



LET'S GO TO SCHOOL FOR A FEW MINUTES, OK – TWO MINUTES!!! Sept - 2026

In many areas where temperatures have presented continuous intense heat this summer, yields are a bit lower than in growing years when daily high temperatures have not held in the 90°F (plus) range. There are reasons for considerable yield declines, and reasons where continuous high temperatures have not adversely affected yields as



significantly. The Timothy grass and alfalfa pictured on this page are both growing this season in an area that has had several seven-to-10-day periods of continuous daytime-high temperatures above 90°F. Both fields have been treated with the products EarthGen215 distribute each year since 2015.

Photosynthesis is the process of growing a plant's leaves capturing light energy from the sun as well as carbon dioxide and hydrogen from the atmosphere and converting that carbon, oxygen, and hydrogen into **photosynthate**. **Photosynthate is the carbohydrate plants produce during photosynthesis**. It is a sugary material that contains primarily glucose. Photosynthate is the energy source for plant growth, development, and storage. Roots also take up some carbon dioxide from the soil that is needed for plant growth and crop production. As temperatures rise above about 85°F, photosynthesis starts to decline. Photosynthesis processes continue declining gradually as temperatures continue rising. For photosynthesis processes to function in plants' leaves, their stomata (Stomata are tiny microscopic pores found mostly on the surface of plant leaves and stems that let the plant exchange gases with the air. A single pore is called a stoma.) need to be open. Once temperatures reach about 85°F, those stomata start to close. More and more of them close as ambient air temperatures rise above about 85°F. Closed stomata do

not capture any carbon or oxygen in the form of carbon dioxide from the atmosphere when they are closed, so the most significant supply of carbon dioxide is cut off. An enzyme called rubisco activase (**Rubisco activase (Rca)** is a regulatory protein-enzyme that "wakes up" and maintains the activity of Rubisco—the primary enzyme responsible for fixing carbon dioxide during photosynthesis) facilitates plants converting the carbon dioxide leaves captured from atmosphere into photosynthate. When temperatures reach about 85°F, rubisco activase starts to become unstable and to denature. As it is denatured, the rubisco activase loses its abilities to facilitate creation of photosynthate. Rubisco activase continues denaturing more rapidly the higher the temperature rises. Also, as temperatures reach and surpass about 85°F photorespiration increases quickly, which wastes the plant's energy and the carbon it would otherwise store and use as needed for growth.

Plant respiration is the mechanism through which photosynthate is broken down to release energy stored in photosynthate. This released energy fuels growth, nutrient uptake from soil, and eventually crop production. As ambient temperatures rise, so does the rate of plant respiration. Rising respiration rates lead to more rapid consumption of photosynthate. So as temperatures rise to a point that photosynthesis begins to slow down, respiration rates are ramping up. This is similar to ourselves!



Alfalfa growing for its 3rd cutting in 2026.

At some point, plant respiration is consuming more energy/photosynthate than photosynthesis is producing. At this crucial point, plant growth stops, and can only resume once temperatures lower enough for photosynthesis to resume producing photosynthate, and energy production (by way of photosynthesis) again exceeds energy consumption by plant respiration. Contributing to plants reaching that crossover point of more energy loss than energy gains is that photosynthesis is active only during daylight hours. Plant respiration occurs during daylight hours and during darkness of nighttime hours. Plant respiration is essential for energy release from photosynthate but it can negatively affect production and storage of photosynthate when it outpaces photosynthesis.



Above is an alfalfa/orchard grass hayfield. In 2026 it has been producing during weeks of consecutive days with highs above 100 degrees F. It has been treated with the products EarthGen 215 carries since 2010.

The temperature threshold at which energy production via photosynthesis can be adversely impacted by the rate of plant respiration varies by species of plants, and by whether a plant is a C3, C4, or CAM. Further, if a plant is exposed to gradual temperature increases, it can acclimate some, to increasing temperatures. In addition, plants can adapt their relative photosynthesis and plant respiration processes if a hot spell is brief—perhaps an occasional hot afternoon, but prolonged, continuous excessive heat during a 10 day to two-week period of time does not allow plants to regulate these two systems and prevent the crossover of plant respiration using more energy than photosynthesis can produce. Once this crossover occurs, plants essentially stop growing. The combination of these processes shows the plant's natural defense system against a permanent wilt that can cause the plants to die.

Examples of crops that are C3 plants include alfalfa, soybeans, wheat, rye, barley, rice, timothy grass, rye grass, Kentucky bluegrass, and tall fescue grass. Generally, these plants all thrive in summertime temperatures at or cooler than about 85 to 88°F. Examples of crops that are C4 plants include corn, sorghum, millets, sugarcane, Bermuda grass, and buffalo grass. These plants use a photosynthetic pathway that first fixes carbon dioxide into a 4-carbon compound, which enables these plants to thrive in higher temperatures and more intense light environments. CAM plants include cacti, succulents, and pineapples. These plants have adapted to arid conditions by using Crassulacean acid metabolism for photosynthesis. Nutrient dense soil that is well structured buffers the decline of plants exposed to prolonged excessive heat. "Prolonged" in this context would be two weeks or more of continuous daytime-highs above 90°F. Well-structured soil usually has more porosity than does poorly structured soil. Well-structured soil holds more plant-available water and allows roots to access that moisture more evenly. During periods of prolonged excessive heat, this access to soil moisture delays the point at which stomata in leaves are forced to close for lack of water,

thereby allowing plant leaves to continue capturing carbon dioxide and some level of photosynthesis to continue creating photosynthate. This ongoing production of photosynthate extends the number of days before plant respiration's use of photosynthate exceeds photosynthesis production of it, and plants stop growing.

Applying the products EarthGen215 distributes as recommended helps build healthy soil structure and furthers development and storage of nutrient dense materials in soil's top eight to 10 inches.

Well-structured soil having more soil moisture and porosity gives soil higher thermal mass and better insulation, which helps root zone temperatures to stay lower and more stable. Poorly structured soil restricts root penetration and development, leaving plants with a more shallow, smaller root system to uptake soil moisture and nutrients. When high temperatures drive up transportational demands, constrained root systems cause a leaf's stomata to close sooner and more significantly throughout each leaf. Plants in poorly structured soil tend to show earlier and steeper declines because stomatal closure starts sooner, midday wilting becomes more severe and prolonged, and the plants are less likely to recover during cooler temperatures overnight. Plants growing in well-structured soil usually show fuller overnight recovery of their photosynthetic abilities.

Applying the products EarthGen215 distributes helps build healthy soil structure, and soil that is nutrient dense. Start planning for 2027 production by designing 2027 plans that will best incorporate practices that build and maintain nutrient dense, well-structured soil. EarthGen215 looks forward to being part of each of those plans for 2027.

Thank you and please call me with any questions!

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