

Causes of Corn Root Lodging

- Root lodging occurs when root growth is unable to anchor the corn plant against the force of the wind.
- Factors that can contribute to root lodging include corn product selection, soil and environmental conditions, insect damage, and herbicide injury.
- Recovery from root lodging depends on the growth stage of the corn plant at the time of the damage.
- Identifying the causes for root lodging can help determine future management options to reduce root lodging.

Factors Cause Root Lodging

- General soil compaction, poor seed placement, and sidewall compaction of the root zone, due to wet conditions at planting, can restrict proper root development (Figure 1).
- Strong winds can pull shallow roots partially out of the soil. Additionally, the stalks can buckle, causing the plant to lodge. Strong winds from one direction may pull the roots on one side of the plant and push roots further into the soil on the other. Disrupting the “anchoring” system may result in buckling. A rotation of the downwind root systems by as few as 10 degrees is enough to cause buckling of the corn stalk. Thunderstorms may also provide powerful downdrafts causing lodging in every direction (Figure 2).
- Severe corn rootworm (CRW) pressure can dramatically contribute to root lodging. Larvae feeding can reduce root



Figure 1. Root lodged corn plants.



Figure 2. Corn root lodging from windstorm.



Figure 3. Corn roots damaged by CRW feeding. Photo courtesy of Croissant, R.L., Colorado State University. Bugwood.org.

systems making plants more vulnerable to wind storms (Figure 3).

- Drought conditions can hinder brace root development by reducing the overall size of the root masses. Brace roots fail to grow without moisture, as cells do not elongate. Also, cloddy soil conditions and shallow plantings can result in underdeveloped root systems, known as “rootless corn syndrome.”
- Drought conditions can make brace roots grow horizontally over the dry, hard soil surface. However, heavy rainfall following drought can help soften the soil and roots will start to penetrate the soil surface, which can alleviate some of the root lodging problem.
- Wet conditions early in the season may inhibit root development or cause shallow roots, preventing the plant from properly anchoring in the soil. Shallow root systems, especially in late planted corn fields, can be prone to potential drought stress and nutrient deficiencies that can result in root and/or stalk lodging (Figure 4). Brace root formation may not occur quickly enough under moist conditions to support the top growth of corn. In addition, excessive moisture conditions can cause incomplete brace root development that can lead to plant lodging.
- Water-saturated soil compared to dry soil at the time of a wind storm can make it easier for the roots to be pulled by the force of the wind.
- Vulnerability to root lodging varies among corn products. Plants are most susceptible during the period of rapid growth just before tasseling.



Figure 4. Stalk lodging. Photo courtesy of Clemson University USDA Cooperative Extension Slide Series, Bugwood.org.

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- Root lodging can also occur in areas where nitrogen was lost due to wet conditions.
- Low soil pH can reduce root growth and development.
- Excess application of certain growth regulator herbicides can cause upcurling or fusing of the brace roots and twisting of other roots.

Can Corn Plants Recover?

It is important to be patient and allow the corn time to recover before estimating potential yield loss. Depending on the severity of the root lodging, corn plants can typically recover by “goosenecking” back upright; however, negative impacts can still occur throughout the remainder of the growing season.

The extent of the goosenecking damage and impact on yield potential is directly related to the corn growth stage when the root lodging occurred. If root lodging occurs:

- Before pollination, the plant is usually able to recover on its own and return to an upright growth pattern within a few days, without severely affecting crop yield potential. However, the lower part of the stalk will likely have a “gooseneck” bend to it that may require slower harvesting to help prevent ear loss.
- During pollination or grain fill, crop yield potential may be decreased.
- At or near pollen shed, the pollination process may not be completely successful, potentially resulting in naked tips or scattered grain on the ears.

Management

Special management practices should be considered for plants that are damaged but survive and for future plantings.

- Lodged corn plants that are laying on each other may be exposed to diseases. Fungicides cannot recover yield potential lost due to lodging, but may help protect against further yield reductions.
- Irrigation management, where possible, can be adapted for corn plants with shallow roots. Irrigation will likely need to be applied more frequently with less water each time to minimize pushing available nitrogen past the root zone.
- Goosenecked stalks can be difficult to harvest, resulting in mechanical harvest losses. The use of after-market corn head reels may be of benefit to help direct stalks into the header. Local equipment dealers, neighbors, and the internet are likely sources for special equipment.
- If lodging was due to CRW larvae feeding, best management practices (BMPs) should be implemented on these fields. If severe feeding and lodging is observed, follow these BMPs:
 - Rotate to soybean crop or another non-host crop to break the CRW cycle.

- Plant Genuity® SmartStax® RIB Complete® corn blend technology with dual modes of action against CRW.
- If a single mode of CRW action is used, such as Genuity® VT Triple PRO® RIB Complete® corn blend technology, incorporate a soil applied insecticide.
- Select corn products with good root strength ratings.

Summary

Understanding the causes of root lodging can provide valuable information and direction for harvesting the damaged field and also for future management decisions. Root lodging can occur as early as the late vegetative stages and as late as harvest maturity. Recovery depends on the condition of the plant at the time of damage. Plants that are knee-high or shorter may recover without noticeable goosenecking, while taller plants may not straighten up but may gooseneck because the upper stalk internodes continue to elongate.

Sources: Carter, P.R. and Hudelson, K.D. 1988. Influence of simulated wind lodging on corn growth and grain yield. *J. Prod. Agric.* 1:295-299.
Corn stalk rots. 1995. University of Illinois Extension. RPD No. 200.
Elmore, R. 2005. Root-lodged corn at or before silking. Iowa State University Extension. Integrated Crop Management publication. <http://www.ipm.iastate.edu/>.
Vagts, T. 2003. Reducing harvest losses in lodged corn fields. Iowa State University Extension. <http://www.extension.iastate.edu/>.
Nielson, R.L. 2002. Root lodging concerns in corn. Purdue University. <http://www.agry.purdue.edu/>.
Thomson, P. 2010. Effects of pre-tassel root lodging on corn performance. The Ohio State University Extension C.O.R.N. Newsletter. 2010-19. <http://com.osu.edu/>.
Lauer, J. 2011. Yield response of flattened (lodged) corn. University of Wisconsin. *Field Crops* 28,49-86, <http://ipcm.wisc.edu/>.
Ransom, J. 2011. Root lodging in corn. North Dakota State University. <http://www.ag.ndsu.edu/>.
Web sources verified 7/14/14.

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