Possible Changes in Catechin and Condensed Tannin Content of Leaves and Bolls with Irrigation and Boll Load

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Summary

Catechin and tannins may suppress plant diseases and insects. Tests were conducted to see if these compounds are affected by irrigation and boll load. Primary leaves 4 to 5 nodes below the apex and 4-day-old bolls were harvested weekly and analyzed for catechin and condensed tannins. After mid-July the catechin content of leaves increased between irrigations, but the tannin content of leaves showed no consistent response to irrigation. The catechin content of bolls showed no consistent response to irrigation, whereas tannins tended to decrease in bolls as stress developed. Partial defruiting apparently caused some increase in catechin and tannin content of leaves and bolls. However, the concentrations of catechin and tannins did not decrease with increasing boll load during the season. The increases in catechin and tannins with partial defruiting suggest that partial loss of fruit may induce chemical changes in the plant that contribute to insect and disease resistance.

Some evidence has accumulated here and elsewhere that water deficit decreases insect numbers. This could be due to a number of factors including temperature, humidity, plant succulence, and chemical composition of plants. Other workers have reported that fruit load affects susceptibility of cotton to verticillium wilt; a light boll load is associated with lowerer susceptibility. Many polyphenolic compounds, including catechins and tannins, complex with and inactivate enzymes and may have fungistatic and insecticidal properties. It is possible that water status and/or boll load affects the concentration of such chemicals in plants. Therefore, we conducted a test during the summer of 1980 to determine possible effects of irrigation and boll load on the concentrations of catechin and condensed tannins in primary leaves about 4 to 5 nodes below the apex and in 4-day-old bolls.

Blooms were removed from the partially defruited plots four days each week and were tagged one day each week so that bolls could be removed for analysis when they were 4 days old.

After mid-July the catechin content of leaves increased between irrigations, but showed no consistent trend in bolls (Table 1). Also, partial defruiting apparently caused a modest increase in catechin content of leaves and, to a lesser extent, bolls. However, catechin content of leaves did not decrease as boll load increased during the season; instead it increased, especially early in the season and in the partially defruited treatment. Thus, the indications are conflicting; an increasing boll load during the progress of the season coincided with increasing amounts of catechin in leaves, whereas the higher boll load in control (compared with partially defruited) plants coincided with less catechin in leaves.

The tannin content of leaves showed no consistent response to irrigation, but tended to decrease in bolls between irrigations (Table 2). If these changes are real they are in the wrong direction to account for any increase in resistance to insects or fungi with water deficit. Both the leaves and bolls of normally fruited control plants usually contained somewhat less tannin than those of the partially defruited plants (Table 2), thus indicating that a heavier boll load may have depressed tannin content. However, there were no consistent decreases in tannin content with increasing boll load during the season.

The results fail to support the notion that water deficit stimulates the accumulation of catechin or tannin in bolls, although there was some evidence of an increase in catechin content of leaves. The defruiting test indicated a negative effect of fruit load on catechin and tannin content of leaves and bolls, but changes during the season did not. Although the differences associated with defruiting were relatively small, it is possible that the increased levels of catechin and tannin could affect fungi (e.g., Verticillium dahlia) and/or insects. If so, such resistance could be a defense mechanism in cotton. That is, a partial loss of fruit caused by insects could induce some resistance.

Table 1. Catechin content of leaves and 4-day-old bolls as influenced by partial defruiting, irrigation, and time of season.*

Date	Leaves		Bolls	
	Control	Defruited	Control	Defruited
	mg/g	mg/g	mg/g	mg/g
4 June	2.04±.19	2.29±.37		
11 June	1.95±.07	1.96±.08		
Irrigated 11 June				
18 June	5.87±.38	6.15±.44		
24 June			32.5±1.8	34.1±1.7
Irrigated 24 June				
25 June	4.51±.11	4.74±.25		
1 July			37.1±0.8	38.5±2.1
2 July	4.62±.25	5.01±.29		
8 July			32.1±1.4	33.9±1.0
Irrigated 8 July				
9 July	5.24±.44	6.50±.24		
15 July			25.5±1.7	32.0±1.0
Irrigated 15 July				
16 July	4.08±.27	6.40±.50		
22 July			20.8±1.2	26.2±0.5
23 July	6.06±.25	9.15±.58		
29 July			28.6±0.6	30.9±1.6
Irrigated 29 July				
30 July	5.90±.47	8.20±.29		
5 Aug.			23.1±2.1	29.3±1.8
6 Aug.	6.70±.67	9.40±.32		
12 Aug.			20.6±4.6	25.4±1.7
Irrigated 12 Aug.				
13 Aug.	4.80±.35	8.00±.81		
19 Aug.			41.1±1.0	46.1±2.9
20 Aug.	6.80±1.1	9.00±1.2		

*Data are averages of 6 replications and standard errors are shown.

Table 2. Condensed tannin content of leaves and 5-day-old bolls as influenced by partial defruiting, irrigation, and time of season.

	Leaves		Bolls	
	Control	Defruited	Control	Defruited
	mg/g	mg/g	mg/g	mg/g
4 June	14.7±0.6	14.7±0.8		
11 June	12.9±0.3	12.3±0.4		
Irrigated 11 June				
18 June	16.5±0.4	17.5±0.6		
24 June			35.8±2.1	31.6±1.9
Irrigated 24 June				
25 June	13.9±0.4	14.7±0.8		
1 July			44.1±0.9	44.3±2.3
2 July	11.1±0.2	12.2±0.4		
8 July			39.2±1.9	43.9±1.3
Irrigated 8 July				
9 July	14.4±1.0	15.8±0.8		
15 July			33.9±2.5	42.9±1.6
Irrigated 15 July				
16 July	15.2±1.1	17.6±1.3		
22 July			40.6±2.2	49.3±2.6
23 July	18.7±0.6	24.2±1.1		
29 July			43.6±2.3	40.4±2.8
Irrigated 29 July				
30 July	16.3±0.9	19.5±0.8		
5 Aug.			42.0±.0.9	49.4±1.8
6 Aug.	16.6±0.5	21.9±1.6		
12 Aug.			23.0±1.1	33.8±0.9
Irrigated 12 Aug.				
13 Aug.	15.2±0.8	17.3±1.2		
19 Aug			31.1±2.4	37.9±1.6
20 Aug.	14.6±1.1	17.5±1.4		