SHORT SEASON COTTON PRODUCTION AS A MEANS OF MANAGING ENERGY INPUTS AND MAXIMIZING RETURNS

M. D. Cannon, W. D. Fisher, W. S. Goldthwaite, J. M. Olvey, L. L. Patterson and E. J. Pegelow

This project was initiated in 1980 under the auspices of the Short Season Cotton Committee, chaired by Dr. R. P. Upchurch. Committee members were: M. D. Cannon, D. D. Fangmeier, W. D. Fisher, R. B. Hine, T. E. Russell, R. A. Selley, B. B. Taylor, T. C. Tucker, Dale Fullerton and Carl Feaster. Ex-officio members were: Scott Hathorn and Robert Fowler. The intent of the Committee was to involve every discipline in the College of Agriculture in a task force approach to problem solving.

Increasing energy costs, plus inflation (brought on in part by increased cost of energy), have caused a rapid escalation in production input costs. Three items of particular concern are: (1) the cost of pumping irrigation water, (2) the increase in insecticide costs, and (3) the astronomical cost of owning and operating farm machinery.

The current long-season management system, although producing the highest per-acre yield of cotton in the entire world, requires additional applications of irrigation water and encourages the proliferation of insect pests.

If the growing season is shortened through early termination of irrigation water and defoliation, immediate cost reductions can be realized. Destruction of the habitat for the pink bollworm and the bollworm-tobacco budworm complex should result in long-range benefits through reductions in overwintering populations of these pests.

Early termination will almost always result in some yield reduction, therefore the problem becomes one of balancing inputs against returns to arrive at feasible solutions to a complex problem. The primary objective of this project is to empirically determine, over a wide range of production practices, a set of alternative solutions from which producers can choose to maximize net returns.

Experiments were initiated at four locations: (1) the Cotton Research Center in Phoenix, (2) the Marana Experiment Farm, (3) the farm of Mr. Paul Prechel approximately 3 miles S.E. of Coolidge, and (4) the Paloma Ranch at Theba, about 15 miles west of Gila Bend, where Mr. Chester Nall is responsible for field operations.

General Procedure

Three irrigation termination dates, approximately two weeks apart, were used at all locations except the Marana Farm where only two were used due to the normally shorter growing season there. Six varieties were used at the Cotton Research Center and Marana, while five were employed at the two off-station locations. A brush roll stripper was compared to the spindle pickers at the Cotton Research Center, Marana Farm and on the Prechel farm. The experimental design at all locations was split plot.

Measurements were made of soil moisture level at least twice between irrigations at both the Paloma Ranch and the Prechel farm. Periodic flower counts were also made at these two locations. Seed cotton samples were taken at all locations to determine levels of aflatoxin.

Portable platform scales were used at both off-station locations for weighing whole-plot yields. The shorter plots on the two experiment stations were bagged and weighed. Second-pick yields were measured from the spindle-picked plots at both off-station locations.

Following is a summary of the production practices and results from each test.

COTTON RESEARCH CENTER-1980

Summary of Cultural Practices

Planted: 11 April - 40" beds.

Irrigation	Insect Control
1 April - preplant	9 June - Temik
29 May	17 July - Sevin
18 June	23 July - Sevin
1 July	29 July - Sevin
16 July	4 August - Sevin
1 August (Last for Cutoff I)	7 August - Pydrin
12 August (Last for Cutoff II)	12 August - Pydrin
28 August	19 August - Sevin
	26 August - Sevin
Previous crop: alfalfa	2 Sept. - Sevin
Fertilizer: 150# urea, plowed down	9 Sept. - Sevin
160# sidedress in May and June	16 Sept. - Sevin
Plant Population: 25,000-30,000 plants per acre	23 Sept. - Sevin

Harvest schedule

Cutoff I

Defoliate - 5 Sept., ground, Bollseye
Strip - 19 Sept.
Spindle - 14 Oct.

Cutoff II

Defoliate - 19 Sept., ground; 2 Oct., air, Bollseye
Strip - 20 Oct.
Spindle - 14 Oct.

Cutoff III

Defoliate - 2 Oct., ground/air; desiccate 7 Nov., ground, Paraquat
Strip - 14 Nov.
Pick - 24 Oct.

A summary of yields for the various combinations of variety, irrigation cutoff date and harvest method is given in Table 1. The warm, dry weather prevailing throughout the fall was extremely favorable for maximum yields in full season production. Cutoff II produced 187 pounds of lint (14%) more than Cutoff I. Cutoff III, in turn, yielded 125 pounds of lint (8%) more than Cutoff II. Variety differences were small, and yields from stripper harvest (AC brush-type stripper with cleaner) were only slightly better than the spindle-picked yields.

MARANA-1980

Summary of Cultural Practices

Planted: 17 April - 40" beds.

Irrigation	Insect Control
24 March - preplant	9 August - Ambush
17 June	13 Sept. - Ambush
11 July	
2 August (last for Cutoff I)	
18 August	
Previous crop: cotton	
Fertilizer: 45# N preplant	
20# N in water 11 July	
Plant Population: 25,000 plants per acre	

Harvest schedule

Cutoff I

Defoliate - 8 Sept., ground, Bollseye
Strip - 17 October
Pick - 16 October

Cutoff II

Defoliate - 13 Oct., air
Strip - 20 Nov.
Pick - 7 Nov.

The yields for this test are given in Table 2. Water penetration in this field was rather poor, and the plant growth was somewhat restricted.

Because of this condition and the warm dry fall, an additional irrigation beyond the August 18 termination undoubtedly would have given further increased yields. Cutoff II produced 256 pounds of lint per acre (28%) more than Cutoff I. In this relatively short cotton, the stripper did a more efficient harvesting job than the picker as evidenced by a 23% higher yield for the stripper. All varieties yielded more with stripper harvest ranging from an increase of 15% for Stoneville 506 to 32% for Deltapine 712.

The gin turnouts for the two tests above are shown in Tables 3 and 4. The stripper was equipped with a cleaner, and the gin turnouts were only 2 to 3% below those for the spindle machine. In the higher yielding cotton (2-1/2 to 3 bales), it was necessary to operate the stripper at a very slow speed, and even then we experienced some plugging of the machine.

Table 1.

SHORT SEASON COTTON
Cotton Research Center-1980
Yield-Pounds Lint Per Acre

	Cutoff I			Cutoff II			Cutoff III		
Variety	spindle	stripper	Ave.	spindle	stripper	Ave.	spindle	stripper	Ave.
7203	1305	1260	1282	1465	1561	1513	1577	1675	1626
7209	1301	1327	1314	1416	1432	1424	1580	1687	1634
Deltapine 70	1253	1160	1206	1432	1496	1464	1626	1589	1608
Deltapine 712	1335	1334	1334	1469	1604	1536	1663	1647	1655
Stoneville 825	1378	1325	1352	1442	1524	1483	1566	1505	1536
Stoneville 506	1304	1265	1284	1411	1542	1476	1628	1552	1590
Ave.	1313	1278		1439	1526		1607	1609	
Ave.	1296			1483			1608		

Variety	spindle Ave.	stripper Ave.	variety Ave.
7203	1449	1499	1474
7209	1432	1482	1457
Deltapine 70	1437	1415	1426
Deltapine 712	1489	1528	1508
Stoneville 825	1462	1451	1457
Stoneville 506	1448	1453	1450
Ave.	1453	1471	
Ave.			1462

Table 2.

SHORT SEASON COTTON
Marana-1980
Yield-Pounds Lint Per Acre

Variety	Cutoff I			Cutoff II			spindle Ave.	stripper Ave.	Variety Ave.
	spindle	stripper	Ave.	spindle	stripper	Ave.			
7203	858	1124	991	1038	1326	1182	948	1225	1086
7209	827	1089	958	1079	1277	1178	953	1183	1068
Deltapine 70	657	879	768	1019	1154	1086	838	1016	927
Deltapine 712	683	935	809	968	1241	1104	826	1088	957
Stoneville 825	797	940	868	1058	1228	1143	928	1084	1006
Stoneville 506	948	1124	1036	1197	1349	1273	1072	1236	1154
Ave.	795	1015		1060	1262		928	1139	
Ave.	905			1161					1033

Table 3.

SHORT SEASON COTTON
Cotton Research Center-1980
Gin Turnout

Variety	Cutoff I			Cutoff II			Cutoff III		
	spindle	stripper	Ave.	spindle	stripper	Ave.	spindle	stripper	Ave.
7203	35.0	30.3	32.6	35.4	29.6	32.5	37.0	31.4	34.2
7209	37.5	33.7	35.6	37.2	30.7	34.0	38.2	32.8	35.5
Deltapine 70	34.1	28.8	31.4	34.2	30.5	32.4	35.1	31.6	33.4
Deltapine 712	33.4	29.6	31.5	33.8	31.8	32.8	34.2	30.1	32.2
Stoneville 825	33.6	28.8	31.2	33.4	30.5	32.0	34.4	30.5	32.4
Stoneville 506	32.7	27.5	30.1	32.7	30.8	31.8	34.2	29.7	32.0
Ave.	34.4	29.8		34.4	30.6		35.5	31.0	
Ave.	32.1			32.5			33.2		

Variety	spindle Ave.	stripper Ave.	variety Ave.
7203	35.8	30.4	33.1
7209	37.6	32.4	35.0
Deltapine 70	34.5	30.3	32.4
Deltapine 712	33.8	30.5	32.2
Stoneville 825	33.8	29.9	31.9
Stoneville 506	33.2	29.3	31.3
Ave.	34.8	30.5	
Ave.			32.6

Table 4.

SHORT SEASON COTTON
Marana-1980
Gin Turnout

Variety	Cutoff I		Cutoff II		spindle Ave.	stripper Ave.	variety Ave.
	spindle	stripper	spindle	stripper			
7203	34.9	31.5	36.5	34.7	35.7	33.1	34.4
7209	36.1	33.1	39.2	36.7	37.6	34.9	36.2
Deltapine 70	32.2	29.9	35.2	32.3	33.7	31.1	32.4
Deltapine 712	33.4	29.1	34.0	32.0	33.7	30.6	32.1
Stoneville 825	32.4	30.4	34.7	32.5	33.6	31.4	32.5
Stoneville 506	33.2	29.5	34.6	32.4	33.9	31.0	32.4
Ave.	33.7	30.6	35.7	33.4	34.7	32.0	
Ave.	32.2		34.6				33.3

OFF-STATION SHORT-SEASON TESTS IN 1980

We closely monitored the field operations conducted in our test areas at Coolidge and Gila Bend in order to determine the various inputs into growing cotton under the different irrigation regimes. We tried to impose as few restraints on the growers as possible. We did specify the approximate target date for defoliation in Cutoffs I and II, but let the grower decide when to cut the water off in each case in order to best achieve these defoliations. Cutoff III was the full-season irrigation treatment, with both water cutoff date and defoliation date decided by the cooperator at each location.

The experimental design was a split plot with 3 irrigation cutoff treatments (the main plot), 5 varieties (the sub plot), and 4 replications. This resulted in 60 experimental units (which we will refer to as plots) at each of the two locations. Each plot at the Coolidge location was 8 rows wide by 600 feet long, while at the Paloma Ranch site (field 35 B-1) the plot size was 6 rows wide by 1,160 feet long. Four rows of each plot were harvested by a 2-row spindle picker, and the seed cotton yield determined by dumping the contents of the picker basket into a scale trailer. Subsamples of the seed cotton from each dump were run through a laboratory gin and these gin turnouts used to calculate lint yields. The same 4 rows of each plot were later second-picked (all spindle harvesting dates were set by the cooperating growers).

The short-season tests at the two off-station sites were sister experiments, but there were some important differences. An additional variable was introduced at Coolidge, where 2 rows of each 8 row plot were stripper harvested. The experimental design at this location thus became a split-split-plot with harvest method (spindle vs. stripper) as the sub-sub-plot. The test area at Coolidge was equally divided between two adjacent fields; flood irrigation in these fields made it desirable to include 8 row buffer strips to each side of the randomized irrigation cutoff treatment areas. This gave a total of 560 rows in the test (including buffers). The single field used at Paloma Ranch, however, was irrigated with siphon tubes so that buffer strips between irrigation cutoff areas were not needed. Since only the center 4 rows of each 6-row plot were used to determine yields, there were 2 adjacent guard rows separating each harvested area. There was a total of 360 rows used in the Paloma Ranch test, not including buffer strips to the outside of the test area.

Coolidge Short-Season Test - Paul Prechel Farm

Summary of Cultural Practices

Planted: dry planted 25 April on 38" beds, 11-12# seed/acre.

Irrigation	Insecticides
26 April - watered up	1 Aug. - Azodrin
9 June	15 Aug. - Ambush and Galecron
30 June	30 Aug. - Azodrin and Galecron
12 July	6 Sept - Ambush and Galecron
26 July	18 Sept - Ambush and Galecron
8 Aug.	
22 Aug. (last for Cutoff I). Seasonal total approximately 36".	
5 Sept.(last for Cutoff II). Seasonal total approximately 40".	
19 Sept.(last for Cutoff III).Seasonal total approximately 44".	

Previous crop: cotton (past 2 years)
Fertilizer: 240# 18-46-0 (43# N) incorporated in late June. Anhydrous ammonia injected twice during July (36# N, 50-55# N). Total of approximately 130# N and 110# P.
Herbicides: Prowl (1½ pt.), preplant.

Harvest schedule

Cutoff I

Defoliate - 15 Sept., ground, DEF; 30 Sept., ground, L-10
Spindle - 6 Oct., 16 Dec.
Strip - 8 Oct.

Cutoff II

Defoliate - 29 Sept., ground, DEF; 11 Oct., ground, DEF
Spindle - 28 Oct., 16 Dec.
Strip - 19 Nov.

Cutoff III

Defoliate - 10 Nov., ground, sodium chlorate; 22 Nov., ground, L-10
Spindle - 28 Nov., 16 Dec.
Strip - 1 Dec.

A summary of lint yields for the various combinations of irrigation cutoff (main plot), variety (subplot), and harvest method (sub-subplot) is given in Table 5. Each yield is the average of 4 replications.

Table 5.

SHORT SEASON COTTON
Paul Prechel Farm, Coolidge, AZ-1980
Yield-Pounds Lint Per Acre

	Cutoff I			Cutoff II			Cutoff III		
Variety	spindle	stripper	Ave.	spindle	stripper	Ave.	spindle	stripper	Ave.
7203	1075	1304	1190	1370	1626	1498	1583	1980	1782
7209	1083	1266	1174	1266	1544	1405	1524	1837	1680
Deltapine 70	1264	1394	1329	1488	1638	1563	1734	1864	1799
Stoneville 825	1227	1364	1296	1471	1570	1520	1673	1773	1723
Deltapine 41	1381	1538	1460	1580	1864	1722	1908	2099	2004
Ave.	1206	1373		1435	1648		1684	1911	
Ave.	1290			1542			1798		

The significant variables affecting yield are presented in tables below. Yields followed by the same letter were not significantly different at the 5% level in the Student-Newman-Keul's range test.

Table 6. Effect of Irrigation Cutoff Date in the 1980 Coolidge Short-Season Test

Date	Lint (lb/A.)	Increase
I (22 Aug.)	1290 c	
II (5 Sept.)	1542 b	+19.5%
III (19 Sept.)	1798 a	+39.4%

There was a nearly linear increase in lint yields associated with the additional growing time and irrigation of Cutoffs II and III, amounting to a gain of over 250 pounds of lint per acre for each successive cutoff date. The total growing time (from watering up to defoliation) was 142, 156 and 198 days for Cutoffs I, II and III, respectively.

Table 7. The Interaction between Harvest Method and Variety in the 1980 Coolidge Short-Season Test

Variety	spindle	stripper	difference
7203	1343 f	1637 b	+21.9%
7209	1291 f	1549 cd	+20.0%
Deltapine 70	1496 de	1632 b	+ 9.1%
Stoneville 825	1457 e	1569 bc	+ 7.7%
Deltapine 41	1623 b	1834 a	+13.0%
Ave.	1442 y	1644 x	

Stripper harvest, using a 2-row Allis-Chalmers brush roll stripper with cleaner, resulted in significantly higher yields for all varieties tested than did spindle harvest. The stripper, however, was limited to an unreasonably low harvest capacity due to the restricted conveying system between the brush rolls and the cleaner. Ground speed was reduced to less than one-fourth that of the spindle machine, and the stripper operator was faced with repeated plugging in the high-yielding plots. We utilized a stripper at this location mainly to get a feeling for the potential of once-over harvesting in a short-season system, assuming that it could be possible to develop a stripper that can harvest high-yielding cotton with an economically feasible ground speed. Table 9 presents gin turnouts (obtained with a laboratory gin) for the different combinations of variety, irrigation cutoff, and harvest method. Due to the cleaner, cotton picked with the stripper had gin turnouts that were only 1-5% lower than the spindle-picked cotton.

Table 8. Average Lint Yields for the Varieties Used in the 1980 Coolidge Short-Season Test

Variety	Lint (lb/A.)
7203	1490 c
7209	1420 d
Deltapine 70	1564 b
Stoneville 825	1513 c
Deltapine 41	1728 a

The strong performance of Deltapine 41 at this location came as somewhat of a surprise, in light of the relatively slow rate of stand establishment from the particular seed lot that we used. As late as mid-July our subjective evaluation was that Deltapine 41 was the weakest performer of the five varieties but, as indicated by the lint yield data, it came on strong later in the growing season.

Bloom counts were taken at irregular intervals (usually once or twice each week during July and August) in 50-foot observation areas within each plot. These data, which are not complete enough to warrant a table or graph in this report, did indicate that peak flowering by all the varieties occurred in late July. A final bloom count on September 3 indicated that all varieties were producing less than 10 new blooms per 50 feet of row. Visual observations beyond this point did not reveal any appreciable additional flowering. The two experimental lines were observed to begin active flowering in late June (at least one week prior to any of the three commercial lines); but actual counting of blooms, beginning on July 9, was too late to quantify the apparent earliness of 7203 and 7209.

Table 9. Laboratory Gin Turnouts for the 1980 Coolidge Short-Season Test

	Cutoff I		Cutoff II		Cutoff III	
Variety	spindle	stripper	spindle	stripper	spindle	stripper
7203	35.8	31.6	34.8	29.8	36.1	33.1
7209	37.2	33.6	36.1	31.0	36.6	34.2
Deltapine 70	35.0	31.0	34.0	30.4	34.1	33.1
Stoneville 825	33.5	29.1	32.1	29.2	32.8	31.0
Deltapine 41	36.4	31.2	35.4	31.7	37.1	34.0
Ave.	35.6	31.3	35.5	30.4	35.3	33.1

Gila Bend 1980 Short-Season Test-Paloma Ranch

Summary of Cultural Practices

Planted: 28 April on 38" beds, 20-21# seed/acre.

Irrigation

18 April - preirrigation
8 May
16 May
1 June
8 June
13 June

Insecticides

Data not yet available

24 June
8 July
19 July
28 July
8 Aug.
18 Aug.
26 Aug. (last for Cutoff I)
± Sept. 3 (last for Cutoff II) Not yet verified but based on 8-day interval.
± Sept. 11 (last for Cutoff III) " " " " " " " "

Previous crop: cotton (past 3 years)
Fertilizer: 400# 18-18-0 (72# N), preplant. Two sidedress applications of Uran 32 (each approx. 64# N). Total of approximately 200# N and 72# P.
Herbicides: Prowl (1½ pt.), preplant.

Harvest schedule

Cutoff I

Defoliate - 15 Sept., ground, Folex
Spindle - 30 Sept., 10 Dec.

Cutoff II

Defoliate - 30 Sept., ground, Folex
Spindle - 22 Oct., 10 Dec.

Cutoff III

Defoliate - 22 Oct., ground, Folex
Spindle - 10 Nov., 10 Dec.

A summary of lint yields for the various combinations of irrigation cutoff (main plot) and variety (subplot) is presented in Table 10. Each yield figure is the average of 4 replications.

Table 10.

SHORT SEASON COTTON
Paloma Ranch-Gila Bend, 1980
Yield-Pounds Lint Per Acre

	Irrigation Cutoff			
Variety	I	II	III	Ave.
7203	869	1057	1080	1002
7209	985	1197	1232	1138
Deltapine 70	1082	1214	1244	1180
Stoneville 825	958	1173	1222	1118
Deltapine 41	991	1268	1202	1154
Ave.	997	1182	1196	1118

The significant variables affecting yield are presented below. Yields followed by the same letter were significantly different at the 5% level in the Student-Newman-Keul's range test.

Table 11. Effect of Irrigation Cutoff Date in the 1980 Gila Bend Short-Season Test

	Date	Lint (lb/A.)	Increase
I	(26 Aug.)	977 b	
II	(3 Sept.)	1182 a	+21.0%
III	(11 Sept.)	1196 a	+22.4%

At this location the additional growing time and irrigation associated with Cutoff III did not appreciably increase the lint yield beyond that obtained in Cutoff II (less than 14 lb/A. difference). The average lint yield in Cutoff II was over 200 lbs. per acre higher than Cutoff I, however, and would certainly justify the additional irrigation and other expenses involved. The total growing time (from planting to defoliation) was 140, 155 and 177 days for Cutoffs I, II and III, respectively.

Table 12. Average Lint Yields for the Varieties Used in the 1980 Gila Bend Short-Season Test

Variety	Lint (lb/A.)
7203	1002 b
7209	1138 a
Deltapine 70	1180 a
Stoneville 825	1118 a
Deltapine 41	1154 a

According to these data the experimental line 7203 had significantly lower lint yields than the other varieties tested at this location. This was in agreement with our subjective evaluation of this variety throughout the growing season. It produced the poorest stand of the five varieties and showed a pronounced yellowing and stunting of many of the plants growing at the tail end of the field, which we felt was probably a differential response to saline conditions. Some of the plants of the 7209 variety also exhibited mild yellowing but appeared otherwise normal.

Observations

This first year of testing has revealed a number of interesting facts and has led to a few tentative conclusions. It should be mentioned that not all the data collected have been analyzed. Seed samples are still being analyzed for aflatoxin, and these data will not be available for several weeks. Also, soil moisture data have not yet been correlated with irrigation information because some of that information is not available at present.

One conclusion is that the merits of a short season program of this nature depends in large measure on two factors, (a) the length of growing season available, i.e., planting time and date of first frost, and (b) the price received for cotton. The long, warm fall and winter of 1980 encouraged growing of the crop just as long as possible. Certainly, this was not a "normal" growing season. The price of cotton shot up during late summer, brought on in part by wide-spread drought across the Cotton Belt. This, of course, means that any incremental yield gained by extending the growing season is enhanced in value and effectively nullifies the projected economies of early crop termination.

The above observations do not mean that the concept of short season cotton is invalidated. Given a more normal growing season, in terms of cool weather in the early fall, the situation would certainly be different. Also, we would probably have to assume that the price of cotton will not remain at its present favorable level.