Comparison of Irrigation Termination Dates on the Yield of Upland and Pima Cotton

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ABSTRACT

Field experiments were conducted in 1988 to begin an assessment of both the agronomic and entomological implications from differences in irrigation termination dates imposed on both upland and pima cotton. Nine study sites were established with non-replicated treatment arrangements. Two replicated experiments were established at Marana, AZ on both upland and pima comparing early and late irrigation terminations. The upland (DPL 20) field was planted 26 April 1988 and irrigation terminations of 18 August (early) and 5 September (late) were imposed. The pima S-6 field was also planted 26 April and irrigation was terminated on 13 August (early) and 1 September (late). Yield measurements showed no significant differences ($P \leq 0.05$) between early or late termination with the DPL 20, but quite substantial and significant differences were observed between treatments in the pima experiment.

INTRODUCTION

There has been a considerable amount of discussion, research, and evaluation carried out in Arizona concerning the gains and losses to a cotton production program as a result of terminating irrigations early or later. Early, late, short season, and full season are all relative terms used to describe various cotton production systems in terms of irrigation termination. Within the context of the experiments described herein, early termination is intended towards providing sufficient water through irrigation so as to provide for the full development of bolls set near the time when cut-out has occurred. This of course is somewhat easier to distinguish for most upland varieties than for pima, due to the more indeterminate nature of pima cotton in general.

There are several aspects of cotton production programs which have received attention in terms of optimization in association with the date of crop termination. One area that has been given a considerable amount of attention has been that of potential benefits associated with insect pest management as a result of terminating cotton early. This argument has been most commonly developed towards pink bollworm control, by diminishing overwintering potentials through early termination. Recently, there has also been interest in early termination for beneficial aspects of boll weevil and whitefly control in cotton.

An obvious means of effectively terminating a crop in most areas of Arizona is through cutting off the irrigation water. However, an associated application of a plant growth regulator to remove small fruiting forms from the plant that will not mature and is often referred to as chemical termination, has also been used in some cases. This removes inefficient sinks for water and nutrients, as well as removing late season feeding and overwintering sites for pink bollworm.

The objectives of these initial experiments were to evaluate the differences between an early and late irrigation termination in upland and pima cotton in terms of harvested lint, and to begin an assessment of the impact such termination treatments have on pink bollworm populations in subsequent years.

METHODS

Nine non-replicated comparisons of irrigation termination date effects on cotton yield were established in Arizona in 1988. Two fully replicated experiments (4 replications each) were established on upland (DPL 20) and pima (S-6) cotton in uniform field areas near Marana, AZ (Pacheco Farms) on a Gila loam and Vinton-Anthony sandy loam (pima S-6), and a Vinton-Anthony sandy loam (DPL 20). Only the replicated studies will be described and discussed. Treatments consisted of an early and a late termination date of irrigation. Both fields were planted on 26 April and the respective dates of irrigation termination are shown in Table 3.

Plant measurements were initiated in May to document the pattern of crop growth and development in each case. Plant measurements consisted of multiple, one meter samples taken on 10 to 14 day intervals in each field study area. Measurements recorded included number of plants m^{-1}, plant heights, number of flowers m^{-1}, number of bolls m^{-1}, and number of mainstem nodes $plant^{-1}$ later in the season. Plots consisting of irrigation termination treatments were 12 rows wide. Yields were measured by harvesting the center four rows of each plot with a mechanical picker on 29 October and 14 November for the upland and pima respectively. Quality analysis on lint samples collected from each plot are being determined, but at this writing these results are not yet available.

Measurements were also taken on a twice per week basis in each study area throughout the season to monitor pink bollworm populations. Adults were monitored using pink bollworm pheromone traps (oil type) and larval infestatin counts from cotton flowers and bolls. Records were also kept regarding heat unit accumulations (86/55°F thresholds) through the season.

RESULTS

A listing of selected plant growth parameters are shown in Tables 1 and 2 for upland and pima fields respectively, from sampling dates in June through August. From Table 1, one can determine some estimate of crop cut-out from the flower numbers m^{-1}. The 30 August measurements taken in both cases were made in the late termination areas. Based upon field measurements and observations, cut-out in the upland field was estimated to have occurred by 10 August, and therefore the early termination treatments were given a final irrigation on 18 August. The decision for the pima termination dates were made in a more arbitrary fashion. Flowering seemed to peak in late August, and a final irrigation was given in the late termination treatments on 1 September.

Yield results are shown in Table 3 for both the upland and pima experiments. The differences in yield between early and late irrigations were not significantly different in the upland study, although the mean for late termination was arithmetically higher.

In the pima study, yield differences were substantially different. The later terminated pima yielded an average of 158 lbs. lint $acre^{-1}$ more than the areas terminated on 13 August. Given the water costs in the Marana area, and assuming any reasonable market price for average grade pima cotton from the 1988 crop, one can easily recognize an economic benefit from the single additional application of approximately six acre inches of water.

The situation in the pima crop under study was certainly conducive to this type of response to a late season irrigation. Due to cool conditions throughout most of May, the crop did not develop rapidly in the early season (Table 2). Conditions in late July and parts of August were not such that good boll set was established. This is attributed in part to higher humidities that developed, leading to higher night temperatures, and ultimately poorer boll set. As a result, the pima field in the study area was not well fruited throughout the plant, having most of the bolls in the upper one-third of the plant structure. Conditions in late August and through September were generally very warm and dry, resulting in a good fruiting period. As a result, the areas in the field maintaining good water conditions through September from the later irrigation were capable of taking advantage of these conditions and set a substantial number of bolls, as well as fully developing other late bolls for harvesting.

This is a situation unique to growing conditions in this area in 1988. It should also be pointed out that this was carried out at an elevation of approximately 2,000 feet. These studies in no way represent a comprehensive

analysis of these types of management options. However, these studies do provide a basis and a beginning to a project that will be substantially expanded and further developed in the 1989 season.

Based on heat unit accumulations (55/86°F) from January 1, the perk emergence of Parent (P), F_1, F_2 and F_3 generation adult pink bollworms were predicted and compared to actual field trap counts (n = 4 per site) (Fig. 1a and b). Generations P, F_1, and F_2 predictions closely parallelled the actual field adult trap counts. However, the actual F_3 generation appeared later than the predictions for both fields. This may be due to insecticide treatments on both these fields in late August, which may have selected for later larvae and maturation of the surviving larvae. Table 4 indicates the field infestations of both fields and the insecticide spray dates.

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Table 1. Mean plant measurement values from Marana, AZ, Upland irrigation termination evaluation, 1988.*

Sampling Date	Plant Height - inches -	Mainstem Nodes Plant^{-1}	Flowers m^{-1}	Bolls m^{-1}
6/14	4	6	0	0
6/30	11	9	0	0
7/14	25	16	1.3	2
7/28	34	17	5.3	24
8/30	40	22	1.5	85

*DPL 20, planted April 26.

Table 2. Mean plant measurement values from Marana, AZ, Pima irrigation termination evaluation, 1988.*

Sampling Date	Plant Height - inches -	Mainstem Nodes Plant^{-1}	Flowers m^{-1}	Bolls m^{-1}
6/14	6	9	0	0
6/30	13	15	0	0
7/14	26	17	3	4
7/28	35	21	4.5	33
8/30	48	24	31	99

*Pima S-6, planted April 26.

Table 3. Mean values of cotton lint yields from the 1988 irrigation termination experiment at Marana (Pacheco's) with DPL-20 and Pima S-6.§

Treatment	DPL - 20		Pima S-6	
	Term. Date	Yield - lbs. lint acre^{-1}	Term. Date	Yield - lbs. lint acre^{-1} -
Early	Aug. 18	1288	Aug. 13	573 a**
Late	Sept. 5	1325	Sept. 1	731 b
$LSD_{0.05}$		NS		47
CV (%)		3		3

§Harvest Dates = October 29 and November 14 for Upland and Pima respectively. Planting date was April 26 for both studies.

**Means followed by the same letter within a column are not significantly different ($P \leq 0.01$) according to a Fisher's LSD.

Table 4. Percent flowers (7 June - 29 June) and percent bolls (200 bolls) (29 July - end of season) infected with pink bollworm larvae in Upland and Pima cotton, Marana, AZ.

Sample date	Field	
	Upland*	Pima*
6/07	0	0
6/14	0	0
6/17	0	0
6/21	0	0
6/25	0	0
7/01	0	0
7/05	0	0
7/11	0	0
7/21	0	0
7/25	2	0
7/28	2	0
8/01	2	-
8/04	0	0
8/05	2	0
8/08	3	0
8/11	8	0
8/15	0	0
8/18	0	0
8/22	0**	6**
8/29	6**	6**
9/06	6	6

*Upland cultivar, DPL 20 planted 26 April Pima cultivar, Pima S-6, planted 26 April.
**Methyl Parathior sprayed for pink bollworm.

Fig. 1A

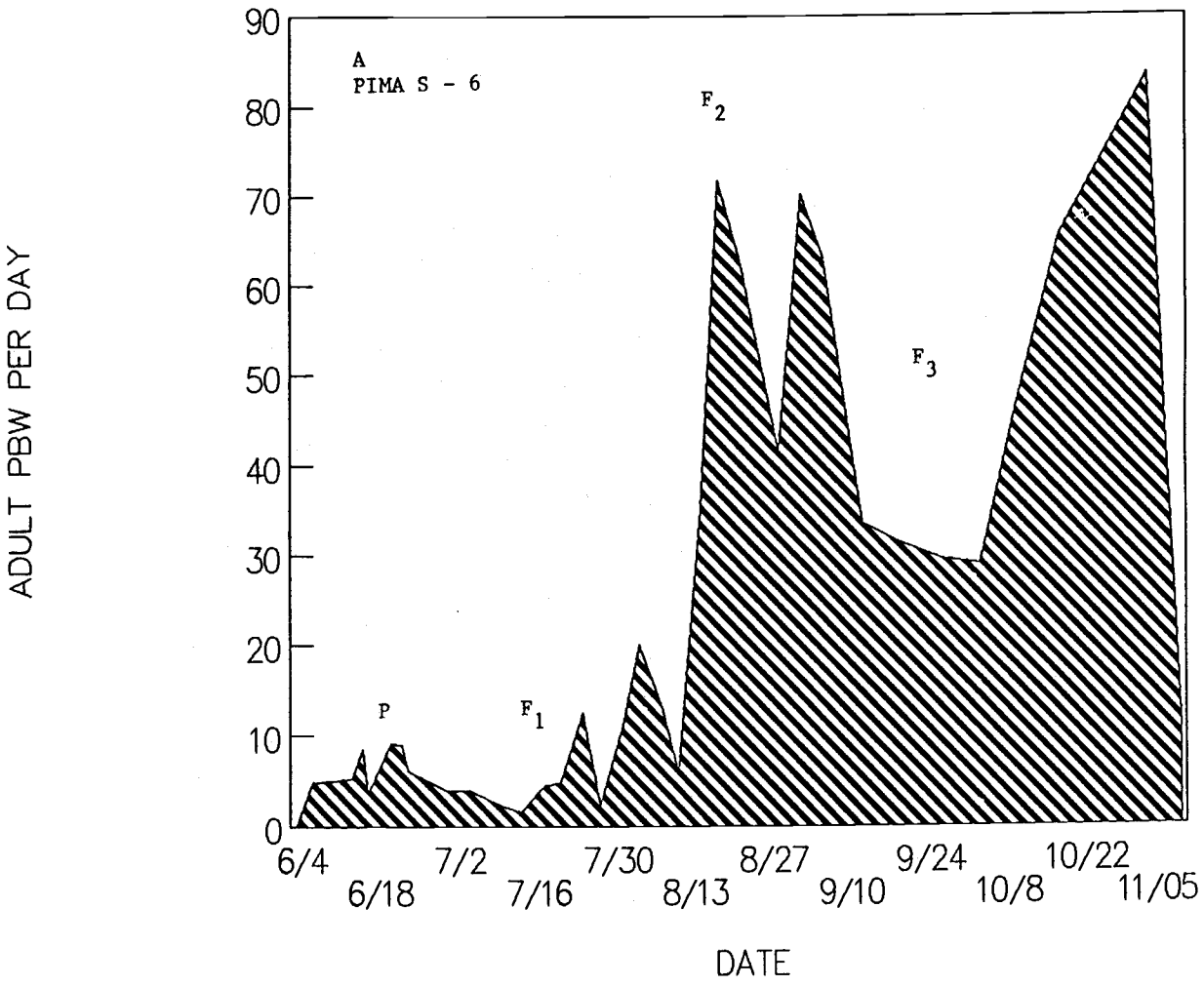
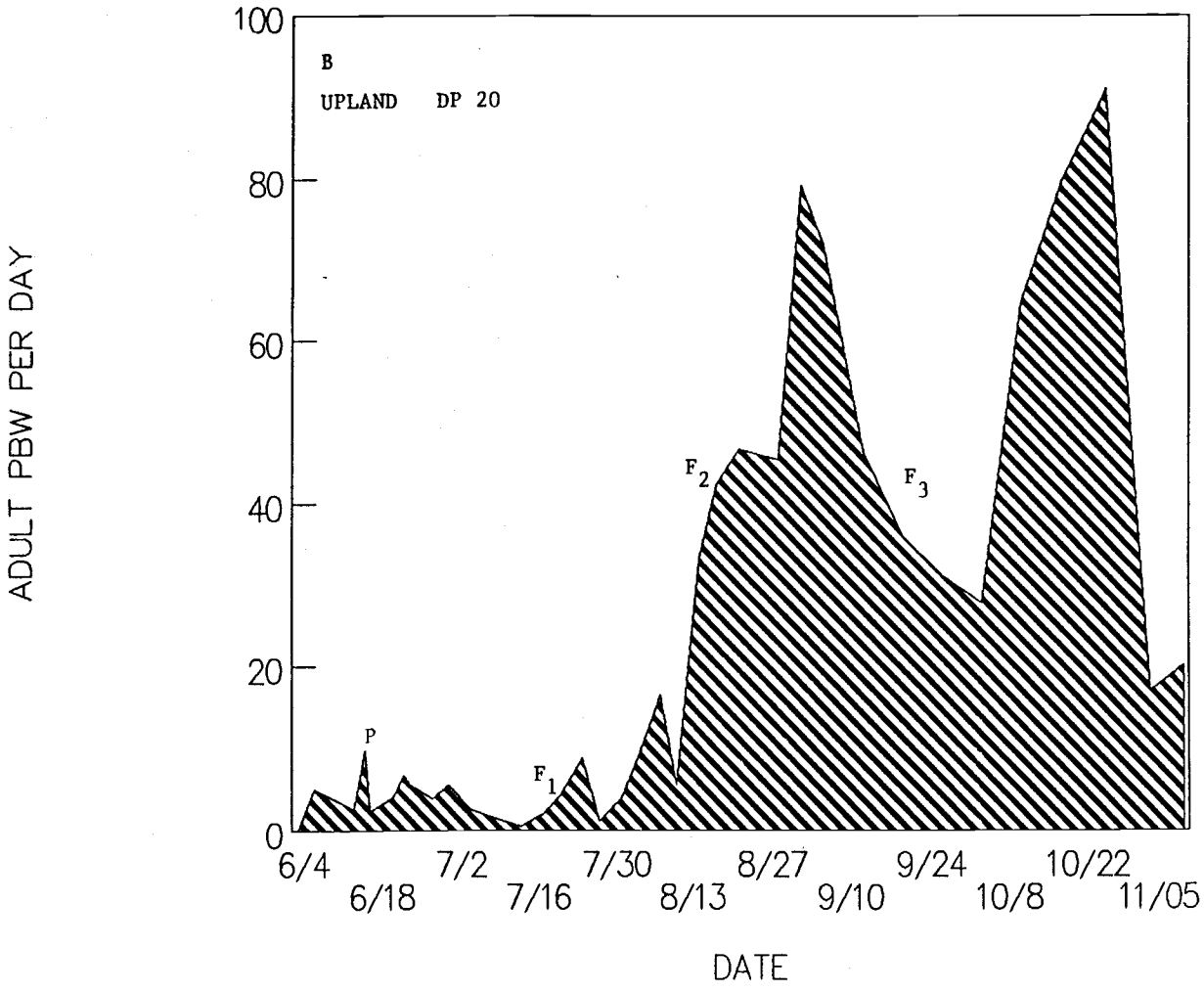

A
PIMA S - 6
P
F1
F2
F3
90
80
70
60
50
40
30
20
10
0
ADULT PBW PER DAY
6/4
6/18
7/2
7/16
7/30
8/13
8/27
9/10
9/24
10/8
10/22
11/05
DATE

Fig. 1B


B
UPLAND DP 20
100
80
60
40
20
0
ADULT PBW PER DAY
P
F1
F2
F3
6/4
6/18
7/2
7/16
7/30
8/13
8/27
9/10
9/24
10/8
10/22
11/05
DATE