Green Crimp in Corn

CROP BULLETIN

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SUMMARY

- Green crimp is the bending or crimping of the corn stalk under high winds while the plant is still green and actively growing, a phenomenon less commonly observed than other forms of wind damage such as brittle snap and stalk lodging following physiological maturity.
- Green crimp can be distinguished from brittle snap by the fact that stalk bending occurs at the internode and does not sever the vascular tissue, which allows the portion of the plant above the bend to continue some degree of growth.
- Effects on corn yield and harvestability depend on the severity and timing of wind damage to the plants.
- Green crimp during vegetative stages (V12 to VT) most commonly occurs immediately below, at or above the primary ear node and is likely associated with weakness of the stalk during rapid growth.
- Green crimp during mid- to late-reproductive growth often occurs lower on the stalk and may be associated with weakening of the stalk due to remobilization of carbohydrates from the stalk to the developing ear.
- Fields that have experienced green crimp should be harvested as early as possible to maximize the harvestable yield.
- Management practices such as timely planting, avoiding excessive planting densities, and selecting a diverse package of hybrids can help reduce the risk of green crimp occurring.

INTRODUCTION

High winds can damage growing corn in a number of ways, one of which is bending or crimping of the stalk, a phenomenon often referred to as green crimp. Green crimp can resemble stalk lodging but occurs while the plant is still green and actively growing, whereas stalk lodging typically refers to crimping or breaking of the stalk after physiological maturity and is often associated with stalk rots. Green crimp can be distinguished from brittle snap (also referred to as green snap) by the fact that stalk bending occurs at the internode and does not sever the vascular tissue, which allows the portion of the plant above the bend to continue some degree of growth. Brittle snap typically occurs at a node and involves the complete breakage of the stalk.

Figure 1. Plant at the R1 growth stage (silking) showing varying degrees of bending and recovery following a severe wind event in Illinois (July 14, 2016).

Green Crimp

- Bending/crimping of the stalk internode
- Does not sever vascular tissue
- Can occur from around V12 through maturity
- If green crimp occurs during vegetative growth, plant can recover to some extent
- Can negatively affect both yield and harvestabil-ity depending on timing and severity of damage

Brittle/Green Snap

- Breakage of the stalk, severing vascular tissue
- Occurs at the node, immediately below, at, or above the primary ear node.
- Occurs most often during rapid vegetative growth (V5-V8 and V12-R1)
- Most productive fields are commonly the most susceptible due to rapid growth rate
- Can result in complete loss of harvestable yield

Stalk Lodging

- Crimping or breakage of the stalk following physiological maturity after grain fill is complete
- Often associated with stalk rots
- Reduces harvestability

Figure 2. Plant at the R1 growth stage (silking) showing varying degrees of bending and recovery following a severe wind event in Illinois (July 14, 2016).

DAMAGE TO PLANTS

Green crimp effects on corn yield and harvestability depend on the severity and timing of damage to the plants. Occurrence of green crimp has been observed from late vegetative growth stages through mid-reproductive growth, approximately V12 to R4. Plants that are still undergoing vegetative growth at the time of green crimp occurrence are capable of some degree of recovery. As with root lodging during vegetative growth, affected plants will bend back toward vertical, which can result in crooked and odd-looking stalks (Figure 1 and 2). Damage at this stage can range from slight bending or leaning to a complete folding over of the stalk. Yield effects tend to correlate to the severity of the damage – a slight bending of the stalk may have little or no effect, whereas a complete folding over of the stalk is likely to be more detrimental.

Green crimp has the greatest potential to affect yield when it occurs around tasseling and silking. At this point the plant has completed vegetative growth, so is no longer capable of righting itself following a wind event, and is just beginning reproductive growth, so effects on kernel set and grain fill will be maximized.

Injury to the plant at this time can also potentially disrupt ear development, making it particularly detrimental to yield. In 2016, instances of abnormal ear development were observed at multiple locations across the Corn Belt following severe storms and high winds. High winds caused some fields to lodge or lean over. In many fields, these storms occurred close to tassel and pollination stages. In some cases, wind damage to plants resulted in abortion of the primary ear which triggered development of an ear at the secondary node, a phenomenon likely due to hormonal disruption in plants following injury (Elmore et al., 2016). Ears growing at the secondary node often exhibited some degree of abnormality and the delay in silking resulted in poor pollination. Yield losses associated with green crimp occurrence around tasseling and silking can vary widely based on severity of damage and other environmental stresses that may be affecting the plants.

Green crimp during grain fill is much more analogous to stalk lodging – it often occurs lower on the stalk and is likely associated with weakening of the stalk due to remobilization of carbohydrates from the stalk to the developing ear. While the term stalk lodging typically refers to crimping of the stalk below the ear after physiological maturity, green crimp during grain fill manifests in much the same way. A key distinction is that stalk lodging as defined here affects only the harvestability of the ear, not its actual yield since grain fill is already complete at this point. Green crimp affects harvestability and yield since the damage takes place prior to physiological maturity before grain fill is complete.

The later that green crimp occurs during grain fill, the less potential there is for yield to be affected. Yield losses of 5-15% have been observed with green crimp that occurred when corn was past ½ milkline. Yield losses due to green crimp that occurs later during reproductive growth are often less than expected relative to the appearance of the crop.

HYBRID DIFFERENCES

As with most adverse weather effects on corn, the nature and severity of green crimp symptoms will often differ among hybrids. These differences may be attributable to specific genetic characteristics of a hybrid or may be due to the growth stage and plant stature of a given hybrid at the time of a severe weather event. Plants that are taller and have larger leaves are generally more susceptible to all types of wind damage. Similar to brittle snap, green crimp is most commonly observed in fields with high yield potential where the plants are undergoing rapid growth.

CONTRIBUTING ENVIRONMENTAL FACTORS

Late Vegetative Through Early Reproductive Stages

Green crimp occurring between the V12 and VT growth stages appears to be influenced by many of same factors related to brittle snap. From V12 through tasseling, the corn plant is undergoing its most rapid stage of growth. It will increase in size to its mature height of 7 to 10 feet in approximately 21 to 28 days, or about 2 to 4 inches of growth per day. A key factor increasing susceptibility to all types of wind damage at this stage is the enlargement in leaf surface area and plant height, which increases wind resistance during a period of potentially severe thunderstorms and wind events (late June, July, or early August depending on the planting date and growing season.) The most common sites for both green crimp and brittle snap at this stage are immediately below, at or above the primary ear node. Upon reaching mature height, the plant becomes more resistant to wind damage as cell walls are strengthened by the deposition of lignin and other structural materials.

Field observations in 2016 and 2017 suggest some degree of correlation between hybrid susceptibility to green crimp and brittle snap. Hybrids in which green crimp was observed often had relatively low ratings for resistance to brittle snap. Whether damage from severe wind manifests as green crimp or as brittle snap may be related to moisture conditions at the time of the wind event. Cells of plants with ample moisture are more turgid and less able to bend without breaking, which can lead to brittle snap under high winds. Conversely, moisture deficit conditions resulting in less turgidity may favor bending of the stalk under high winds rather than breakage. Cell turgidity can be influenced by soil moisture conditions ahead of the wind event as well as the time of day when the wind occurs. Brittle snap is often associated with thunderstorms that occur in the early morning hours when temperatures are cooler and plant cells are more turgid.

Figure 3. Green crimp and brittle snap resulting from high winds between the V12 and VT growth stages commonly occur on the stalk near the primary ear node. Top: Green crimp following a wind storm in Illinois in 2016. Above: Brittle snap following storms in Texas in 2011.

Mid- to Late-Reproductive Growth Stages

Green crimp during mid- to late-reproductive growth may be associated with weakening of the stalk due to remobilization of carbohydrates from the stalk to the developing ear. As the plant goes through vegetative growth, photosynthate is directed to the stalk for temporary storage. Upon successful pollination, ear development places a great demand on the plant for carbohydrates. When the carbohydrate demands of the developing kernels exceed the supply produced by the leaves, stalk and root storage reserves are tapped. University studies indicate that during grain fill, about 60 to 70% of the non-fiber carbohydrates in the stalk are moved to other parts of the plant, but primarily the ear (Daynard et al., 1969; Jones and Simmons, 1983). This stalk depletion begins approximately two to three weeks following silking. Environmental stresses which decrease the amount of photosynthate produced by the plant can force plants to extract even greater percentages of stalk carbohydrates, which preserves grain fill rates at the expense of the stalk.

Figure 4. Green crimp in corn in Hall County, Nebraska (August 27, 2017).

Stress factors that reduce photosynthesis during grain fill will lead to greater remobilization of carbohydrates which may increase the risk of green crimp. Foliar diseases are one such factor that can reduce plant photosynthesis by reducing effective leaf area. Low solar radiation during grain fill has also been associated with incidence of green crimp. Photosynthesis is most efficient in full sunlight. Studies show that the rate of photosynthesis increases directly with intensity of sunlight. One experiment indicated that photosynthesis rates are reduced more than 50% on an overcast day compared to a day with bright sunshine (Moss et. al., 1960). Prolonged cloudy conditions during ear fill often result in severely depleted stalk reserves. In 2017 corn growers in the California Central Valley experienced the effects of prolonged heat and lower than normal solar radiation creating the perfect conditions for weakened stalks (Figure 5).

Figure 5. Green crimp in corn in the California Central Valley in 2017.

MANAGEMENT CONSIDERATIONS

For a field that has experienced green crimp, the best management option available is to harvest it as early as possible to maximize the harvestable yield. The longer the crop stays in the field the more stalk quality will degrade, which can result in greater harvest losses.

A number of management practices can help reduce the risk of green crimp occurring. Planting a package of hybrids with a range of maturities is always advisable to spread risk associated with stress events during the growing season. Hybrids that differ in maturity go through their windows of susceptibility to stress factors at different times. Planting a package of diverse hybrids spreads the risk of injury, as it is unlikely that all hybrids will be at the same stage of development at the time of any one storm.

Timely planting may also help reduce risk of green crimp. Occurrence of green crimp in Illinois in 2016 and California in 2017 tended to be associated with later-planted corn. Later planting tends to result in taller plants, which will be more susceptible to wind damage. Early planting may also help plants advance through the rapid growth phase during vegetative growth when they are more susceptible to green crimp and brittle snap before the latter part of the summer when stress conditions and severe weather are more likely.

Carefully managing seeding rate for hybrids in which green crimp has previously been observed can reduce the risk of it occurring again. Avoiding higher than optimum seeding rates can reduce the stress load on plants from intraspecific competition allowing them to be more resilient against stressful weather events.

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