is not possible to include it in this summary. Acala SJ-2 and GC-510 yielded an average of 249 lbs/A more (p=0.003 for the orthogonal contrast) than the "columnar" (COL 2, DP-895, and SJ-2 modified) cottons. Removal of fruiting branches after the first position (SJ-2 MOD) resulted in an average decrease of 175 lbs/A lint (11 percent). This orthogonal contrast was significant only at p=0.11. Columnar cottons required an average of 15.6 fruiting branches for yield compared to an average of 13.9 for Acala SJ-2 and GC-510. This is an increase in the flowering cycle of approximately 9 days. Modifying Acala SJ-2 increased the flowering cycle 2.3 fruiting branches or 11 days (p=0.044).

Modification of SJ-2 resulted in increased PAR penetration to the ground on July 11 and July 30. GC-510 also tended to have greater PAR at the lower depths of the canopy during the first two sample dates. Genetic columnar cottons did not have increased PAR at the ground level or at fruiting branch number three. PAR interception by leaves above FB 7 was less for COL 2 than for SJ-2, GC-510, or DP-895 during July.

The interaction between variety and zone was significant for the percentage of total yield in a portion of the plant. Genetic columnar varieties averaged 74.6 percent of their total yield on FB-1 positions compared to 66.2 percent for the two Acala varieties. Modification of SJ-2 greatly increased the percentage of of total yield produced on the first eleven fruiting branches. Since retention percentage of the harvest zone was not greatly improved and boll size was not increased, yield decreases noted for the modified SJ-2 were associated with loss of yield from secondary positions. Although there was some compensation by FB-1 positions, it was not enough to sustain high yield levels. This suggests the need for more than one fruiting position per branch is important for yield potential.

On a complete plant basis modified SJ-2 had an average boll size that was 0.75 grams per boll greater than normal SJ-2. Genetic columnar cottons had boll sizes on vegetative positions which averaged 99 percent of the whole plant average while the Acala varieties averaged only 85 percent of normal size at the same position. Likewise, the Acala varieties showed more marked depression in boll size at FB3 1-4 than did the columnar cottons. Hence, columnar cottons produced a lower percentage of total yield in the previously identified "bad boll zones" of the plant, and based on boll size data it appears bolls in columnar "bad zones" were more fully developed than bolls at the same location for Acala varieties.

Changing canopy architecture by growing columnar cottons appeared to decrease fiber quality variation but was lower yielding that typical Acala cottons. Columnar cottons were excessively vegetative and this may have contributed to decreased yield.

Future Plans: Continue evaluations regarding the influence of canopy architecture on fiber quality variation. Columnar cottons may be less sensitive to water stress and will require different cultural practices to optimize their yield potential. Pima cotton is a new crop to the SJV. We will plan a wide range of Pima work designed to develop base line growth and development data, determine optimum plant density, monitor response to Pix, continue water management studies, and evaluate the USDA Arizona germplasm for cultivars which are superiorly adapted to the SJV. The focus of Pix work will be to evaluate its benefit from a compressed flowering cycle as a water saving strategy. We will continue to evaluate the currently approved Acala varieties for yield as well as collect the growth and development data which quantifies varietal determinacy level.