What Causes Cutout in Cotton?

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Summary

A test was conducted to investigate possible involvement of abscisic acid (ABA) in cutout (cessation of growth and flowering). Neither a higher boll load on control than partially defruited plants nor an increasing boll load during the season was associated with a higher concentration of ABA in primary leaves. The ABA content of bolls of control plants was slightly higher than that of partially defruited plants when plants were stressed, but this difference may have been due to a difference in the amount of stress in control and defruited plants. The results indicate that bolls are not a source of ABA for primary leaves and that ABA is not likely a major factor in causing cutout. However, analyses of growing points are needed for a more definitive conclusion.

Cutout is the term given to the temporary cessation of growth and flowering. It is a gradual, not a sudden, event and is characterized by a gradual slowing of growth, a longer interval between successive nodes and, therefore, a decrease in the rate of blooming, and a gradual increase in the rate of boll shedding. The causes of cutout have not been determined, although it is known that nitrogen, water, boll load, variety, soil type, and temperature all affect cutout to some extent. Many plant processes are under hormonal control. Abscisic acid (ABA) promotes dormancy in some plants, inhibits growth, and may increase boll shedding. Therefore, it seemed to us to be a hormone that may regulate cutout.

Boll shedding can be decreased and cutout delayed by partially defruiting cotton plants. Therefore, we removed all the white blooms from six plots 4 days each week. In addition, young bolls were removed 1 day each week. No blooms were removed from the controls. We determined the ABA content of 4-day-old bolls and primary leaves (at the 4th to 5th node below the apex) during June, July, and August to see if ABA increased with boll load or whether the control plants contained more than the partially defruited plants.

Partial defruiting decreased the boll load (Fig. 1) and decreased the rate of boll shedding (Fig. 2). Because ABA was first isolated from the carpel walls of cotton bolls, some think that bolls are a source of ABA in cotton. If this is the case, control plants should contain more ABA than partially defruited plants becuase they carry more bolls, and the ABA content should increase as the boll load increases during the season. We did not find this to be the case.

At no time did we find more ABA in leaves of control than in leaves of partially defruited plants (Table 1). In fact, the defruited plants usually contained a little more ABA in their leaves than the control plants. Likewise, there was no increase in ABA content of leaves with increasing boll load during the season. The ABA content of leaves apparently changed with irrigation, but appeared to reach a minimum in late July and early August (Table 1) when boll load was near the maximum (Fig. 1). Therefore, a higher boll load apparently decreased, rather than increased, the ABA content of leaves.

Bolls of normally fruited (control) plants sometimes contained a higher concentration of ABA than those of partially defruited plants (Table 2), but not always. ABA content of bolls increased as stress developed between irrigations, and the largest difference between control and defruited treatments occurred during these stress periods. It is possible that partially defruited plants developed a more extensive root system than the controls and, therefore, were not as stressed for water.

A significant correlation between ABA content and abscission (shedding) rate of bolls was found in the control, but not in the partially defruited, plants. ABA content of bolls varied with irrigation, but there did not appear to be a marked increase with increasing boll load or a large consistent difference between control and partially defruited plants.

Our results indicate that bolls are not a source of ABA for primary leaves and that ABA is not likely to be a major factor in causing cutout. Analyses of ABA and other hormones in growing points will have to be made before a definite conclusion is justified, however.

Table 1. Abscisic acid content in leaves of control and partially defruited plants during the fruiting season.

Date	Control	Defruited	Irrigation dates
	ug ABA/g	ug ABA/g	
11 June	1.02±.05	1.41±.25	11 June
18 June	0.96±.05	0.94±.07	
			24 June
25 June	0.61±.03	0.69±.05	
2 July	1.05±.18	1.20±.18	
			8 July
9 July	0.29±.02	0.35±.06	
			15 July
16 July	0.79±.02	0.89±.09	
23 July	0.54±.03	0.61±.07	
			29 July
30 July	0.11±.02	0.14±.03	
6 August	0.41±.04	0.54±.05	
			12 August
13 August	0.12±.01	0.20±.05	
20 August	0.30±.02	0.33±.06	
Average	0.56	0.66	

Table 2. ABA content of 4-day-old bolls and percentage boll abscission as influenced by partial defruiting and irrigation during the season.[a]

Dates of anthesis	Control		Defruited		Correlation coefficient
	ABA	Abscission	ABA	Abscission	
	ug/g	%	ug/g	%	r
26, 27 June	2.10±.17	20±10	1.91±.06	13±4	0.25
3, 4 July	2.94±.14	45±6	2.39±.08	16±4	0.47
Irrigated 8 July					
10, 11 July	1.99±.11	38±5	2.08±.17	20±6	0.03
Irrigated 15 July					
17, 18 July	2.67±.17	62±10	1.79±.06	36±4	0.32
24, 25 July	4.18±.27	87±6	3.15±.26	43±5	0.68
Irrigated 29 July					
31 July, 1 Aug.	2.50±.27	70±9	2.66±.31	62±8	0.02
7 Aug.[b]	---	96±4	---	84±4	---
Irrigated 12 Aug.					
14, 15 Aug.	1.24±.09	18[c]	1.58±.14	24±3	---
24 Aug.	4.04±.27	---	2.78±.33	---	---
Correlation for the season	$r=0.63^{**}$,	n=37	r=0.35 ,	n=41	
Combined		$r=0.57^{**}$,	n=78		

[a]Data are averages of 6 replications and standard errors of the means are shown.

[b]Too few bolls were harvested to permit ABA analysis.

[c]Bloom counts were pooled for the 6 replicates on 14 August.

Fig. 1

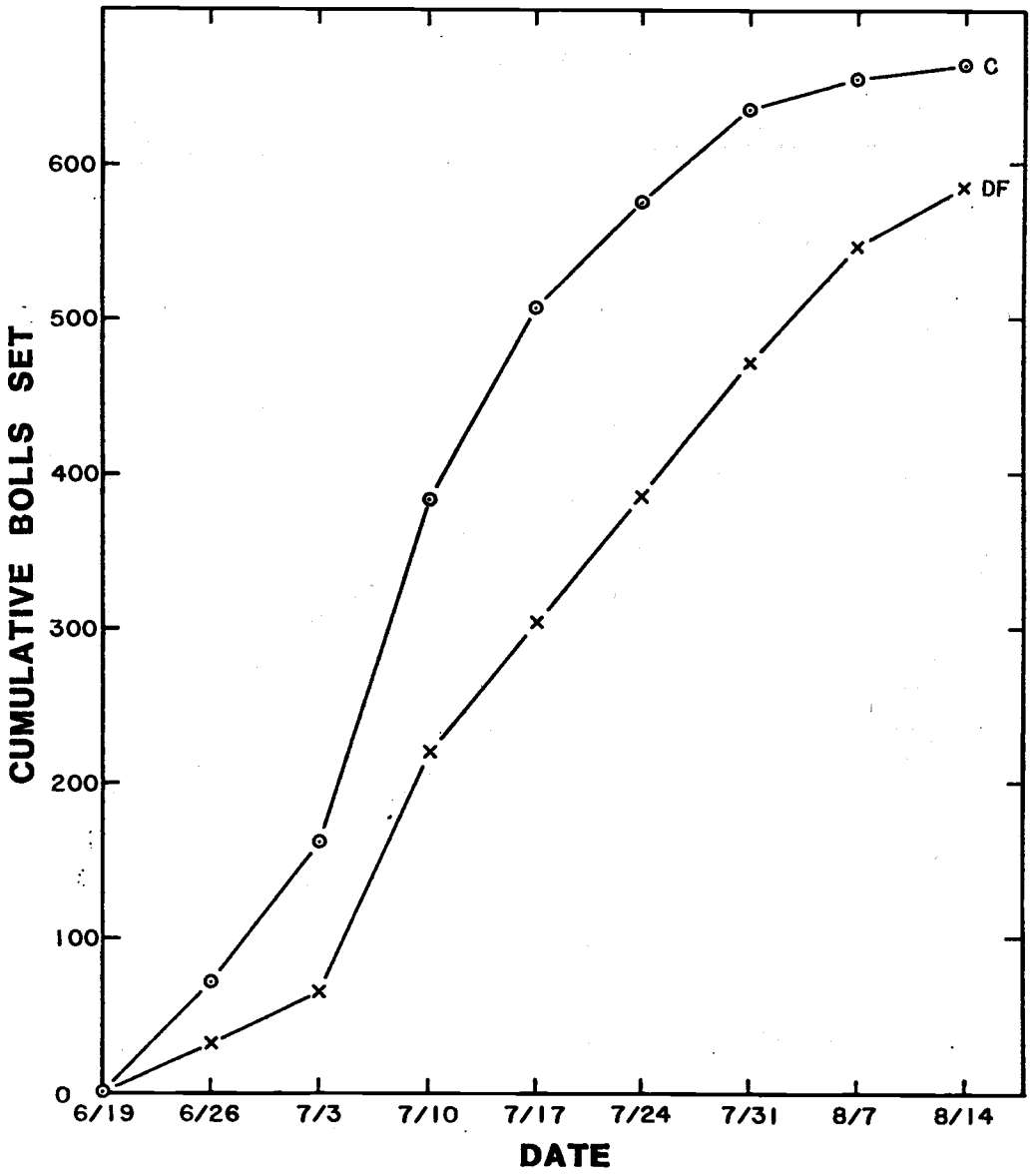

Fig . 1. Influence of partial defruiting on boll loading during the season. C is control and DF is partially defruited.

Fig. 2

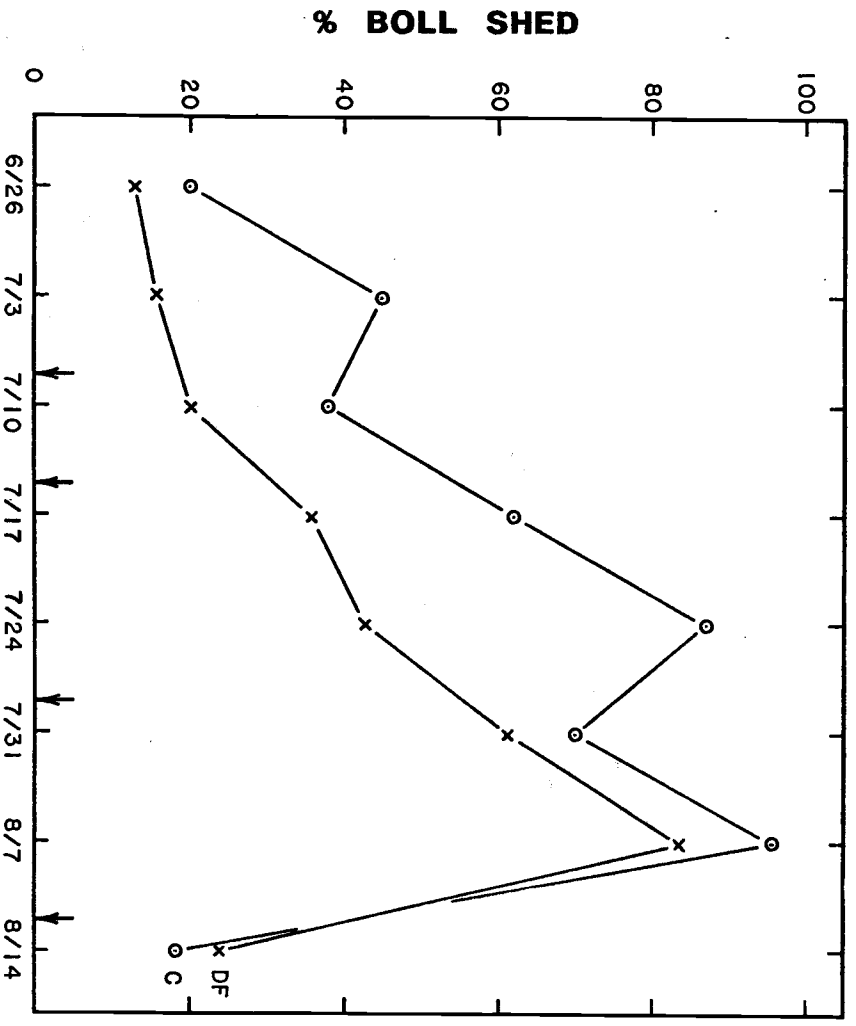

Fig. 2. Boll shedding rates during the season as influenced by partial defruiting.