RESOPONSE OF COTTON TO LEAF AND TERMINAL REMOVALS AT VARIOUS GROWTH STAGES

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Rationale and Background

Many natural occurrences have the potential to reduce cotton lint yield by causing physical damage to vegetative and reproductive plant tissues. Mechanical damage to foliage, stems, and terminals from crusting, sandblasting, insect damage, animal feeding, and severe weather events can cause significant damage to stems and foliage at various stages of crop development. More specifically, severe weather events such as hail storms have been observed to cause light to severe damage to many crops including cotton, and the associated crop injury often varies within a given agricultural field or across a farm due to the sporadic nature of the storms. Whether attributed to biotic or abiotic factors, physical damage to terminals has the potential to delay maturity and reduce the yield and/or fiber quality of cotton. Accurate estimation of lint yield loss following a particular stress requires an understanding of the propensity of the cotton plant to recover during the remainder of the growing season. Estimating expected yield loss based on the timing and severity of crop injury is important for the purpose of grower compensation for insurance claims in the event of injury, replanting decisions for producers and consultants, and recommendations from university Extension personnel. Since gaining an understanding of a crop plant's ability to recover from injury is essential for consultants and commodity producers in order to make sound replanting decisions and for accurate estimation of crop loss by insurance providers, the objective of this study was to determine the response of cotton to leaf and terminal removal during various growth stages throughout the growing season.

Materials and Methods

A replicated field trial was conducted at the Pee Dee Research and Education Center located in Florence, South Carolina during the 2013 and 2014 growing seasons. Treatments consisted of 17 different combinations of leaf and terminal removal based on cotton growth stages. PHY 499 WRF plants were either completely defoliated (100% defoliation) or had half their leaves removed (50% defoliation) by hand at the 4-leaf stage, at matchhead square, at early bloom, and at early bloom plus 2 weeks. Terminals were also removed by hand in combination with the defoliation treatments on half the plots during the same growth stages. An untreated check was also included. Plots were arranged in a randomized complete block design with four replications. Plots consisted of 4 rows, spaced 38 inches apart and were 40 feet long. Data collected included boll size, boll numbers, and a final plant map at the end of the season (plant height, number of nodes, total fruiting sites, vegetative branches, boll location on the main stem nodes and on sympodial branches) from one meter of row. At season's end, plots were machine-harvested with a Case 1822 plot picker. Seed cotton was ginned on a 10-saw gin and gin turnout calculated. Data were evaluated by analysis of variance (SAS Institute Inc., Cary, NC).

Table 1. Lint yield, seedcotton, gin turnout, total bolls produced and average boll size of PHY 499WRF in response to removing various amounts of leaves and terminals at different growth stages during the 2013 and 2014 growing seasons at the Pee Dee Research & Education Center in Florence, SC.

Leaf Removal Treatment											
Leaf Removal Growth Stage	Amount of Leaves Removed	Terminal Removed	Lint Yield		Seedcotton		Gin Turnout		Total Bolls		Boll Size	
			2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
			lbs/acre				*%*		*bolls/m²*		*g/boll*	
untreated	0% Removed	no	1483	1583	3319	3508	44.8	45.1		92		4.6
4-leaf	50% Defoliation	no	1402	1784	3155	3938	44.5	45.3		96		4.8
4-leaf	50% Defoliation	yes	1514	1416	3439	3121	44.1	45.4		104		4.3
4-leaf	100% Defoliation	no	1320	1066	2992	2382	44.1	44.8		74		3.9
4-leaf	100% Defoliation	yes	796	770	1866	1720	42.5	44.8		70		3.6
Matchhead Square	50% Defoliation	no	1509	1539	3413	3336	44.2	46.2		78		4.8
Matchhead Square	50% Defoliation	yes	1454	1492	3310	3207	44.0	46.5		84		4.6
Matchhead Square	100% Defoliation	no	1311	842	3035	1848	43.1	45.3		62		4.1
Matchhead Square	100% Defoliation	yes	780	984	1797	2167	43.4	45.2		66		4.1
Early Bloom	50% Defoliation	no	1273	1340	2837	2958	44.9	45.4		88		4.6
Early Bloom	50% Defoliation	yes	1347	1368	3112	2958	43.5	46.3		88		4.2
Early Bloom	100% Defoliation	no	346	769	765	1720	45.1	44.8		50		5.4
Early Bloom	100% Defoliation	yes	624	564	1479	1427	41.5	44.1		56		4.1

Early Bloom + 2 weeks	50% Defoliation	no	1451	1698	3224	3654	45.2	46.5		92		4.8
Early Bloom + 2 weeks	50% Defoliation	yes	1199	1329	2631	2708	45.6	46.3		84		4.6
Early Bloom + 2 weeks	100% Defoliation	no	346	412	886	894	42.8	45.4		58		3.1
Early Bloom + 2 weeks	100% Defoliation	yes	424	494	963	1049	44.0	47.2		50		3.0
LSD (0.05)			340	221	778	475	1.8	1.2		20		1.1
CV (%)			26	16	26	16	3.5	2.1		22		21
Trial Mean			1095	1144	2484	2505	44.0	45.6		76		4.3

Red numbers are significantly lower than the untreated check at the 0.05 level of probability.
Green numbers are significantly greater than the untreated check at the 0.05 level of probablility.

Table 2. Plant stand, plant height, total nodes, number of monopodial branches and total boll production and location of PHY 499WRF in response to removing amounts of leaves and terminals at different growth stages during the 2014 growing seasons at the Pee Dee Research & Education Center in Florence, SC.

								Leaf Removal Treatment					
								Sympodial Bolls			Total Bolls		
Leaf Removal Growth Stage	Amount of Leaves Removed	Terminal Removed	Plant Stand	Plant Height	Total Nodes	Monopod. Branches	Monopod. Bolls	1st Pos.	2nd Pos.	3rd Pos.	Nodes 6-10	Nodes 11-15	Nodes 16-20
			plts/m	cm/plt	no/plt			Bolls/plant					
untreated	0% Removed	no	11	79	19	1	0.4	6.2	1.5	0.7	4.6	2.9	0.6
4-leaf	50% Defoliation	no	11	79	18	1	1.0	5.2	2.1	0.8	4.9	2.9	0.4
4-leaf	50% Defoliation	yes	11	83	16	3	3.4	4.4	1.3	0.3	3.2	2.7	0.1
4-leaf	100% Defoliation	no	10	77	19	3	1.0	4.5	1.9	0.7	2.8	3.6	0.7
4-leaf	100% Defoliation	yes	11	78	16	3	1.7	3.9	1.3	0.5	2.9	2.6	0.1

Matchhead Square	50% Defoliation	no	8	76	18	2	1.6	6.3	2.2	0.8	4.8	3.4	0.4
Matchhead Square	50% Defoliation	yes	11	55	13	2	1.5	4.2	1.6	0.6	5.2	1.1	0.1
Matchhead Square	100% Defoliation	no	11	78	19	2	0.4	4.3	1.0	0.8	3.0	2.3	0.8
Matchhead Square	100% Defoliation	yes	10	58	15	2	1.8	3.4	1.4	1.4	3.6	1.6	0.8
Early Bloom	50% Defoliation	no	10	80	18	2	1.1	5.7	2.1	0.8	4.9	3.0	0.6
Early Bloom	50% Defoliation	yes	8	76	17	2	1.1	5.5	1.9	0.3	4.6	2.8	0.5
Early Bloom	100% Defoliation	no	11	76	18	2	0.6	4.1	0.8	0.4	2.4	2.0	0.9
Early Bloom	100% Defoliation	yes	8	76	17	2	1.1	3.6	0.8	1.4	2.6	2.7	0.4
Early Bloom + 2 weeks	50% Defoliation	no	12	75	17	1	0.7	5.5	1.6	0.5	4.8	2.0	0.5
Early Bloom + 2 weeks	50% Defoliation	yes	10	71	16	1	1.2	4.9	2	1.1	5.3	2.4	0.1
Early Bloom + 2 weeks	100% Defoliation	no	13	77	18	1	0.3	3.7	0.7	0.5	3.6	0.7	0.6
Early Bloom + 2 weeks	100% Defoliation	yes	9	77	17	2	1.0	4.2	0.9	0.8	4.3	1.5	0.1
LSD (0.05)			NS	10	2	1	0.8	0.9	0.7	0.7	1.1	1.0	NS
CV (%)			18	12	9	32	61.4	16.3	38.2	75.5	23.8	36.4	103.9
Trial Mean			10	75	17	2	1.2	4.7	1.5	0.8	4.0	2.4	0.5

Red numbers are significantly lower than the untreated check at the 0.05 level of probability.

Green numbers are significantly greater than the untreated check at the 0.05 level of probablility.

Summary

1) Lint yields were similar in both years of this study with 1483 and 1583 lbs/acre produced in the untreated check plots in 2013 and 2014, respectively (Table 1).
2) Cotton plants appeared to be able to compensate for terminal loss before early bloom (4-leaf and matchhead square) when only 50% of the foliage was removed in both years. Lint yields were only significantly reduced before early bloom in 2014 when plants were completely defoliated and when plants were completely defoliated and terminals removed in 2013 and 2014 (Table 1).
3) Lint yields were more drastically impacted when leaves and terminals were removed after early bloom, especially when plants were completely defoliated (Table 1). Yield decreases appeared to be the result of reduced boll production in most plots and by reduced boll size when plants were defoliated in other plots (Table 1).
4) Leaf and terminal removals appeared to influence the internal partitioning of carbohydrates within bolls, but differences varied between years. In 2013, gin turnout was reduced by the complete defoliation of plants at the 4-leaf stage, at early bloom, and at early bloom plus 2 weeks, but was increased by some leaf removal treatments in 2014 (Table 1).
5) Plants compensated to terminal and foliage loss by increasing the development of monopodial branches during the growing season; however, most of the plants subjected to leaf removal developed significantly fewer mature bolls at first position sympodial branch locations and at nodal positions lower on the main stem (Table 2).