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The Emergence Process in Corn

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Successful germination alone does not guarantee successful emergence of a corn crop. The coleoptile must reach the soil surface before its internal leaves emerge from the protective tissue of the coleoptile. Growth stage VE refers to emergence of the coleoptile or first leaves through the soil surface (Abendroth et al., 2011).

As with all of corn growth and development, germination and emergence are dependent on temperature, especially soil temperature. Corn typically requires from 100 to 120 GDD (growing degree days) to emerge. Under warm soil conditions, the calendar time from planting to emergence can be as little as 5 to 7 days. Under cold soil conditions, emergence can easily take up to four weeks.

Elongation of the **mesocotyl** elevates the coleoptile towards the soil surface. The mesocotyl is the tubular, white, stemlike tissue connecting the seed and the base of the coleoptile. Technically, the mesocotyl is the first internode of the stem.

Useful Tip: Mesocotyls have the physiological capability to lengthen from at least a 6-inch planting depth. Realistically, corn can be planted at least three inches deep (if necessary to reach adequate moisture) and still emerge successfully.

As the coleoptile nears the soil surface, exposure to the red light wavelengths of solar radiation causes a change in the supply of one or more growth hormones from the coleoptile to the mesocotyl tissue and mesocotyl elongation comes to a halt (Vanderhoef & Briggs, 1978). Since the depth at which the emerging seedling senses red light is fairly constant, the resulting depth of the crown (base) of the coleoptile is nearly the same (1/2 to 3/4 inch) for seeding depths of one inch or greater.

Useful Tip: When corn is seeded very shallow (less than about 1/2 inch), the crown of the coleoptile will naturally be closer to the soil surface if not right at the surface. Subsequent development of the nodal root system can be restricted by exposure to high temperatures and dry surface soils.

Continued expansion of the leaves inside the coleoptile eventually ruptures the coleoptile tip, allowing the first true leaf to emerge. If mesocotyl elongation has successfully elevated the coleoptile tip to the soil surface, emergence of the first true leaves will also occur successfully above the soil surface.

Troubleshooting Considerations

Several factors can cause the coleoptile to split prematurely, allowing the leaves to emerge underground. Usually, more than one of the following factors are present when this problem occurs, making it difficult to place the blame on any one factor.

Exposure to light at deeper soil depths than usual due to cloddy seedbeds, dry seedbeds, sandy soils, or open slots in no-till.

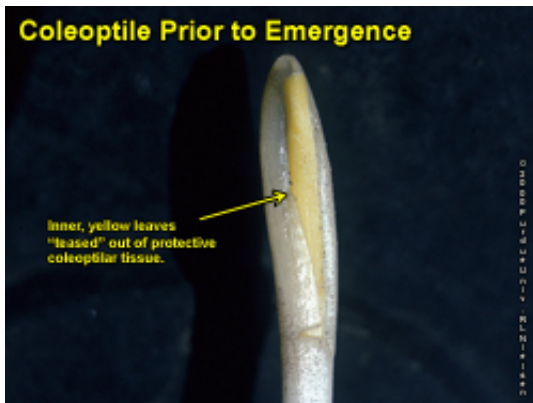
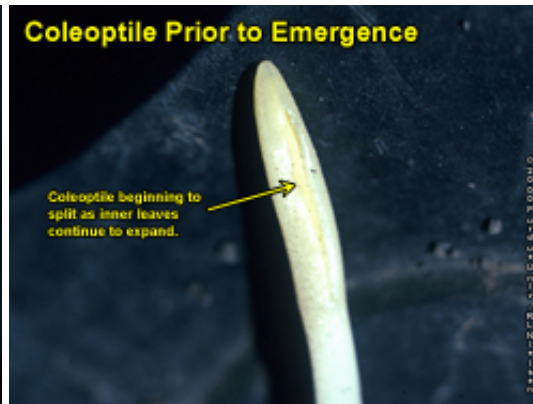
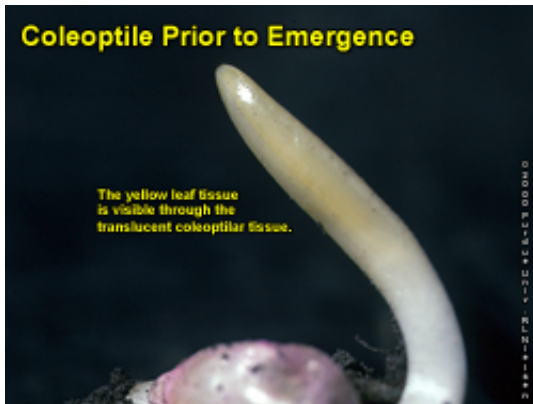
Injury from certain herbicides, particularly under stressful environmental conditions. Symptoms include corkscrewed coleoptile, swollen mesocotyl and true leaves emerged from side of coleoptile.

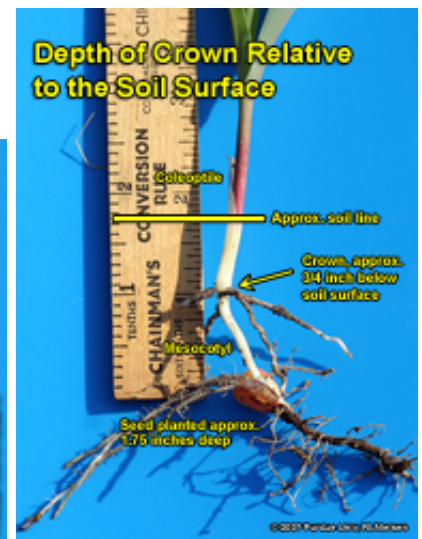
Surface crusting, cloddy seedbeds, rocky seedbeds, planter furrow compaction, or otherwise dense surface soil that physically restrict mesocotyl elongation and coleoptile penetration. The pressure of the expanding leaves within the coleoptile eventually ruptures the side of the coleoptile. Symptoms include corkscrewed coleoptile, swollen mesocotyl and true leaves emerged from side of coleoptile. Note the similarity to those symptoms from herbicide injury.

Cold temperature injury, either from exposure to long periods of soil temperatures less than about 50F (10C) or from exposure to wide daily swings (25 to 30 degrees) in soil temperatures. Symptoms include absence of emerged coleoptile, corkscrewed mesocotyl or coleoptile and true leaves emerged from side of coleoptile. Note the similarity to those symptoms from herbicide injury.

Useful Tip: The mesocotyl should remain firm, white and healthy through at least the 6-leaf stage, if not longer. If it is mushy, discolored, or damaged prior to this stage, then it is likely part of the crop problem being investigated.

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Related References

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