Delayed Pollination Effects on "Zipper Ears" in Corn

CROP BULLETIN

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KEY POINTS

- Environmental stress to corn during pollination can cause reduced kernel set down one side of a corn ear, a phenomenon commonly referred to as zipper ears.
- Specific factors that contribute to zipper ear formation are not fully understood.
- A field experiment was conducted to try to artificially induce the formation of zipper ears by imposing stress during pollination and selectively delaying pollination along one side of a corn ear.
- When zipper ears occurred, the affected side of the ear corresponded to the side of the ear with delayed pollination.
- Under a higher stress environment, zipper ear response started to become apparent when pollination was delayed for as little as one day.
- In a corn field, delayed pollination might occur on the bottom side of a silk brush because silks at the top and sides of the silk brush are the first silks to capture limited quantities of falling pollen.

STRESS EFFECTS ON CORN EAR DEVELOPMENT

When corn experiences severe stress during pollination, a common result is incomplete pollination or kernel abortion near the tip of the ear, a phenomenon commonly referred to as tip-back. The silks for the kernels near the tip are the last to emerge, so they can miss pollination if silking is delayed due to stress and will be the first to abort if resources are constrained during grain fill. A less common manifestation of pollination stress is poor pollination or kernel abortion that extends all the way down one side of the ear. This type of ear malformation is often referred to as zipper ears or banana ears, as the ear will often bend in a shape resembling a banana due to the lack of kernels on one side (Figure 1).

Although not necessarily a common occurrence, zipper ears are one of the more frequently observed forms of abnormal ear formation – most corn growers have likely come across zipper ears at some point. However, the reasons why ears develop in this manner are not fully understood. Poor pollination and/or kernel fill will often occur on the side of the ear angled toward the ground. Differential heating around the circumference of the ear due to differences in sun exposure and physical obstruction of silks on the underside of the ear by other silks draped over them have both been proposed as possible factors contributing to the formation of zipper ears (Nielsen, 2019).

Figure 1. Corn ear showing aborted kernels down one side of the ear in a zipper ear pattern. Stress at pollination can result in missing kernels, while stress after pollination commonly results in very small or aborted kernels.

SILK EXSERTION

Under normal growing conditions, silks emerge from the developing ovule and grow in a straight line along the central axis of the ear (Figure 2). Silk emergence within the silk brush is on the same side of the cob as the ovule to which this silk is attached. In addition, silks exserting from ovules at the base of the ear form the outermost ring of silks in the silk brush. As silks exsert from ovules proceeding toward the tip of the ear, these silks emerge progressively toward the middle of the silk brush. Silks exserting from ovules at the tip of the ear emerge at the center of the silk brush. Any stress or event that inhibits silk growth or inhibits pollination within a specific portion of the silk brush therefore affects an associated specific location of ovules on the corn ear.

Figure 2. Corn ear showing silks growing along the axis of the ear.

FIELD RESEARCH ON ZIPPER EARS

A field experiment was conducted during the summer of 2021 that sought to better understand factors contributing to the occurrence of zipper ears by artificially inducing their

formation. This experiment involved imposing stress during pollination and selectively delaying pollination along one side of a corn ear.

Delayed Pollination

Silks of ears were covered to inhibit pollination (Figure 3). On the day of exposure, the silk brush was clipped to as length of 1.5 inches (3.8 cm) and a portion of silks was separated from the silk brush and covered to delay pollination of the selected silks for a specific duration of time. The main portion of the silk brush remained uncovered. The selected, covered silks were uncovered at 1, 2, 3, 4, or 5 days after the main silk brush was uncovered. Silk position around the ear was described as if the circumference of the ear was a clock with the 12 o'clock position being the portion of the ear facing the corn stalk. The 12 o'clock position of the ear was marked when the ear was evaluated at maturity.

Figure 3. Illustration of the procedure to delay pollination of selected silks. (A) Silks are covered to inhibit pollination; (B) Silks are clipped to 1.5 inch; (C) A selected portion of clipped silks are separated from the silk brush; (D) The separated portion of silks are covered to prevent pollination.

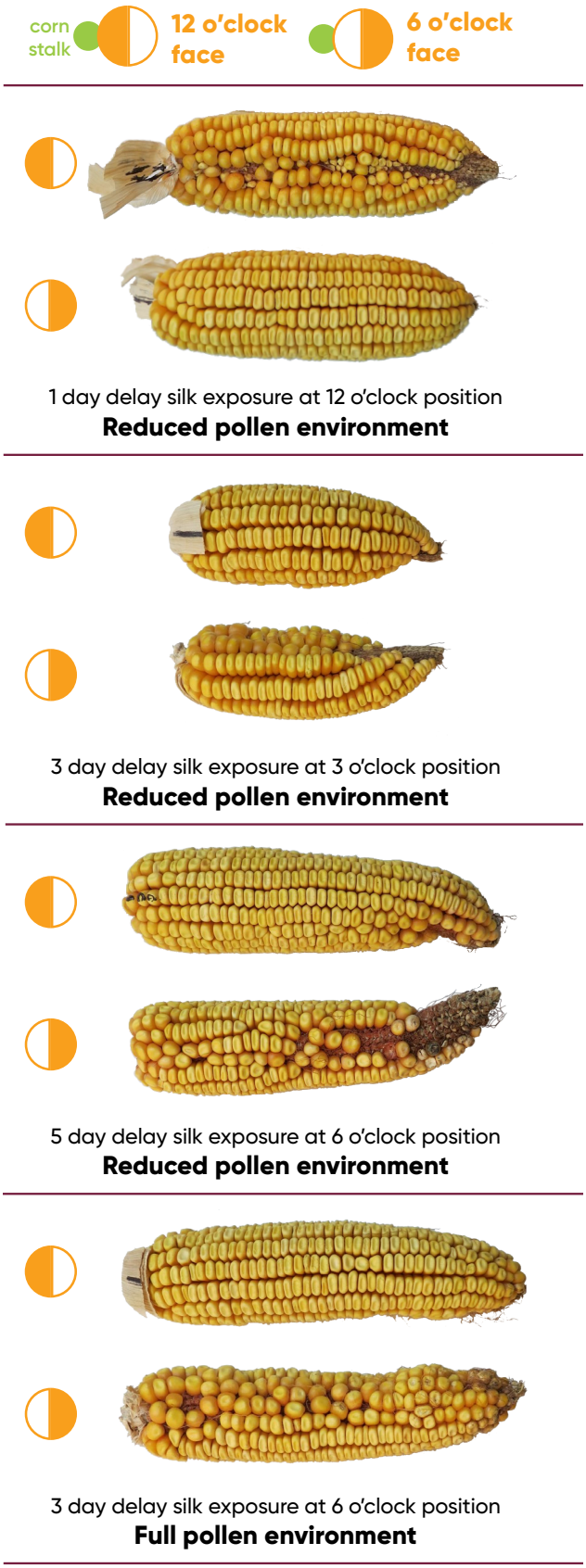

Figure 4. Representative ears showing kernel set with responses similar to those of zipper ears at maturity when pollination is delayed on selected silks.

Pollination Stress

This study was conducted in two environments. In the first environment, the corn field received approximately two inches of rain just before pollination started. These corn plants were under very little stress. This environment was labeled as the full pollen environment. Weather conditions were the same for the second environment. However, in the second environment, corn plants were detasseled just before pollination. As tassels were pulled, the upper three leaves of corn plants were removed with the tassel. These corn plants were located 7.5 feet from the nearest tassel. Ears developing in this environment were stressed by reduced leaf matter to support sugar production and by reduced pollen densities. This environment was labeled as the reduced pollen environment.

FIELD RESEARCH RESULTS

When zipper ears occurred, the affected side of the ear corresponded to the side of the ear with delayed pollination. Not all ears with delayed silk exposure expressed reduced kernel set, presumably because it was difficult to completely cover selected silks to fully eliminate exposure to pollen. Zipper ears were much more common in the reduced pollen environment than in the full pollen environment. In the more stressed environment, zipper ear response started to become apparent when pollination was delayed for as little as one day (Figure 4).

FACTORS CONTRIBUTING TO ZIPPER EARS

In this study, reduced kernel development along one side of the ear occurred more often when plants were growing in the reduced pollen environment. Two stress factors were more prevalent in this environment – pollen densities were reduced, due to the spatial separation for tassels shedding pollen and developing silks and ears were under increased nutritional stress, due to the removal of the upper leaves from the plant.

Environmental conditions that reduce pollen production, such as intensive insect feeding on pollen, and environmental conditions that reduce ear growth and vigor, such as drought, heat, cold, or nutrient stress, increase the risk of delayed pollination on one side of the ear which could result in barrenness or the formation of zipper ears on the side of the ear with the delayed pollination.

Delayed pollination was artificially induced in this study. In a corn field, delayed pollination might occur on the bottom side of a silk brush because silks at the top and sides of the silk brush are the first silks to capture limited quantities of falling pollen. Depending on the severity of the stress, zipper ears could begin to form with a pollination delay as short as one day.

REFERENCES

Nielsen, R.L. 2019. The “Zipper” Pattern of Poor Kernel Set in Corn. Corny News Network. Purdue University Extension. http://www.kingcorn.org/news/timeless/Zipper.html

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