CROP INSIGHTS

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Wind Lodging Effects On Corn Growth and Grain Yield

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Summary

- Wind lodging often occurs in late June and early July when thunderstorms are likely and corn is most vulnerable. Later brace root development will reduce the risk of lodging.
- Wind lodging is not always related to root injury but is more frequent and severe when root systems are reduced by insect feeding or restricted by compaction or dry soils.
- In a two-year study on lodging effects, corn plots at the V10 to R1 growth stages were saturated by irrigation and then immediately pushed over perpendicular to row direction.
- Upper parts of plants straightened to vertical within 2 days after lodging at each growth stage both years. Lodging did not change silk dates or harvest grain moisture.
- Grain yield was reduced only 3 to 4% by lodging at V10 to V12 stages, but losses increased to near 10% for lodging at V13 to V15 stages, and to 15 to 25% for lodging after V17.
- This study demonstrated that combine harvest speed would likely need to be reduced to minimize harvest losses in lodged fields, especially if lodging occurred at VT or R1.

Introduction

The corn plant has three different stages of root development: seminal root formation at germination and emergence, nodal root development during vegetative growth and brace root development immediately prior to and during flowering. These root systems provide water and nutrients to the plant, and structural support to keep the plant anchored and upright throughout its development. Nevertheless, root lodging is a fairly common occurrence in corn fields across North America.

Wind lodging often occurs in late June and early July when severe thunderstorms are likely and corn is most vulnerable. Corn in mid-vegetative stages of development has sufficient top growth to be impacted by severe winds but inadequate brace root formation to firmly anchor plants against these forces. This Crop Insights will discuss wind-induced lodging and its effects on corn development and grain yield.

Causes of Root Lodging

Wind lodging usually occurs when soils are saturated by heavy rain and the rain occurs with high winds. These conditions soften the soil while simultaneously applying lateral forces on the plant. Wind lodging is not always related to root injury.

"Goose-necked" corn plants following an early July storm.

However, it is more likely and often more severe when corn root systems are reduced by insect feeding or restricted by compaction or other soil characteristics.

Corn rootworm feeding: Corn plants are more likely to lodge if roots are damaged by corn rootworm larvae. Feeding by this corn pest may reduce root systems by half or more, with obvious impacts on their anchoring function.

Soil characteristics: Certain soil characteristics may be just as detrimental to corn root mass as insect feeding. General soil compaction as well as sidewall compaction of the seed furrow restrict proper root development. Hot, dry surface soils, loose or cloddy soil conditions and shallow plantings can lead to severely under-developed root systems, commonly known as "rootless corn syndrome". Soil moisture is needed to help remediate this problem and reduce the high risk of lodging.

Study on Effects of Lodging on Corn

A two-year study was conducted to evaluate the effects of root lodging on corn development and yield (Carter and Hudelson, 1988). To simulate the effects of wind lodging, corn plots at the V10 to R1 growth stages were saturated with irrigation water and then immediately pushed over perpendicular to row direction (Figures 1 and 2). A stalk angle of 20 to 30 degrees from the soil surface was achieved by the root-lodging treatment. Care was exercised to avoid breaking or cracking the lower stalk or crown region when manually applying the treatment.

Some plants are partially uprooted when wind-lodging occurs.

Wind-Lodging Study Results

Upper parts of plants straightened to vertical within 2 days after lodging at each growth stage both years (Figure 2). Lodging did not change silk dates or harvest grain moisture. But the angle between the below-ear stalk and the soil surface at harvest decreased the later lodging occurred, due to more pronounced "goose-necking" (Table 1 and Figures 3 and 4). Stalks were always vertical or nearly vertical at or above the ear, even for V17 to R1 lodging treatments.

Table 1. Simulated wind lodging influence on stalk development, ear number and grain yield. Values are averages of three hybrids.

Growth Stage*	Below-Ear Stalk Angle (Degrees)	Ear Node Height (inches)	Ears/ Plant	Grain Yield Bu/ acre	Grain Yield % of Control
Year 1					
Control	90	57	1.04	199	100
V10	85	52	1.06	191	96
V13-V14	61	40	1.05	182	91
V17-R1	36	29	0.91	151	76
Year 2					
Control	90	52	1.14	187	100
V11-V12	73	41	1.15	181	97
V15	50	33	1.08	168	90
VT	22	18	1.00	160	86

* Growth stage at time of wind-lodging treatment.

Grain yields were decreased by lodging both years, with greater reductions as lodging growth stage was delayed (Table 1). Yield was reduced only 3 to 4% by lodging at V10 to V12 stages, but losses increased to near 10% for lodging at V13 to V15 stages, and to 15 to 25% for lodging after V17.

Though not measured directly in the study, there are several physiological factors in the plant which likely contributed to the yield loss from root lodging. Plant energy used to curve the stalk upward after lodging may limit grain production. Uptake of soil moisture and nutrients might be decreased. Light penetration through root-lodged plants may be restricted and cause yield losses. Other studies have shown that reduced ear number, like that for plants lodged during V17 to R1 stages (Table 1), can be caused by increased barrenness when light penetration through the corn canopy is limited.

Losses Could Be Greater With Dry Seasons And Harvest Difficulty

Growing conditions were favorable for high corn yields during both study years. Soil moisture shortages could result in greater yield losses, if root injury following lodging limited plant moisture uptake.

Also, losses with combine harvest could be greater than the hand-harvested yields shown in Table 1. Following lodging, plants straightened to the extent that ears were at least 18 in. above the soil surface at harvest (Table 1 and Figures 3 and 4).

Figure 1. Research plot immediately after artificially induced “wind lodging” at the V12 growth stage.

Figure 2. Same plot as above three days after simulated wind lodging.

Figure 3. Left to right, control (no lodging) and plants with simulated wind lodging at V10, V12, and V16 stages. Lodging occurred in July, photos were taken in early September.

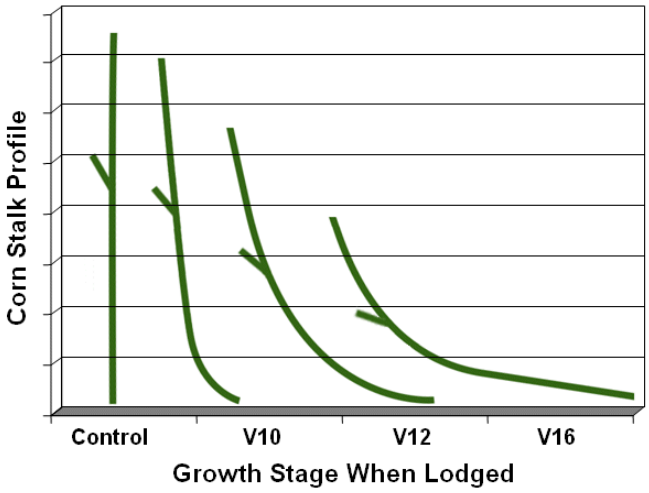

Figure 4. Graphic representation of corn stalk angle and ear height following simulated wind lodging at V10, V12, and V16 stages vs. control (no lodging)

Therefore, combine harvest would be possible, but harvest speed would likely need to be decreased to minimize harvest losses. This is especially important if lodging occurs at VT or R1 stages when goose-necking will likely be pronounced and ear heights reduced.

Probable Impact of Wind Lodging at Later Growth Stages on Corn Yield and Harvestability

Wind lodging can also occur during the grain-filling stages of corn development, but it occurs less frequently than at earlier stages. Although the author is unaware of any studies addressing this period, it is reasonable to assume that yield losses would be at least as great, and probably greater, than lodging at earlier stages.

- Physiological yield losses from lodging during grain fill would likely equal or exceed those during the tassel/silk stages, which were about 25% in the study reported here.
- Harvest losses from lodging during grain fill may be greater than those incurred from earlier lodging. This is because plants will not be able to straighten by goose-necking to the same extent as at earlier stages, because internode elongation has been completed.

Reference

Carter, P.R., and K.D. Hudelson. 1988. Influence of simulated wind lodging on corn growth and grain yield. J. Prod. Agric. 1:295-299.