Agronomic Spotlight

Purpling in Corn Seedlings

- It is not uncommon to see a purple coloration (purpling) in corn seedlings during a prolonged period of cool weather.
- Purpling is the result of an accumulation of anthocyanin pigment in plant leaves.
- In most cases, the purpling disappears after favorable weather returns and is not considered to affect yield potential.
- In some cases, purpling may be an indication of phosphorus deficiency within the plant caused by inadequate soil fertility or restricted root growth due to soil compaction or root injury.

During a prolonged period of cool weather, it is not uncommon for corn seedlings to exhibit a purple coloration (purpling) of the leaf sheaths, tips, and margins, or entire leaf blades, as a result of a buildup of a pigment called anthocyanin. Generally, this condition is not a cause for alarm and symptoms will disappear after favorable weather returns. **The most common causes of purple corn seedlings do not translate into reduced yield potential. However, it may be prudent to identify if there are yield-limiting factors contributing to purple corn seedlings, such as soil fertility issues.**

Anthocyanin Pigment

Anthocyanin, the pigment responsible for purpling, is the same pigment that causes a reddish-purple coloration in red grapes, red cabbage, autumn leaves, and many other plants. In some plants, anthocyanin production is associated with stresses including cool temperatures, nutrient deficiencies (namely phosphorous), and pest and pathogen infestation.[1]

- Generally, purpling occurs in corn seedlings because of a temporary phosphorus deficiency and an accumulation of sugars within the leaves due to restricted root growth and reduced respiration caused by cool temperatures.
- Purpling may also be an indication of phosphorus deficiency in the plant due to an inability to uptake sufficient phosphorus because of inadequate soil fertility or restricted root growth caused by soil compaction or root injury.

Cold-Induced Purpling

Stress-induced gene expression. Some anthocyanin genes are induced by cool temperatures (a stress response).[2] Anthocyanin production is also associated with diminishing levels of phosphorus within the plant.[3] Corn products vary in terms of the number of genes for anthocyanin production and their potential to turn purple. Some corn genotypes contain no genes for anthocyanin and may not turn purple.

Sugar accumulation. The anthocyanin pigment occurs in the form of a sugar-containing molecule. When plants are able to photosynthesize (make sugars) during the day but temperatures are too cool at night for optimal respiration (the breakdown of sugars for energy), sugars can build up in the leaves. Excess sugars can further encourage anthocyanin pigment formation. Once temperatures warm up, the excess sugars will be metabolized and plants will regain their normal green appearance.

Temporary phosphorus deficiency. In the early stages of growth, plants rely on nutrients in the seed for growth and development. When the seed reserves are depleted, which occurs around the V3 stage in corn, plants must rely on their root system to obtain the nutrients they need. Cool, wet soils can temporarily restrict root growth, which can result in young seedlings with insufficient root systems that are incapable of intercepting sufficient phosphorus from the soil. Phosphorus deficiency within the plant will affect sugar metabolism since phosphorus is required for the transport of sugars throughout the plant and for respiration.

Other Possible Causes of Purpling

Inadequate soil fertility, compaction, and root injury. Inadequate soil phosphorus, compaction, and root injury from pests, diseases, or herbicides can limit a plant's ability to intercept and absorb enough phosphorus for normal growth. Phosphorus deficiency in corn results in dark green colored plants that are stunted with thin stems. Severe phosphorus deficiency can lead to reddish-purple coloration of leaf tips, margins, and sheaths of older leaves. Newer leaves are not affected.

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Figure 1. Phosphorus deficiency symptoms (left) may appear very similar to cold-induced purpling (right).

Will Yield Potential be Affected?

While the accumulation of anthocyanin pigment in leaves is not considered to affect yield potential, the underlying cause of the purpling may impact yields.

- If purpling occurs in corn seedlings during a prolonged period of cool temperatures (especially at night), the condition should resolve on its own after the weather improves and plants resume normal growth. In this case, purpling is not considered to affect yield potential. The purpling will be uniform throughout the field.
- If purpling is caused by phosphorus deficiency in the soil or long-term root growth restriction, it is likely to affect yield potential and should be remediated. Purpling in this case may occur in isolated areas of the field where the condition is more severe. Purpling in older plants (V7 and older) is likely due to phosphorus deficiency in the soil.

In general, when the distribution of purple plants is uniform throughout the field, it is likely due to the cool temperatures. If purpling is isolated to certain areas of the field, it may be an indication of a yield-limiting stress.

Sources

[1] Davies, K.M. (editor) 2004. Plant pigments and their manipulation. Annual Plant Reviews. vol 14. Blackwell Publishing Ltd., CRC Press LLC.

[2] Christie, P.J., Alfenito, M.R., and Walbot, V. 1994. Impact of low-temperature stress on general phenylpropanoid and anthocyanin pathways: Enhancement of transcript abundance and anthocyanin pigmentation in maize seedlings. Planta. 194: 541-549.

[3] Henry, A., Chopra, S., Clark, D., and Lynch, J. 2012. Responses to low phosphorus in high- and low-anthocyanin coleus (Solenostemon scutellaroides) and maize (Zea mays). Functional Plant Biology. 39(3), 255-265.

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