FRUITING DISTRIBUTION PATTERNS AMONG THREE COTTON VARIETIES UNDER IRRIGATED CONDITIONS

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Abstract

A field experiment was conducted at the UA Maricopa Agricultural Center (MAC) to determine the fruiting distribution patterns of two commonly grown Upland varieties, DP 33b and DP 5415, and one American Pima variety, Pima S-7. Results indicate that cotton plants (*G. hirsutum* L. and *G. barbadense* L.) produce total yield at fruiting branches one through 18, with the majority of yield occurring at fruiting branches one through 12. Among these fruiting branches, the majority of yield is occurring at fruiting positions one and two. These results indicate that the bulk of the yield is produced early in the season and declining as the season progresses, in general with the highest yields occurring at fruiting branch one and then declining at subsequent fruiting branches.

Introduction

Information concerning the fruiting distribution patterns for commonly used cotton (*Gossypium spp.*) cultivars in the southwestern United States is limited. The fruiting distribution patterns of these cultivars will aid in understanding where the majority of the yield is being produced on the cotton plant. This information can be particularly useful in the development and application of a cotton monitoring program employing some form of plant mapping. This can help growers time irrigations and fertilizer applications when they are needed most by the crop.

The first sympodial (fruiting) branch usually occurs at node five to seven (Jenkins et al., 1990). A cotton plant will usually produce 16 to 18 sympodial branches with two to five lateral fruiting positions on each branch (Jenkins et al., 1990). Of the total possible fruiting sites, usually only a small fraction of them will eventually mature and be harvested. A cotton plant will also produce one or two monopodial (vegetative) branches that have the potential of bearing fruit.

In general, cotton plants will mature bolls on position one more often than they will on positions two, three and four. It has been shown that 76% of the total yield occurs at position one on sympodial branches, 18 to 21% of the yield occurs at position two, and two to four percent of the yield is produced from all other fruiting positions on the sympodial branches (Jenkins et al., 1990). Kerby and Buxton (1981) reported that 76% of the bolls retained were on the first position of sympodial branches, and that six to eight percent of the bolls retained came from fruiting sites other than positions one and two on sympodial branches (Kerby and Buxton (1981)). Monopodial branches were found to produce three to nine percent of the total yield for Delta type varieties (Jenkins et al., 1990). Jenkins et al., (1990) found that bolls at position one will be larger than those at positions two, three and four. They found that sympodial branches at nodes nine through 14 produce the bulk of the lint in the modern cotton. Kerby and Buxton (1981) found that only a small percentage of mature bolls occur on nodes higher than node 16 on Acala cotton varieties in the San Joaquin Valley of California.

The objective of this study was to determine the fruiting distribution patterns of two commonly used Upland (*G. hirsutum L.*) varieties, DPL 5415 and DPL 33b, and one American Pima (*G. barbadense L.*) variety, Pima S-7, under conventional irrigated management practices in Arizona.

Methods and Materials

This study was conducted in 1996 on two sites at the Maricopa Agricultural Center. The first site was planted with DPL 5415 and Pima S-7 on 21 March 1996 on a Casa Grande sandy loam. The experimental design was a split plot within a randomized complete block with three replications. The second site was planted with DPL 33b on 10 April 1996 on a Trix sandy clay loam. The experimental design consisted of a randomized complete block with four replications. Each plot consisted of eight, 40 in rows that extended the entire length of the irrigation run (600 ft). All inputs such as water, fertilizer, and pest control were managed in an optimal fashion. Plant populations within each plot consisted of approximately 40,000 plants/acre.

After the field was defoliated, a 3.07 m section in one row of each plot was marked. Plants in the marked section were collected, counted, and removed. Bolls were removed and separated by each fruiting site on each sympodial branch. The bolls harvested at each fruiting branch by positions one through four were recorded with the cotyledonary node counted as zero. The weight of the bolls from each fruiting branch by position was determined using an electronic balance. The number of bolls and the mass of cotton produced at each fruiting site were then determined. All cotton on the monopodial branches was harvested as one position. The numbers of bolls per sample were also recorded.

Results and Discussion

Fruiting distribution patterns among varieties do tend to vary from variety to variety. Although there are differences among varieties, one can see that there is a distinct fruiting pattern that all varieties follow (Figures 1 and 2). The first

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fruiting branch for the Upland varieties occurred at node seven in this study and node nine for the Pima variety. When averaging the total number of fruiting branches, DP 5415 and DP 33b produced 18 and 17 fruiting branches, respectively. The Pima variety produced an average of 16 fruiting branches.

Based upon the means of seedcotton weight from all fruiting branches, the analysis of variance showed no significant differences among varieties with respect to sympodial branches, due in part to a large degree of variation experienced. Although, when sympodial branches were pooled together into zones consisting of six nodes per zone, there were significant differences among the varieties with respect to vertical fruiting patterns (Figure 3). Zone 0, consisting of all monopodial branches, showed no significant differences among varieties. Zone 1, consisting of sympodial branches one through six, showed a significant difference between DP 33b and Pima S-7 (Observed Significance Level, OSL=0.0439) with Pima S-7 producing a significantly higher yield at Zone 1. Zone 2, consisting of sympodial branches seven through 12, also indicated a significant difference among the varieties DP 33b and Pima S-7 (OSL=0.0105), again with Pima S-7 producing a significantly higher yield in Zone 2. Zone 3, consisting of nodes 12 through 18, showed no significant differences among varieties (Figure 3)(Table 1).

When comparing the transgenic variety, DP 33b, with its non-transgenic parent, DP 5415, regarding yield production at the four fruiting zones, analysis of variance show that there is no significant differences between the two varieties ($P<0.05$)(Figure 4). When comparing fruiting branches within the Upland varieties, there were again significant differences among fruiting branches within each variety (Figures 5 and 6). When comparing Pima S-7 with the Upland species, analysis of variance indicated that there are no significant differences in yield at Zones 0, 2, and 3. Although, there was a significant difference in yield production at Zone 1 (OSL=0.0125), with the Upland varieties producing higher yields (Figure 7). When comparing fruiting branches within the Pima variety, there are significant differences in yield among fruiting branches (Figure 8).

When comparing horizontal fruiting patterns (yield × position) the analysis of variance revealed a significant difference with respect to yield by fruiting positions among varieties (OSL=0.0001)(Figure 2)(Table 2). At position 1 there was a significant difference in yield produced among the three varieties. Both DP 33b and DP 5415 produced significantly higher yields at position 1 than Pima S-7. At position 2 there was again a significant difference among the three varieties (OSL=0.0007). DP 33b produced significantly higher yields at position 2 than either DP 5415 or Pima S-7. DP 5415 and Pima S-7 showed no significant differences in yield at position 2. At position 3, Pima S-7 produced significantly higher yields than DP 5415. DP 33b did not produce yields significantly different than either DP 5415 or Pima S-7 at position 3. There were no significant differences among varieties with respect to yield at position 4 ($P<0.05$). Results for percent total yield by position were similar to those proposed by Jenkins et al., (1990) and Buxton and Kerby (1981)(Table 2). Analysis of variance also indicate differences with respect to yield by position within each variety (Figures 9-11).

When comparing the transgenic variety, DP 33b, with its non-transgenic parent, DP 5415, with respect to yield production at each fruiting position, analysis of variance indicated no significant differences in yield at positions 1, 3, and 4 ($P<0.05$). DP 33b produced significantly higher yields at position 2 than DP 5415 (OSL=0.0015)(Figure 12). When comparing the Upland species with Pima S-7 with regard to yield by fruiting position, there were no significant differences in yield among the two species at fruiting positions 2, 3, and 4 ($P<0.05$). The Upland species produced significantly higher yields at position 1 compared to Pima S-7 (OSL= 0.0023)(Figure 13).

In conclusion, cotton plants from this study produce total yield at fruiting branches one through 18, with the majority of yield occurring at fruiting branches 1-12, or Zones 0-2. Among these fruiting branches, the majority of the yield is occurring at fruiting positions one and two. These results indicate that the majority of yield in cotton is occurring early in the season and declining as the season progresses, in general with the highest yields occurring at fruiting branch one and then declining at subsequent fruiting branches. These observations further further the importance of proper early management in cotton production if one is to obtain maximum yields efficiently.

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Table 1. Differences in % yield by fruiting zone among varieties, MAC.

	% Total Yield			
	Fruiting Zone			
Variety	**0**	**1**	**2**	**3**
DP 33b	57	26	14	3
DP 5415	32	41	21	6
Pima S-7	22.5	43	28	6.5

Table 2. Differences in % yield by fruiting position among varieties, MAC.

	% Total Yield			
	Fruiting Position			
Variety	**1**	**2**	**3**	**4**
DP 33b	58	29	9	4
DP 5415	65	21	9	5
Pima S-7	48	30	15	7

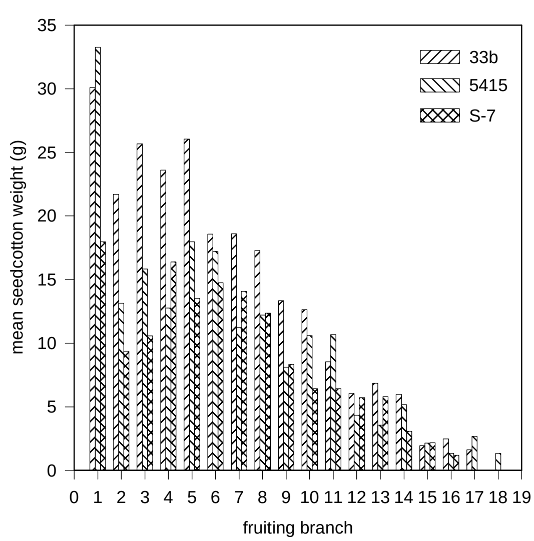
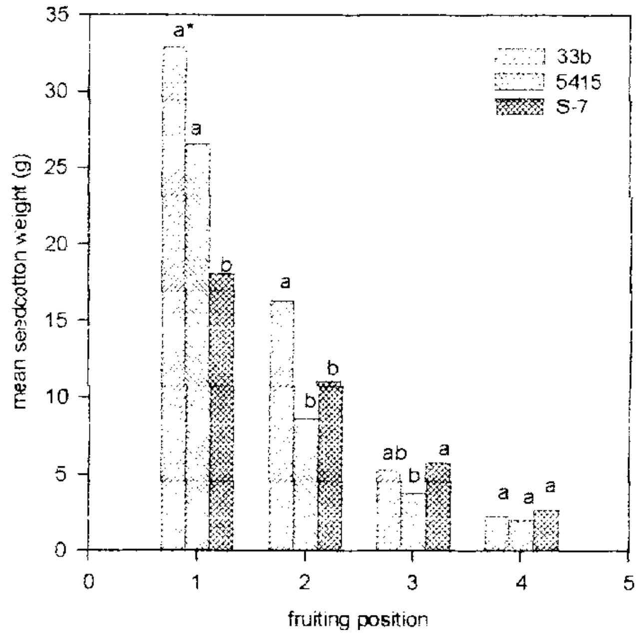
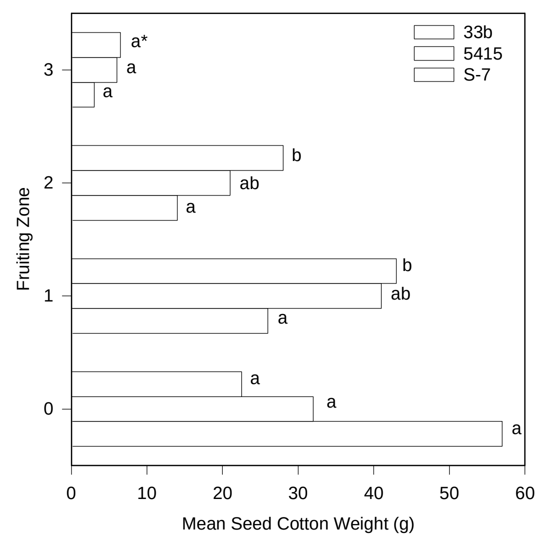


Figure 1. Yield comparison of fruiting branches among varieties.



*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 2. Yield comparison of fruiting positions among varieties.



*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 3. Comparison of yield produced at each fruiting zone among varieties.

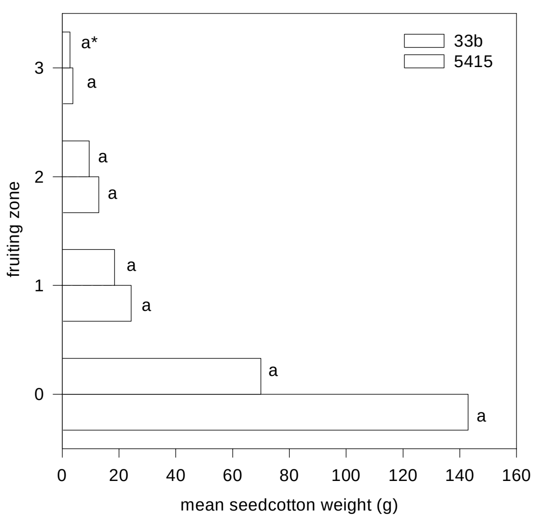


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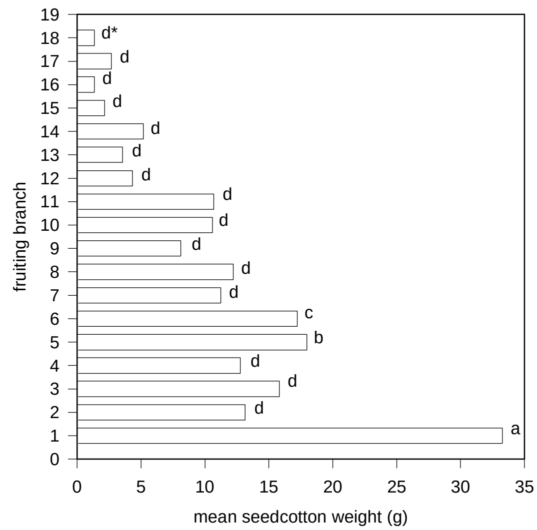
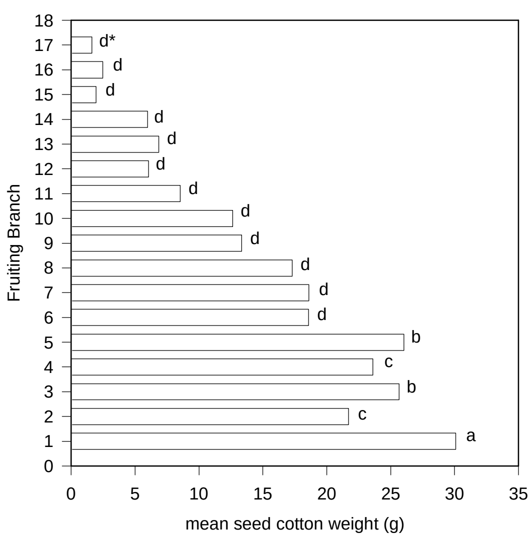
Figure 4. Comparison of yield production by fruiting zone between DP 33b and DP 5415.



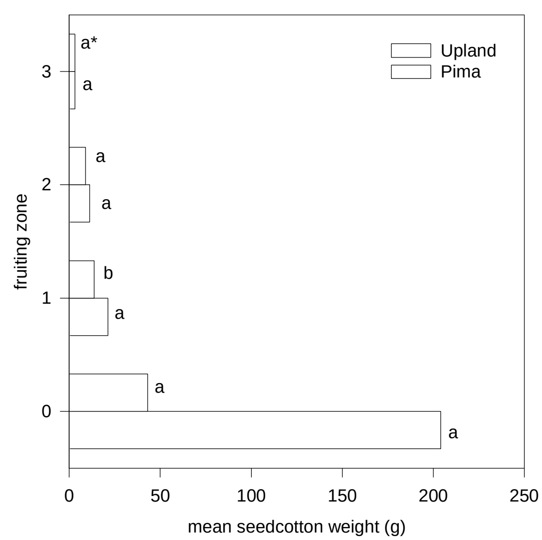
*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 6. Comparison of fruiting branches within the variety DP 5415.



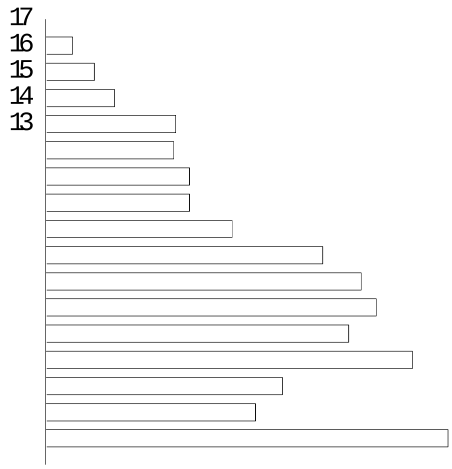
*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 5. Comparison of fruiting branches within the variety DP 33b.



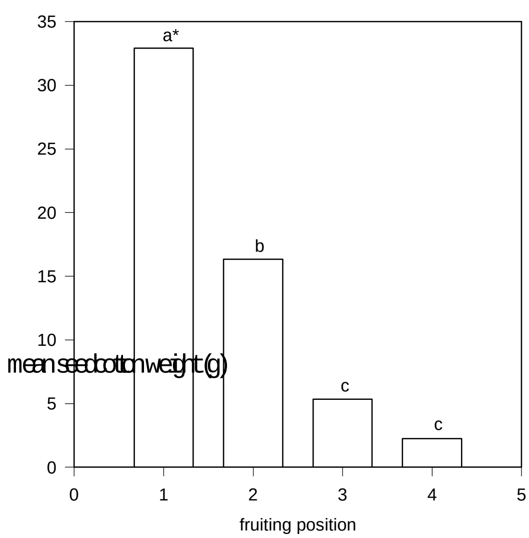
*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 7. Comparison of yield production by fruiting zone among Upland and Pima species.



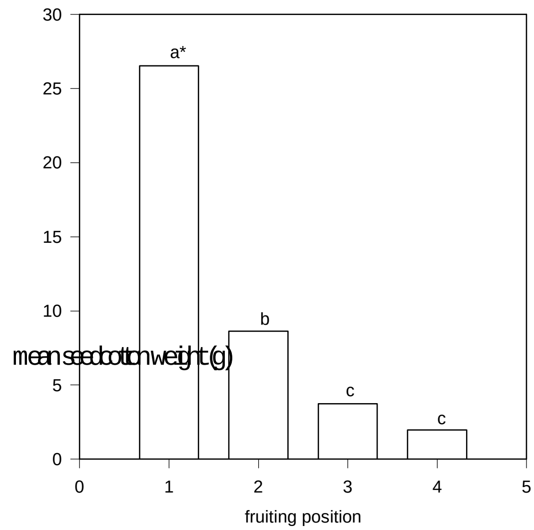
*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 8. Comparison of fruiting branches within the variety Pima S-7.



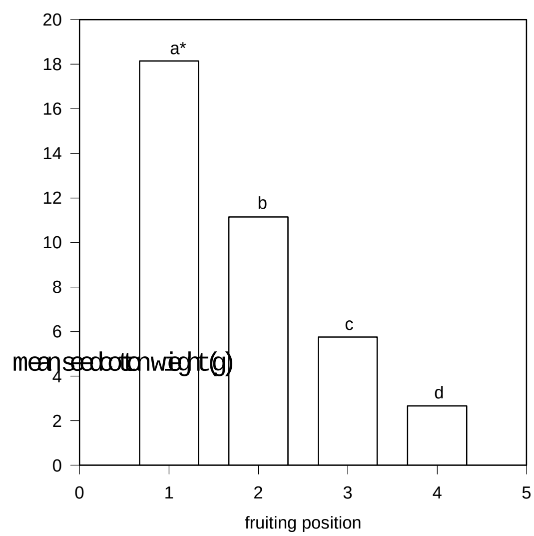
*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 9. Yield comparison of fruiting positions within the variety DP 33b.



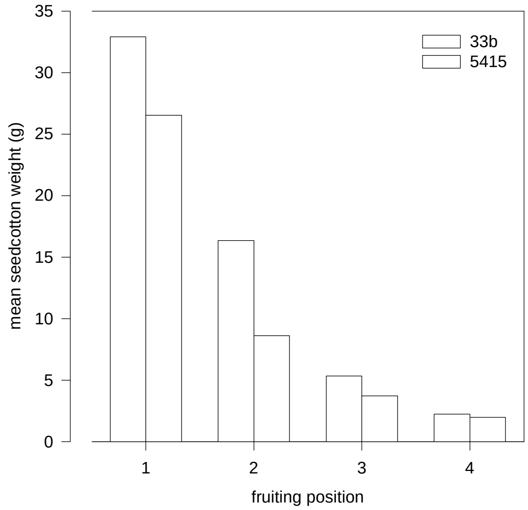
*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

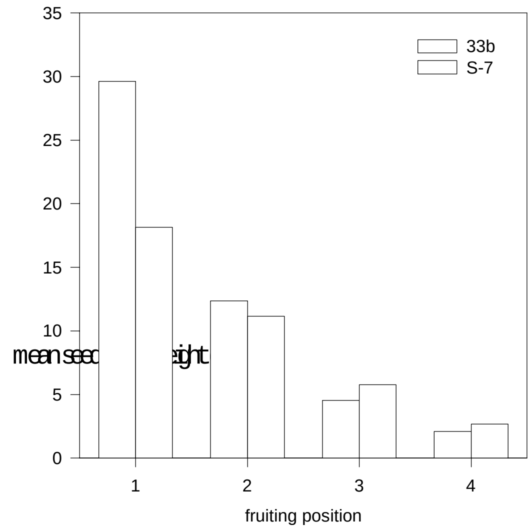
Figure 10. Yield comparison of fruiting positions within the variety DP 5415.



*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 11. Yield comparison of fruiting positions within the variety Pima S-7.





*Means followed by the same letter are not significantly different (P<0.05) according to Duncan's means separation.

Figure 12. Yield comparison of fruiting positions between Upland varieties.

*Means followed by the same letters are not significantly different (P<0.05) according to Duncan's means separation.

Figure 13. Yield comparison of fruiting positions between Upland and Pima species.