Response of Corn to Multiple Defoliation Events

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INTRODUCTION

Current National Crop Insurance Services (NCIS) Corn Loss Instructions provide a procedure for assessing yield losses to a corn field damaged by more than one hail storm on different dates and stages of development during the growing season. As hybrid genetics have improved and plant populations have increased over time, it is necessary to assess whether these changes influence corn response to defoliation differently than in the past. This study was undertaken to determine how much yield loss occurs in corn subjected to multiple defoliation events and compare these losses with those indicated by current NCIS Corn Loss Instructions.

OBJECTIVES

1. To determine effects of multiple defoliation events ("second losses") on grain yield in corn.
2. To compare these "actual yield losses" with those estimated by the current NCIS Corn Loss Instructions.

METHODS

- Field experiments were conducted on research farms at the University of Illinois and University of Minnesota from 2012-2014 and at The Ohio State University from 2014-2016.
- 3 m x 3 m plots were planted in a randomized complete block design with four replications.
- Thirteen defoliation treatments were imposed at three stages of development (Table 1).
- Defoliation treatments consisted of either 100% (Fig. 1) or 50% leaf removal. 50% leaf removal involved cutting 60% off of every other leaf and stripping the leaf area from one side of the mid-rib on the remaining leaves. Subsequent leaf removal only treated leaves that were not previously damaged.
- Percent total light intercepted was measured using a Line Quantum Sensor (Li-Cor Biosciences, Omaha, NE) at tassel.
- The center 1.8 m of the two center rows were hand harvested for yield and kernel weights and kernels ear^{-1} were recorded.

Table 1. Defoliation treatments.

Control	• None
1 Loss	• 50% at 10-leaf
	• 100% at 10-leaf
	• 50% at 15-leaf
	• 100% at 15-leaf
	• 50% at Tassel
2 Losses	• 50% at 10-leaf + 50% at 15-leaf
	• 50% at 10-leaf + 50% at Tassel
	• 100% at 10-leaf + 50% at 15-leaf
	• 100% at 10-leaf + 50% at Tassel
	• 50% at 15-leaf + 50% at Tassel
	• 100% at 15-leaf + 50% at Tassel
3 Losses	• 50% at 10-leaf + 50% at 15-leaf + 50% at Tassel

RESULTS AND DISCUSSION

Fig. 1. 100% defoliation at 15-leaf stage, S. Charleston, OH, 2016. (Photo taken 7/11/2016)

Actual yield losses for each state (Table 2), averaged across leaf removal treatments and years, were lower than the NCIS chart loss estimates but similar across states: 36% - chart loss vs 20% - IL, 24% - MN, and 21% - OH. Treatments limited to leaf loss at the 10-leaf and 15-leaf stages were generally similar to chart losses. Treatments which included a 50% leaf loss at tassel averaged a yield loss of 25% for IL, 28% for MN, and 26% for OH compared to 48% for the chart loss estimate. The multiple defoliation treatment that resulted in greatest yield loss (100% leaf removal at the 15-leaf stage followed by 50% leaf removal at tassel) also resulted in the greatest reduction of light interception (Fig. 2) and kernel weight (Fig. 3).

Table 2. Comparison of chart loss vs observed loss.

% leaf loss at stage:			Chart	Actual Loss, %‡		
10-leaf	15-leaf	Tassel	Loss†	Illinois	Minnesota	Ohio
50			6	6	4	2
100			16	11	17	5*
	50		15	12	11	12
	100		51	36*	49	38*
		50	31	18*	16*	22*
50	50		16	11	15	16
50		50	33	16*	24	23*
100	50		39	18*	25*	21*
100		50	67	23*	27*	27*
	50	50	34	21*	20*	17*
	100	50	88	47*	63*	48*
50	50	50	35	22*	18*	24*
Average			36	20	24	21
Average with loss at T¶			48	25	28	26

† Estimates from NCIS Corn Loss Instructions (2015).
‡ Il and MN 3-yr avg, 2012-2014; OH 2-yr avg, 2014-2015.
¶ T=defoliation at Tassel.
*Actual loss significantly different from chart loss at LSD (0.05).

Differences in light interception at tassel and kernel weights of the UTC and 50% defoliation at the 10-leaf stage were negligible. Light interception at tassel correlated closely with yield across different leaf loss treatments. Lower grain yields were associated with reduced canopy light interception caused by 100% defoliation treatments at 15-leaf and 50% defoliation treatments at tassel (Fig. 2). Yield reductions associated with defoliation were primarily related to reductions in kernel numbers per ear (Fig. 3). Kernel numbers per ear were more sensitive to defoliation than kernel weight which showed only a slight reduction as grain yield decreased as the result of greater defoliation injury.

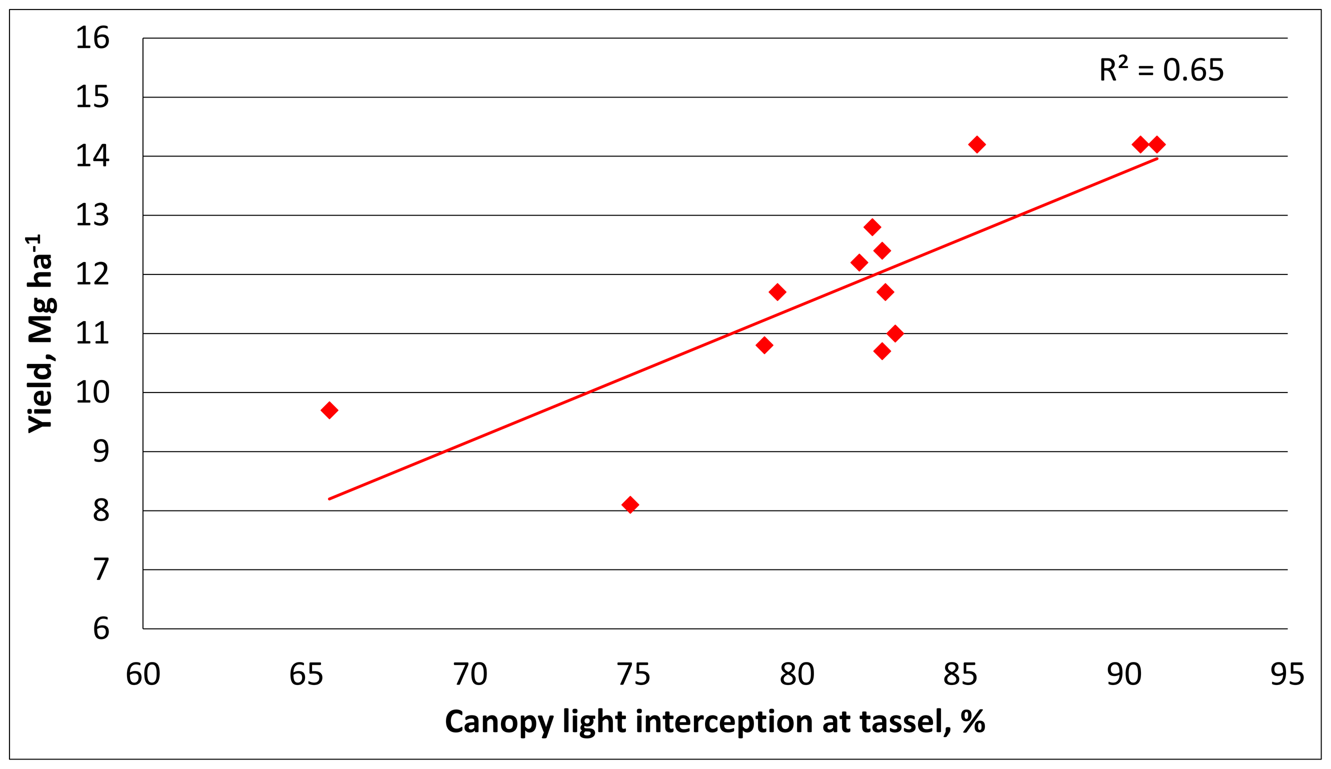

Fig. 2. Canopy light interception at tassel, S. Charleston, OH 2015.

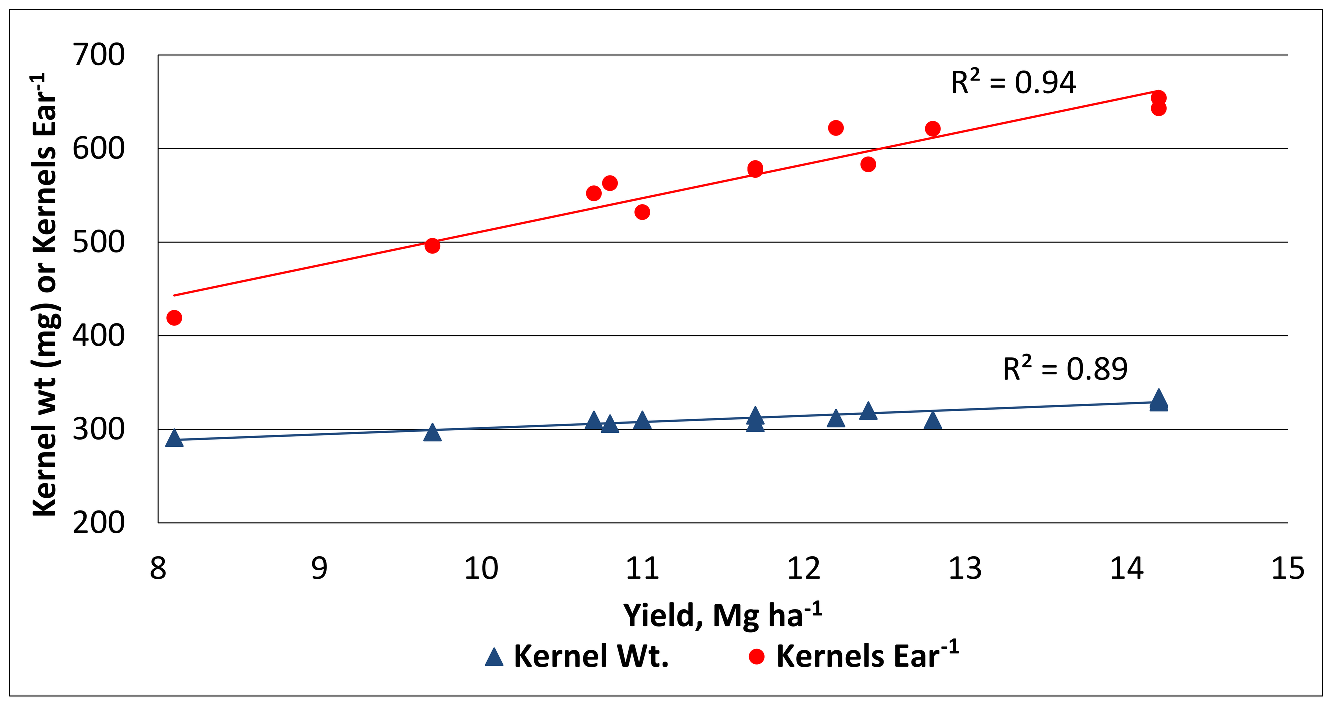

Fig. 3. Kernel weights and kernels ear^{-1} vs. yield, S. Charleston, OH 2015.

CONCLUSIONS

- Actual losses and NCIS chart loss estimates were generally similar for treatments involving leaf removal only at the vegetative stages.
- Treatments that involved leaf removal at tassel were consistently lower than estimated chart losses.
- Treatments with 50% leaf loss at tassel resulted in yield loss averaging only half of estimated chart loss.

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