

GROW HOW KNOW HOW: A CLOSER LOOK AT PLANT NUTRITION

 **PCT | Sunrise**[®]
Local grow how.

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ALL ABOUT THE ESSENTIALS: BALANCED NUTRIENTS FEED THE CROP AND YIELD HEALTH

For healthy, strong plants, good nutrient management matters. All plants need 16 essential nutrients to survive and thrive throughout the growing season, because each nutrient feeds a critical plant function. Nutrient deficiencies can result in slow or reduced plant growth, poor health and limited yield.

Common Visual Symptoms of Nutrient Deficiencies.

When a deficiency exists, plants exhibit unusual coloring, leaf damage and/or stunted growth. The good news is that it's possible to correct deficiencies before they negatively impact your yield. Properly identifying those deficiencies is the first step.

Nutrients all have varying degrees of mobility in plants, which influences where the deficiency symptom will first appear. When mobile nutrients (nitrogen, phosphorus, potassium and magnesium) are deficient, symptoms show up in older leaves, typically found in the lower portion of the plant. For immobile nutrients (boron, calcium, copper, iron, manganese, molybdenum, sulfur and zinc), young leaves, typically at the top of the plant, are impacted.

Some crops are more susceptible to certain nutrient deficiencies than others and deficiencies can impact crops in different ways. For example, chlorine deficiencies are rare in Ohio-grown corn and soybeans because the required quantities are supplied naturally by rainfall.



Leaf yellowing (chlorosis)

When plants do not receive the nutrients necessary for photosynthesis and/or chlorophyll production, leaves and at times, the entire plant will yellow.



Leaf browning (necrosis)

In later stages of nutrient deficiencies, affected plant tissue browns and dies.



Stunted growth

Nutrients play various and important roles in plant functions, such as stem elongation, photosynthesis and protein production. When those nutrients are deficient, plant growth slows.

Common symptoms of nutrient deficiencies in corn and soybean plants

Nitrogen	Corn: Chlorosis or necrosis, along with stunted plant growth, initiating from the leaf middle and moving outward on the leaf. Soybean: Older leaves show signs of chlorosis.
Phosphorus	Corn: Chlorosis on older leaves of young plants and stunted growth. Soybean: Stunted plants with delayed blooming and maturing.
Potassium	Corn and soybean: Chlorosis occurs first on older leaves, beginning outside of the leaf margins, which can develop into necrosis.
Manganese	Corn and soybean: Interveinal chlorosis (yellowing between the dark green veins of the leaves) of younger leaves.
Sulfur	Corn: Chlorosis or striping first appears on younger leaves. Soybean: Chlorosis first appears on younger leaves.

Dig In: Soil Conditions Can Impact Nutrient Availability

Soil properties correlate with crop health. While Ohio soils generally contain reasonable levels of organic matter, nutrient availability can vary across the state. Specific field environments and soil conditions can increase the potential of finding a nutrient deficiency.

Deficiencies Are More Likely to Occur When Soil Is/Has...

7
N
Nitrogen

- + Cool and/or wet for an extended time shortly after planting.
- + Dry after mid-season.
- + Sandy.

15
P
Phosphorus

- + Cool and excessively wet, dry or compacted.

19
K
Potassium

- + Excessively dry and compacted.
- + Excessively wet.
- + Sandy.

20
Ca
Calcium

- + Very low pH.
- + Acidic.

12
Mg
Magnesium

- + Very sandy and acidic in moderate to high rainfall areas.

16
S
Sulfur

- + Cool and dry.
- + Acidic, sandy or low in organic matter.

5
B
Boron

- + Excessively dry.
- + Sandy and low in organic matter or has high pH.

29
Cu
Copper

- + Very high organic matter.
- + High pH.

26
Fe
Iron

- + High pH.
- + Calcareous.

25
Mn
Manganese

- + Dry.
- + Sandy.
- + High pH or high organic matter content.

42
Mo
Molybdenum

- + Very low pH.
- + Acidic or highly weathered.

30
Zn
Zinc

- + Cool and wet.
- + Low organic matter.
- + High pH.

16 Essential Elements for Plant Health.

The 16 essential elements are divided into three categories, which include macronutrients, secondary macronutrients and micronutrients. Plants require macronutrients in much greater quantities than secondary macronutrients and micronutrients, but all are crucial. Nutrients are derived naturally from the air, water or soil and supplemented with fertilizer.



Source	Element	Classification	Function	
Air and water	Carbon (C)	Carbon, hydrogen and oxygen are non-mineral structural elements present in the atmosphere and environment.		
	Hydrogen (H)			
	Oxygen (O)			
Air and soil	Nitrogen (N)	Macronutrient: Elements needed in the largest quantity.	Nitrogen is a major component of chlorophyll, which is how plants use sunlight energy to produce sugars and form amino acids.	
Soil and fertilizer	Phosphorus (P)		Phosphorus is involved in cell membrane function and integrity and energy storage and transfer.	
	Potassium (K)	Potassium is important for plant metabolism, regulating water and adapting to stress.		
	Calcium (Ca)	Secondary macronutrient: Plants require these in smaller quantities.	Calcium is critical for cell division and formation.	
	Magnesium (Mg)		Magnesium is needed for chlorophyll production.	
	Sulfur (S)		Sulfur helps develop enzymes and forms amino acids and chlorophyll.	
	Soil and fertilizer	Boron (B)	Micronutrient: Needed in low – even trace – concentrations.	Learn more about micronutrients on page 6.
		Chlorine (Cl)		
		Copper (Cu)		
		Iron (Fe)		
		Manganese (Mn)		
Molybdenum (Mo)				
Soil and fertilizer	Zinc (Zn)			

THE BIG IMPACT OF MICRONUTRIENTS

Micronutrients are essential to plant growth and balanced nutrition. Though crops require them in very small quantities, these elements are no less important than macronutrients and secondary macronutrients. Micronutrients support many plant functions — including plant processes and growth — and can help increase your potential for high yield.

Micronutrients and Their Contributions to Corn and Soybean Plant Health

5
B
Boron

- + Supports nutrient transfer throughout the plant.
- + Strengthens cell wall biosynthesis, which influences growth factors, including tassel and silk formation in corn and nodule development, branching and flower retention in soybeans.

25
Mn
Manganese

- + Promotes efficiency in plant photosynthesis, increasing overall plant development and growth.
- + Activates plant enzymes.

17
Cl
Chlorine

- + Helps plants manage water stress and resist fungal diseases.
- + Aids in plant metabolism.

42
Mo
Molybdenum

- + Helps plants use nitrogen more effectively.

29
Cu
Copper

- + Important for chlorophyll and seed production, protein synthesis and respiration.

30
Zn
Zinc

- + Important for starch and protein formation, root development and timely plant maturity.

26
Fe
Iron

- + Essential for development of chlorophyll and activation of respiration processes.

Diagnosing Deficiencies.

Micronutrients are found naturally in soil and absorbed by plants through their roots. When an essential micronutrient is not available or accessible for a growing plant — due to low nutrient levels in the soil, unbalanced pH levels in the soil, excessively wet or dry soil, root damage or another reason — physical symptoms emerge, ranging from discoloration to abnormalities, reduced growth to yield loss.

That’s why it is important to evaluate the presence — or lack — of micronutrients in your fields.

In addition to surveying plants for symptoms of deficiencies, regular soil testing and plant tissue sampling and analysis provide complete assessments

and accurate diagnoses. Soil testing helps you understand the nutrient levels of the soil. Plant tissue analysis supplements soil testing to determine the nutritional status of your crops, including the effectiveness of your current nutrient management practices. An experienced agronomist can help you navigate the considerations and complexities of these tests to pinpoint issues.

What’s more, because plants use micronutrients to process or work with other nutrients, a deficiency in one nutrient may closely resemble the malnutrition characteristics of another. An agronomist can provide solutions and corrective actions to supplement soil with the micronutrients your crop needs.

Symptoms of deficiencies in corn and soybean plants	
Boron	Corn: Short and bent ears, barren stalks, poor kernel development and whitening of younger leaves. Soybean: Crinkling leaf tips and interveinal chlorosis of younger leaves.
Chlorine	Corn and soybean: Chlorosis of younger leaves.
Copper	Corn: New leaves develop a blueish-green tint; tips and edges of older leaves develop necrosis.
Iron	Corn and soybean: Interveinal chlorosis of younger leaves.
Manganese	Corn and soybean: Interveinal chlorosis of younger leaves.
Molybdenum	Soybean: Interveinal chlorosis and cupping of younger leaves.
Zinc	Corn: Stunted growth and leaves with broad white stripes near the midrib. Soybean: Interveinal chlorosis of younger leaves.



THE FUNDAMENTALS OF BIOSTIMULANTS

Biostimulants include diverse formulas of substances or microorganisms that are applied to seed, plants or soil to promote plant growth, health and quality. They can fit seamlessly into what you already do for your crops to enhance the investments you are already making.



Raise the Bar for Plant Health.

Used throughout the season — from seed germination to plant maturity — biostimulants help develop robust root systems, mitigate plant stress and enhance the development of soil microorganisms by breaking down crop residue. Together, these actions can lead to improved overall crop quality.

Classification and Regulation.

While there is no universally agreed-upon definition of biostimulants, most agree that this plant health technology is neither a fertilizer or pesticide — it is, perhaps, in a category of its own.

Biostimulants help plants more efficiently take up nutrients, but they do not provide the

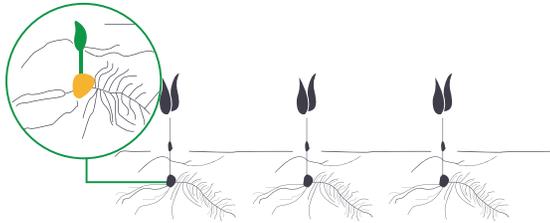
actual nutrition or operate through the same mechanisms as fertilizers. Similarly, biostimulants help improve overall plant health — which makes them more resistant to pests and diseases — but they do not offer any direct actions against pests or disease.

What's more, biostimulants are not currently regulated in the United States or in any other country. At present, international and national working groups and coalitions from industry associations and federal and state agriculture departments are banding together to address this plant health technology from all sides, including determining a universal definition and recommending a framework for establishing a regulatory process.

Biostimulant type	Health benefit to plants
Acid-based biostimulants like humic and fulvic acids	Enhance root health by creating a shield around root systems for more robust growth and better nutrient uptake.
Seaweed and organic extracts	Mitigate strain on plants by increasing plant tolerance to and recovery from abiotic stresses, such as drought, excessive water and extreme temperatures.
Microorganisms	Boost plant health, increase flower production and support the growth of more vigorous root systems. Increase soil health by breaking down cellulose, proteins, lipids, starches and chitins in heavy no-till crop residue to release nutrients.

DETERMINING NUTRIENT RETURN ON INVESTMENT

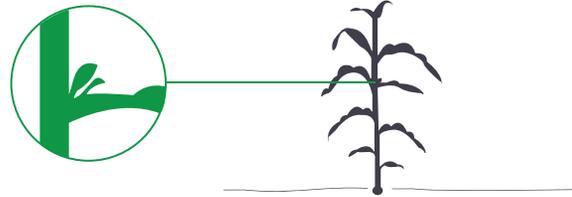
Today's progressive farmers are willing to maximize yield potential when it positively impacts profits. However, the thought of adding fertilizers and biostimulants to their plans may seem like a step in the wrong direction. Let's explore situations where focusing on crop health provides a strong return on investment (ROI).



Starter Fertilizers.

Starter fertilizers are a great way to get the essential nutrients crops need for growth right from the start. They promote nutrient uptake, robust root development and uniform emergence. According to research from The Ohio State University (OSU), plants treated with starter fertilizers consistently result in early-season plant height and dry matter accumulation. Faster growth can also translate to earlier silking and drier grain at harvest.

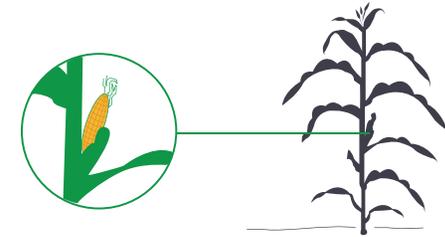
However, a strong start doesn't always correlate with higher yields. While Farm Journal plots have consistently demonstrated yield advantages of at least 3-10 bu. per acre in corn, the Tri-State Fertility Guide shows starter fertilizers provide the most yield benefit in adverse situations. Cold soils, late planting, low soil fertility, planting corn-on-corn and high crop residue are where starters shine. With more acres transitioning to conservation tillage and unpredictable planting weather, applying starters can provide more consistent protection for your biggest investment.



Micronutrients.

Experts agree that simply feeding crops micronutrients doesn't guarantee higher yields, but they can be effective when deficiencies are known or in soils with high potential. After tissue testing 26,000 samples from across the U.S., Winfield United determined that 78 percent of U.S. corn is deficient in zinc, while soybeans are becoming increasingly low in copper and potassium.

Tissue testing is the first step to deciding if micronutrients make economic sense for your farm. If a deficiency is identified, growers should talk with a local agronomic expert to determine the best approach. One way OSU researchers suggest testing for yield advantage is leaving an unfertilized strip in the field to compare with areas that received the micronutrient. Yield monitors or weigh wagons can help determine if the application increased yield and provided an economic benefit.



Biostimulants.

With biostimulants being fairly new to the marketplace, the economic return is still difficult to quantify. Ingredients like seaweed extracts, bacteria, amino acids and microorganisms can protect seedlings, enhance root development and also help breakdown residue in fields. Like starters and micronutrients, they benefit farmers most in adverse situations. For growers seeking more sustainable solutions to plant health, they represent another tool in the toolbox. Growers strive to increase ROI by choosing inputs wisely and reducing negative impacts on the environment and making fields more productive.

Remember, even if you have less money to spend on inputs, always consider the return on investment. The most profitable plan often uses the right input on the right acre in the most efficient way.

PCT | SUNRISE®: YOUR LOCAL GROW HOW EXPERTS

Get fields of knowledge with PCT | Sunrise. We're your local grow how experts, providing you with innovative, customized crop nutrition products and local agronomic expertise.



PCT | Sunrise **Your Local Grow How Experts.**

PCT | Sunrise is a progressive crop technology company that is locally owned by Sunrise Cooperative, Inc. We offer a product lineup that encompasses precise blends of starters, foliars, finishers, adjuvants and biologicals that contribute to healthy crops. PCT products are specially formulated to help you improve plant health and enhance your crop protection strategies at precise times throughout the growing season. The result? Stronger plants and high-yielding crops.

In addition, we provide local expertise to help you get a strong return on investment for your farm. Sunrise Agronomy Solutions Advisors (ASAs) work with PCT agronomists to offer you customized solutions and guidance every step of the way. What's more, PCT | Sunrise participates in comprehensive, on-farm studies to gather information on how products perform in the field, which can help you make informed, data-driven decisions for your full-season approach to crop health, protection for your biggest investment.



Sunrise Cooperative **A Leader in Agricultural Knowledge.**

Sunrise is a leading agricultural and energy cooperative — and 100 percent farmer owned — that spans from the Ohio River to Lake Erie. Our team of expert agronomists, certified crop advisors, precision ag specialists and custom applicators deliver solutions and services through a network of locations throughout Ohio. Simply put, everyone at Sunrise Cooperative is committed to growing your success.

In addition, we leverage the technology of our strategic partners to offer the latest in seed genetics. We also provide proper seed treatment options, crop inputs and custom applications to keep you moving forward.

THE PCT | SUNRISE® APPROACH

PCT Sunrise offers a comprehensive system that feeds and protects your crops throughout the season, allowing your crops to start strong and stay strong all the way to harvest.

Full-Season Crop Health.

Create a holistic approach that provides the right nutrients at the right time with PCT | Sunrise starters, foliars and finishers. Each product is agronomically designed to help you maximize yields and profits. We also offer micronutrients, biologicals and adjuvants that complement your nutrition program, alleviate plant stress, improve overall health and enhance the performance of your crop protection products. Local PCT experts can help you determine the right product and application method to achieve a successful growing season.



START STRONG.

Stimulate germination and encourage seedlings to instantly capture nutrients, accelerate root development and increase efficiency of uptake during early growth stages. Feed your corn and soybeans the key nutrition ingredients they need to stand strong against adverse soil and weather conditions.

TRANSFORM CROPS.

Increase nutrient uptake and correct plant deficiencies with individual micronutrients that are double chelated; protecting them from being tied up in the soil unavailable to the plant.



ACCELERATE GROWTH.

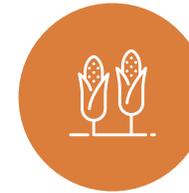
Correct visible and invisible nutrient deficiencies, improve nutrient uptake and keep crops healthy and developing to maturity. Feed crop growth immediately, regardless of soil pH or environmental factors, to achieve consistently higher yields.

BOOST HEALTH.

Multiple modes of action and a combination of beneficial microbes, biologicals and organic acids help stimulate root growth, promote plant growth, reduce stress and ensure sound nutrition throughout the growing season.

PROTECT AND ENHANCE.

Achieve effective control across various environmental conditions on target weeds, insects and diseases by preventing drift and promoting compatibility with nutritional products.



FINISH BIG.

Add nutrients in the last stages of growth to ensure your crops develop to their full potential. Give corn, soybeans and wheat the energy and protection needed for strong yields and excellent health.

SET UP FOR SUCCESS.

This concentrated blend of beneficial microorganisms breaks down cellulose, proteins, lipids, starches, lignins and chitins in heavy no-till crop residue to release nutrients and build soil health for the next crop.



PLANTING

PCT|Sunrise
StandUp®

StandUp® starter blends are the first step in your nutrient management program. They initiate early-season growth for quick, uniform emergence and maximum plant stands.

Uniquely formulated starter products for a strong start to the growing season.

PCT|Sunrise
NutraBurst™

NutraBurst™ products give plants specific micronutrients they need throughout the growing season.

Micronutrient blends for season-long plant health.

PCT|Sunrise
BioBuild™

BioBuild™ products promote growth and overall health of young corn and soybean plants for high yield potential.



POST-EMERGENCE

PCT|Sunrise
FolrFeed®

FolrFeed® products give crops a mid-season nutritional boost and provide early protection from pests and diseases.

Foliar blends for your mid-season nutrient management system.

PCT|Sunrise
BioBuild™

BioBuild™ products promote growth and overall health of young corn and soybean plants for high yield potential.

PCT|Sunrise
AdjuTec™

AdjuTec™ adjuvants improve the efficacy of your crop protection products throughout the growing season.

Multiple blends sourced and formulated with the highest quality, state-of-the-art, low-use-rate adjuvants for your farm.



LATE-SEASON APPLICATION

PCT|Sunrise
GrainMaker™

GrainMaker™ finishers give crops a final boost of nutrients as harvest nears to help maximize yields.

Finishers to enhance your crop's potential.

PCT|Sunrise
BioBuild™

BioBuild™ products promote growth and overall health of young corn and soybean plants for high yield potential.

PCT|Sunrise
NutraBurst™

NutraBurst™ products give plants specific micronutrients they need throughout the growing season.

Micronutrient blends for season-long plant health.



POST HARVEST

PCT|Sunrise
BioBuild™

BioBuild™ products promote growth and overall health of young corn and soybean plants for high yield potential.

GETTING STARTED: STEPS TO CREATING AN EFFECTIVE APPROACH

Intrigued by the PCT | Sunrise® approach? It's time to reach out to one of our local "grow how" experts to get started creating your customized plan. Here are a few things we'll need to know:



1. Testing.

Before you get started with PCT, it's important to know the issues that exist in your fields. Have results from recent soil and tissue tests available so we can help you select the right products. If you haven't soil or tissue tested your crops, it's a service we offer and highly recommend.

2. Utilization

Our products can be utilized with a variety of application options fitting the needs of your farm throughout the season. Starter fertilizers work well in-furrow or injected two x two (meaning two inches to the side of the seed and two inches below the soil). Products such as our BioBuild biologicals can be applied as seed treatments or in-furrow to enhance biological activity and encourage fast emergence. PCT foliar and PCT finisher fertilizers are compatible with many crop protection products and can be tank mixed and sprayed as part of a mid-season plan.

3. Equipment.

Knowing your current equipment and precision technology needs will help us determine the right action plan. Whether it's upgrading your planter with Precision furrow jets or getting you aligned with one of our custom application services, we have the right program for you. We offer custom crop protection application, dry fertilizer and lime spreading as well as aerial application to ensure you have the proper application for every season.

MINIMIZING ENVIRONMENTAL IMPACT

Protecting the land that sustains us all is as important as ever. That's why we're focused on helping you maximize your yields while minimizing environmental impact.

Our Commitment to Sustainability Runs Deep.

PCT | Sunrise® is dedicated to doing the right thing for the environment. As part of our commitment to environmental stewardship, we deliver new technologies that align with nutrient regulations and best practices that reduce impact on water quality throughout the state.

PCT agronomists work closely with Sunrise Agronomy Solutions Advisors (ASAs) to offer you an abundance of knowledge and individualized plans that help you minimize runoff and retain the nutrients you pay for. After all, nutrients are more efficient when they are retained within your field's boundaries and in the crop rooting zone and not lost into the environment.

We Make Nutrient Management a Priority.

To keep our water sources pure and work toward the long-term improvement of Lake Erie's water quality — and to help you do the same — we adopted the 4R Nutrient Stewardship framework for best management practices to properly manage fertilizers and cropping systems.

Most of Sunrise Cooperative's agronomy locations are either certified in 4R Nutrient

Stewardship or are in the process of becoming certified. Through this voluntary program, we make a concentrated effort to significantly reduce and prevent applied nutrients from running off fields by providing farmers across the state with ongoing education and responsible nutrient management practices.

When the right fertilizer source is used at the right rate, at the right time and in the right place, your farm can reap economic benefits and contribute to a cleaner environment.

4R Nutrient Stewardship Principles.



Right Source. We deliver balanced plant nutrition that meets your crop's needs in forms that are most efficiently recovered by plants.



Right Rate. Using timely, accurate soil samples, we match your field's nutrient levels to historical yield levels and future yield goals. From there, we match nutrient application rates to crop needs, carefully ensuring we are not overapplying nutrients when they are not needed.



Right Time. When it comes to feeding plants, timing is everything. For quick uptake and maximum crop benefit, we time fertilizer availability when crops need them, while also taking into consideration factors that can challenge plant nutrition.



Right Place. To most effectively use nutrients, we can physically place them where they are most available to the plant. Because nutrients are vulnerable near the soil surface, we concentrate them in areas where they are more resistant to loss and closer to plant roots. Some nutrients are best fed to the plant through the leaves, using foliar fertilizers.



GET IN TOUCH WITH PCT | SUNRISE

We're ready to help you improve your yields with advanced crop nutrition. Contact us now to develop your custom approach and learn more about special offers geared toward getting started.

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