WHY IS MY CORN LEAFING OUT BELOW GROUND?

Occasionally, when checking corn seedling emergence, a seedling is found that has “leafed out” underground and never broke through the soil surface. This is usually the result of any factor that inhibits normal mesocotyl elongation. The mesocotyl is the part of the seedling between the seed and the coleoptile. It serves as the “lift” that pushes the coleoptile to the surface as well as a pipeline for nutrients from the seed to the developing plant until the nodal roots begin to provide the necessary nutrients.

Mesocotyl growth and elongation can be impacted by several factors including: soil crusting and compaction, imbibitional chilling, exposure to acetanilide herbicides in conjunction with cold and wet soil conditions, cold shock, kernel position in the soil, soil planting conditions that allow the coleoptile to be exposed to light prior to reaching the soil surface, deep planting, or any combination of these factors.

Can soil compaction/crusting cause the seedling to leaf out underground?

Yes. This is often the major reason that the seedling is leafing out underground. Planting in wet soil conditions can lead to sidewall compaction or surface crusting. This is particularly true with heavier texture soils with low organic matter. A hard, driving rain after planting is also a major cause of soil crusting (Figure 1).

In some cases, as illustrated in Figure 2, soil crusting that occurs while the seedling is spiking can cause the emerging leaves to be trapped.

Figure 1. Trapped seedling causing a corkscrewed mesocoytl as a result of soil crusting.

I have had trouble in the past with soil crusting, what can I do to help prevent it, and if it does happen what I can I do help reduce the impact on my corn stand?

Physical crusts are most commonly found in the Corn Belt in the spring. Most soil crusting is caused by a structural degradation of the soil aggregates as a result of the force of water droplets associated with high-intensity storms or irrigation. Soils that have a wide range of particle sizes and are weakly aggregated have many soil pores; the force of the droplets causes the pores to be filled with finer particles. Upon drying, a layer of crust is formed, reducing water infiltration and gas exchange, potentially hindering seedling emergence.[1]

The potential for soil crusting can be reduced by protecting the soil surface as much as possible from the force of the rain drops by using a no-till cropping system and allowing some crop residue to cover the row surface. Increasing the organic matter in the soil through adding manure or planting a cover crop can also limit soil

Figure 2. Corn leaves trapped by crusted soil.

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crusting. Limit tillage to the minimum needed to prepare the basic seedbed prior to planting. Planting when conditions are most favorable for emergence shortens the amount of time to emergence, narrowing the window for a crust to form.

Breaking the crust on an existing field is best achieved with a rotary hoe (Figure 3). While newer models of rotary hoe are self-cleaning and can handle some crop residue, older models may not be able to be used in reduced tillage systems. Additionally, reduce the weight of the tractor as much as possible and use the smallest tractor that can handle the equipment to help reduce soil compaction.

Could my herbicide program cause the seedlings to leaf out underground?

Injury by some chloroacetamide herbicides can occur under cool and wet conditions that slow the emergence process and metabolism within the corn seedling, causing leafing out underground.[2]

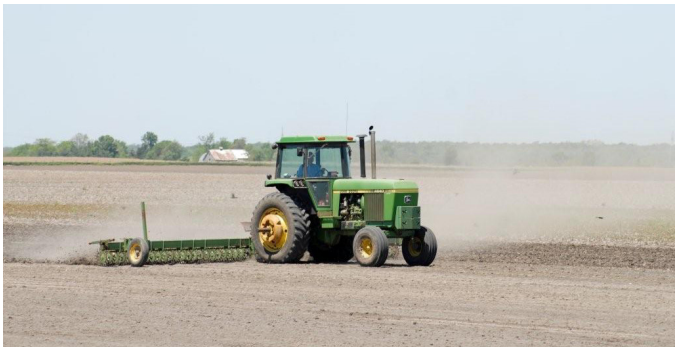

Figure 3. Rotary hoe.

It was extremely cold right after I planted. Is leafing out the result of cold shock?

Possibly. While not completely understood, cold soils or wide fluctuations in soil temperatures during the emergence process have been thought to cause the "corkscrewing" of the mesocotyl (Figure 4 and 5).

The underlying theory of how cold temperatures induce corkscrewing is that the cold temperatures unevenly damage the cells around the mesocotyl, where the cells on the uninjured side continue to grow and multiply at unusually high rate. Thus, as those cells continue to grow and the cells on the injured side do not, the mesocotyl becomes twisted into the corkscrew shape. The exact temperature needed to cause this effect is unknown.[3]

Figure 4. Corkscrewed mesocotyls result in leafing out underground.

Figure 5. A corkscrewed mesocotyl, but emergence will most likely be successful.

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What is imbibitional chilling and could it have caused this phenomenon?

While imbibitional chilling may have caused the seedling to leaf out underground, a more common result of imbibitional chilling is death of the seed. When the seed is placed in the soil, it imbibes (takes in) water to about twice the weight of the seed in the first 24 to 36 hours after planting. If the water is extremely cold, it can result in death of the embryo. The seed will only swell, or the radicle may just start to emerge but then germination will stop.[3]

Does kernel position in the row result in leafing out underground?

While kernel position may influence the shape of the mesocotyl, it is doubtful that kernel position within the soil will result in leafing out underground. Keep in mind that during the germination process, the coleoptile emerges from the embryo side of the kernel. If that side is placed down in the soil, the coleoptile emerges underneath the kernel and must elongate horizontally until the mesocotyl passes the end of the kernel and then it will bend upward. This may result in a somewhat bent but not corkscrewed mesocotyl.[4]

How does exposure to light cause corkscrewing of the mesocotyl?

When the coleoptile reaches the surface, it is exposed to red wavelengths of light, which induces the release of growth hormones that cause the mesocotyl to stop elongating. The coleoptile sheath splits and the leaves expand, and emergence from the soil is complete. However, if the coleoptile is exposed to light at deeper soil depths because of poor seedbeds (clods, dry) or seeding conditions (wet soils and failure to collapse the seed furrow) it may result in leafing out underground.[3]

Sources:

[1]Duiker, S.W. 2017. Soil crusting. Pennsylvania State University Extension. https://extension.psu.edu/soil-crusting

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[3]Nielsen, R.L. 2019. Emergence failure in corn. Purdue University Extension. https://www.agry.purdue.edu/ext/corn/news/timeless/EmergenceFailure.html

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