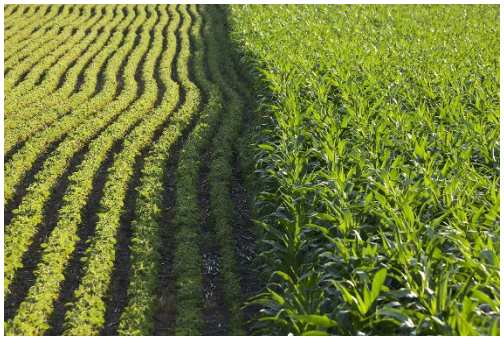
Cooperative Extension Service

Ohio County Farm & Home News

PHOTOSYNTHESIS – THE ULTIMATE YIELD PRODUCER

The following article is from Dr. Dennis Egli, U.K. Professor Emeritus, discussing the importance of sunlight and photosynthesis in determining your ultimate yield in grain crops.

The keys to high yield include variety selection, planting date, population, fertilizer and control of weeds and pests. Photosynthesis doesn't make the list, but there is no yield without photosynthesis. High yield requires high photosynthesis.



Think about it – a corn producer plants about 20 pounds of seed per acre and, 100 to 120 days later, harvests 250 bushels (14,000 pounds) of corn and leaves about 14,000 pounds of leaves, stems and husks, plus an unknown amount of roots, in the field. That 20 pounds of seed produced more than 28,000 pounds of plant material per acre. That is the miracle of photosynthesis.

Years ago, scientists pondering how a small seed could produce a large plant, concluded that the sustenance for growth must come from the soil. But when they grew a willow tree in a large soil-filled pot they found no decrease in the weight of the soil, so they mistakenly concluded that growth came from water.

Finally, in the early 1800's, they demonstrated that the increase in plant weight came from carbon dioxide in the air (with a small contribution from water) in the presence of sunlight – in other words, they discovered photosynthesis.

Photosynthesis in green plant tissues uses the energy in sunshine to convert carbon dioxide into simple sugars that are the building blocks for all plant tissues. Energy from respiration of these simple sugars is used to acquire nitrogen and to make starch, protein, oil, cellulose and all the many compounds that make up a plant.

Photosynthesis requires energy (from the sun), carbon dioxide, warm temperatures (but not too warm), water (mostly just evaporates from the leaves), and mineral nutrients to function.

Photosynthesis not only feeds us, but, for most of recorded history, it provided the energy to cook our food, heat our homes and, more recently, to move us from place to place. The plant tissues that ultimately, over geologic time, became coal and petroleum, which came from photosynthesis.

Photosynthesis of a field of corn or soybean reaches a maximum when the leaves completely cover the ground because only sunlight that is intercepted by the leaves is used in photosynthesis. Only weeds benefit from sunlight that reaches the soil. Maximum yield requires complete ground cover near the beginning of reproductive growth.

We don't often think about it, but crop management is all about providing the ideal environment for photosynthesis.

We irrigate, fertilize, adjust row spacing, and control weeds and pests, in large part, to maximize photosynthesis. Managing for maximum yield is maximizing photosynthesis.

Biochemists tell us that there are two types of photosynthesis (there is a third, but it doesn't appear in any common crops). Most crops have C3-type photosynthesis (first stable product is a 3-carbon sugar) while only a few crops use the C4 system (first stable product is a 4-carbon sugar). C4 crops have higher photosynthesis rates and a greater tolerance to high temperatures,

while the photosynthesis rate of C3 crops increases when the carbon dioxide concentration in the air goes up. Carbon dioxide levels in the air increased from 280 ppm at the beginning of the industrial revolution to roughly 426 ppm today. This increase contributed to higher yields of C3 crops and is also causing climate change. C4 crops do not respond to higher carbon dioxide levels.

Interestingly, most of the crops that feed the world (rice, wheat, barley, soybean, peanuts, potatoes, all the grain legumes) have C3 photosynthesis, while the more productive C4 photosynthesis is found only in corn, sorghum, and millet.

The rate of photosynthesis – the amount of carbon fixed per acre per day – is directly related to the crop growth rate (pounds of dry matter per acre per day) and to yield – the higher the growth rate, the higher the yield.

Yield was reduced when we shaded soybean communities during reproductive growth to reduce the sunlight they received and photosynthesis (Egli, 1993). A 30% shade treatment reduced yield by 28%, while a 63% treatment reduced yield by 58% averaged over 2 years and 2 varieties. One could show the same response to water deficits or poor fertility. Reducing photosynthesis reduces yield.

The duration of photosynthesis is also important, especially during the seed-filling period – the longer the seed-filling period, the more time there is for photosynthesis and the higher the yield. There is evidence in several crops that selection for higher yield by plant breeders increased the length of the seed-filling period and yield. The length of the vegetative growth period is not always related to yield.

Photosynthesis – the ability of a green leaf to use energy in sunlight to fix carbon is the fundamental process that makes agriculture possible. Growing crops is basically a matter of managing photosynthesis. We will depend on photosynthesis as long as our food comes directly or indirectly from green plants. Strange as it may seem, this basic process that feeds us also produced the fossil fuels that may ultimately kill us if we continue to burn them, increasing the carbon dioxide concentration in the air and causing climate change.

"RINSE & RETURN" PESTICIDE CONTAINER RECYCLING – JULY 9TH

We will have our first collection of "Rinse & Return" Pesticide Container Recycling program Wednesday, July 9th at AgriGro Farm Center, from 9:00 a.m. till 11:00 a.m.

This is an excellent program for disposing of your 5 gallon and smaller pesticide containers. By recycling the containers, new products can be made from the plastic.

To participate simply:

- Triple rinse the containers as you empty the chemical, so residue is removed
- Remove label and container caps and dispose of them. The caps are a different type of plastic.
- Tie a string thru 15-20 containers for easy loading and it prevent the containers from blowing out of the pickup
- Bring containers to collection site
- We will have a second collection on September 17th at the same time and location, if you are unable to make tomorrows collection.

UPCOMING EVENTS:

- July 9 – "Rinse & Return" Pesticide Container Recycling; AgriGro Farm Center; 9:00 a.m. till 11:00 a.m.
- July 22 – U.K. Corn, Soybean & Tobacco Field Day; U.K. Research & Education Farm, Princeton; 8:00 a.m. till noon
- July 22 – Beef & Forage Field Day; U.K. research & Education Farm, Princeton; 1:30 p.m. till 4:00 p.m.
- July 23 – Farm Succession Seminar: Building the Bridge to Farm's Future; Owensboro Convention Center, Owensboro; 8:00 a.m. till 4:30 p.m.