

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 cultivars, DP 33b and DP 5415, and one American Pima cultivar, 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 fruiting branches one through 12, 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 declines as the season progresses.*

Introduction

Information concerning the fruiting distribution patterns for commonly used cotton (*Gossypium* spp.) cultivars in the southwestern United States is limited. Understanding the fruiting distribution patterns of these cultivars can potentially impact crop management. This information can be particularly useful in the development and application of a cotton monitoring program employing some form of plant mapping. This can also help determine when irrigations and fertilizer applications are needed most by the crop.

The first sympodial (fruiting) branch usually occurs at node five to seven. 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 with several cotton cultivars grown in the Mississippi Delta 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. Monopodial branches were found to produce three to nine percent of the total yield for Delta type cultivars (Jenkins et al., 1990). Jenkins et al., (1990) also 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 cultivars they evaluated. Kerby and Buxton (1981) found that only a small percentage of mature bolls occur on nodes higher than node 16 on Acala cotton cultivars common to the San Juaquin Valley of California.

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

Methods

This study was conducted in 1996 on two sites at the Maricopa Agricultural Center (MAC). The first site (site 1) was planted with DP 5415 and Pima S-7 on 21 March 1996 on a Casa Grande sandy loam. The experimental design was a randomized complete block with three replications. The second site (site 2) was planted with DP 33b on 10 April 1996 on a Trix sandy clay loam. The experimental design was a

randomized complete block with four replications. Plots consisted of eight, 40 in rows that extended the entire length of the irrigation run (600 ft) for both sites. 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. Plots were managed for complete first fruiting cycle development. Final irrigations were applied on 17 August 1996, and 19 August 1996 for sites one and two, respectively.

After the field was defoliated, a 3.07 m section in one row of each plot was marked. Plants in the marked section were counted, and removed. Seedcotton was removed and separated by each fruiting site on each sympodial branch. The bolls harvested on each fruiting branch by positions one through four were recorded with the cotyledonary node counted as zero. The weight of the seedcotton 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 total numbers of bolls per sample within the 3.02m section were also recorded. Data was analyzed in accordance to procedures outlined by Steele and Torrie (1980) and the SAS Institute (1988).

Results

Fruiting distribution patterns among cultivars were found to vary among the three cultivars analyzed. However, there are differences among cultivars as a distinct fruiting pattern among the cultivars was evident (Figures 1 and 2). The average first fruiting branch for the Upland cultivars occurred at node seven in this study and node nine for the Pima cultivar. When averaging the total number of fruiting branches, DP 5415 and DP 33b produced 18 and 17 fruiting branches, respectively. The Pima cultivar 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 cultivars 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 cultivars with respect to vertical fruiting patterns (Figure 3). Zone 0, consisting of all monopodial branches, showed no significant differences among cultivars. 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 revealed a significant difference among the cultivars 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 cultivars (Figure 3).

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

When comparing lateral fruiting patterns (yield \times position)(Figure 2 and Table 2) the analysis of variance revealed a significant difference with respect to yield by fruiting positions among cultivars (OSL=0.0001). At position 1 there was a significant difference in yield produced among the three cultivars. 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 cultivars (OSL=0.0007), with DP 33b producing 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. There were no significant differences among cultivars with respect to yield at position 4 ($P < 0.05$). Results for percent total yield by position (Tables 1 and 2) were similar to those

proposed by Jenkins et al., (1990) and Buxton and Kerby (1981). Analysis of variance also revealed differences with respect to yield by position within each cultivar (Figures 9-11).

When comparing the transgenic cultivar 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 among positions 1, 3, and 4 ($P < 0.05$). DP 33b produced significantly higher yields ($OSL = 0.0015$) at position 2 than DP 5415 (Figure 12). When comparing the two Upland cultivars with Pima S-7 with regard to yield by fruiting position, there were no significant differences in yield between the two species at fruiting positions 2, 3, and 4 ($P < 0.05$). However, the Upland cultivars produced significantly higher yields ($OSL = 0.0023$) at position 1 compared to Pima S-7 (Figure 13).

Summary

Cotton plants from this study produced total yields 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 was found at fruiting positions one and two. These results indicate that the majority of the yield potential in cotton cultivars occurs early in the season and declines as the season progresses. In general, the highest yields occurred at fruiting branch one and then declined with subsequent (higher) fruiting branches. These observations reinforce the importance of early season management for optimum cotton production.

References

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Table 1. Percent yield mean by fruiting zone among cultivars, Maricopa, Az, 1996.

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

Table 2. Percent yield mean by fruiting position among cultivars. Maricopa, Az, 1996.

<u>Cultivar</u>	<u>% Total Yield</u>			
	<u>Fruiting Position</u>			
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
DP 33b	58	29	9	4
DP 5415	65	21	9	5
Pima S-7	48	30	15	7

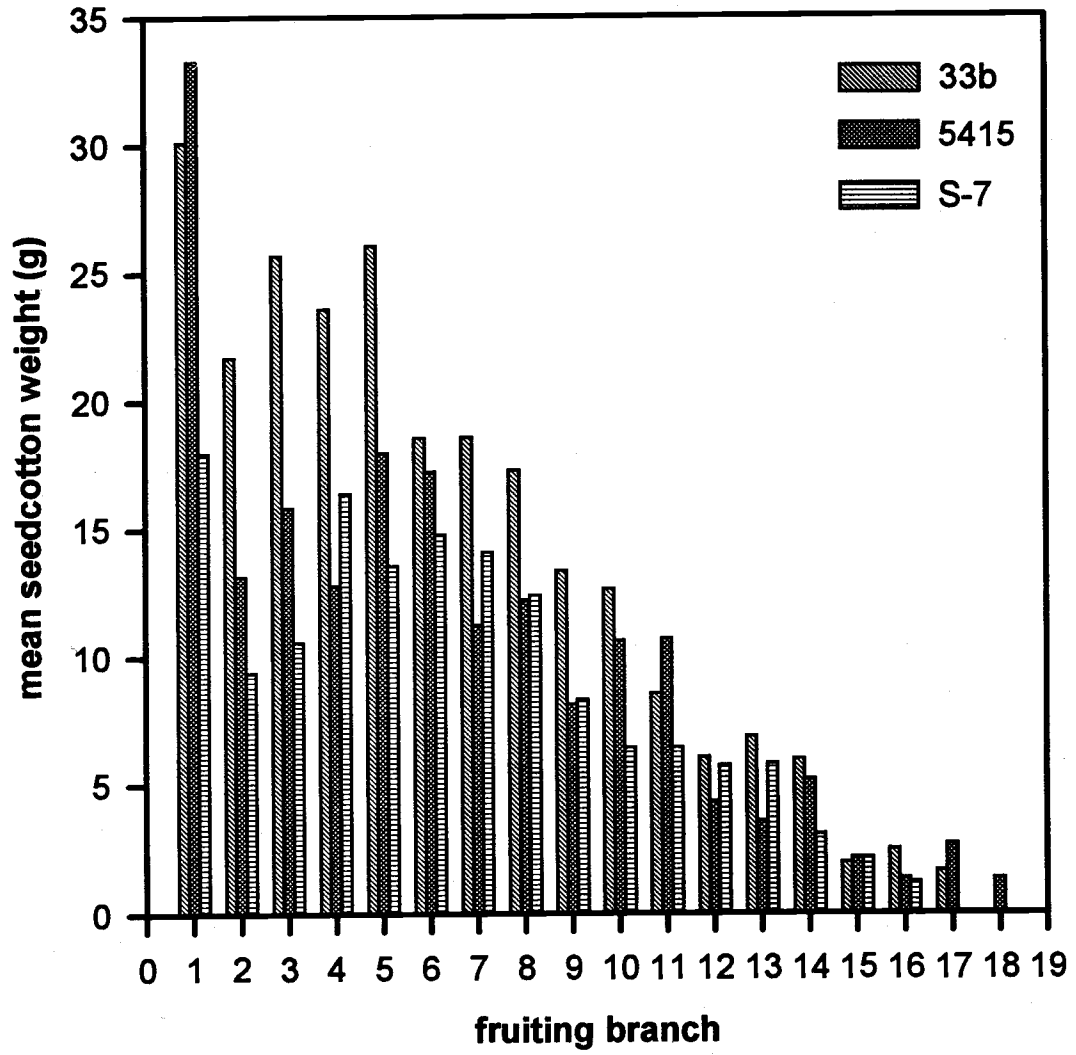


Figure 1. Yield comparison by fruiting branches among three cultivars.

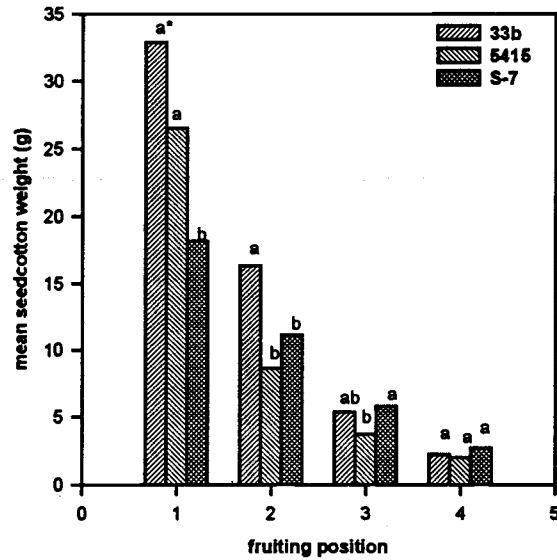


Figure 2. Yield comparison by fruiting positions among cultivars.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

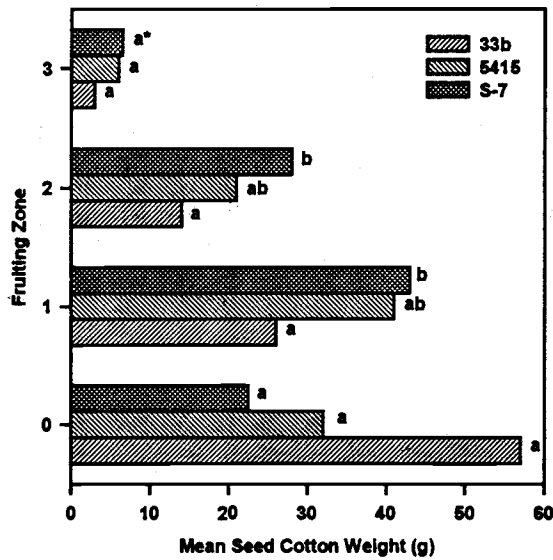


Figure 3. Comparison of yield produced by each fruiting zone among cultivars.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

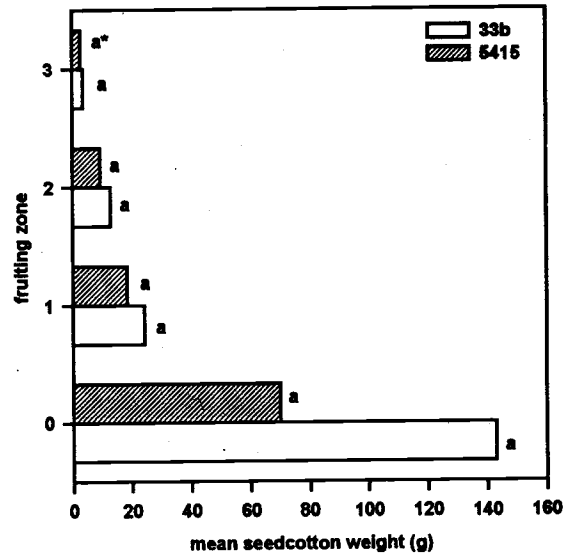


Figure 4. Comparison of yield production by fruiting zone between DP 33b and DP 5415. *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

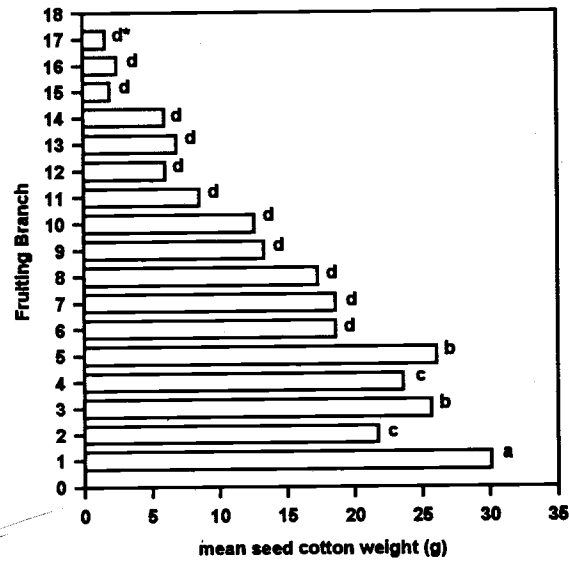


Figure 5. Comparison of yield among fruiting branches for DP 33b. *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

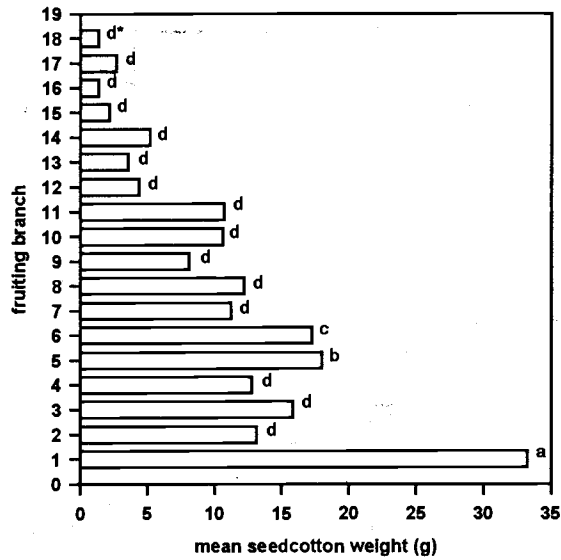


Figure 6. Comparison of yield among fruiting branches for DP 5415.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

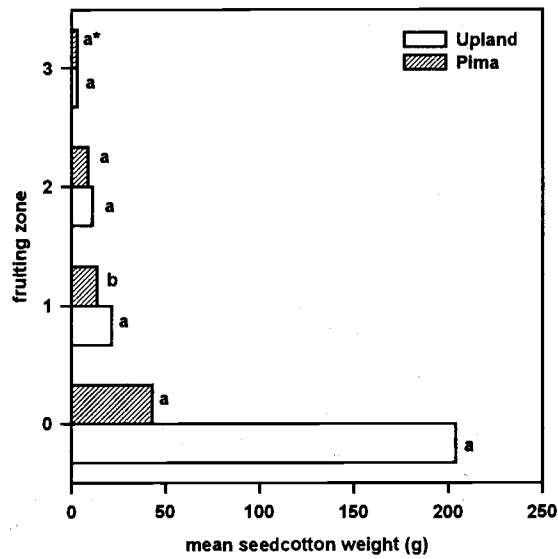


Figure 7. Comparison of yield production by fruiting zone between Upland and Pima.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

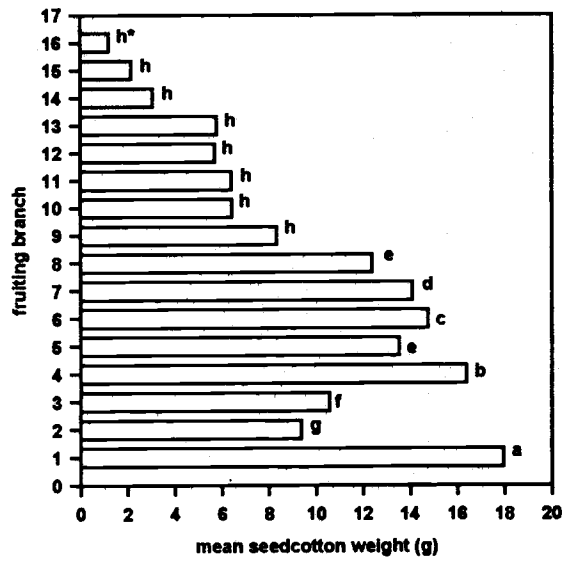


Figure 8. Comparison of yield among fruiting branches for Pima S-7.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

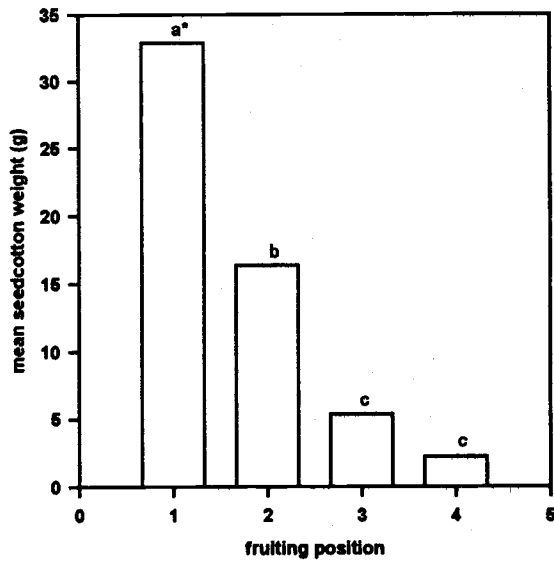


Figure 9. Yield comparison among fruiting positions for DP 33b.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

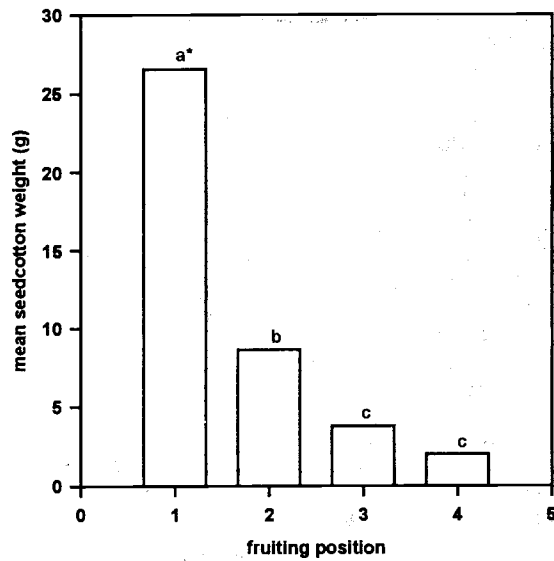


Figure 10. Yield comparison of fruiting positions for DP 5415.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

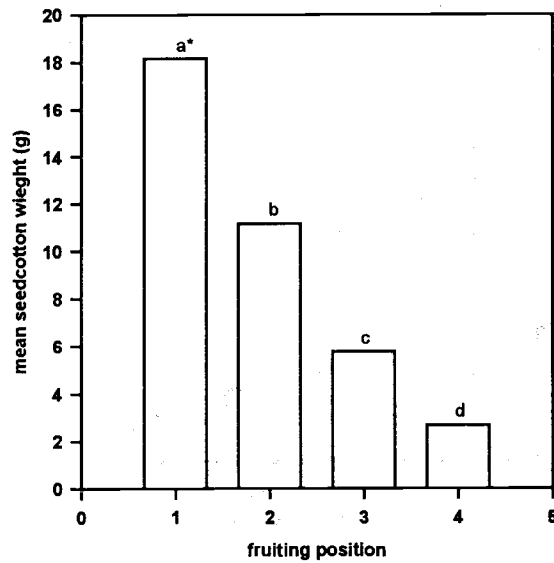


Figure 11. Yield comparison of fruiting positions for Pima S-7.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

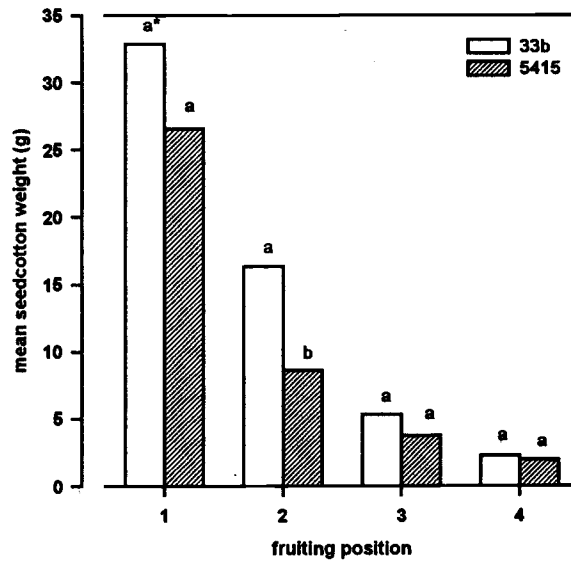


Figure 12. Yield comparison of fruiting positions between Upland varieties.
 *Means followed by the same letter are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.

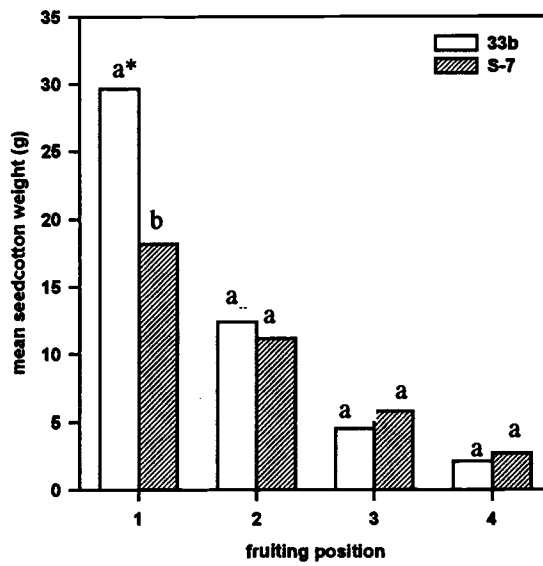


Figure 13. Yield comparison of fruiting positions between Upland and Pima.
 *Means followed by the same letters are not significantly different ($P < 0.05$) according to a Duncan's means separation procedure.