



Trusted Advisors. Proven Solutions.

Micronutrient Essentials for Better Soybean Yields



Micronutrients, Plant Health, and Higher ROI

Micronutrients are essential to plant growth and yield, even in small amounts. Deficiencies in elements like iron, zinc, and boron can limit performance, reduce nutrient uptake, and impact overall crop health.

Recognizing and addressing these deficiencies early is key to maximizing productivity. Monty's has solutions designed to support micronutrient availability and uptake, helping growers correct imbalances and drive stronger, more resilient crops.

Healthier crops mean higher yields!



Nitrogen

Role in plant development

7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro	
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium		Secondary
5 B Boron	17 Cl Chlorine	25 Mn Manganese		26 Fe Iron
28 Ni Nickel	29 Cu Copper	30 Zn Zinc	42 Mo Molybdenum	Micro
1 H Hydrogen	6 C Carbon	8 O Oxygen	Non-Fertilizer	



Nitrogen Deficiency in Soybeans

Nitrogen is a compound of vitamins, amino acids and energy systems within the plant, which form its proteins. Thus, N is directly responsible for increasing protein content in plants.

Lack of N and Chlorophyll means the plant will not utilize sunlight as an energy source to carry on essential functions such as nutrient uptake.

Nitrogen is necessary for chlorophyll molecules, is involved in photosynthesis.



Nitrate NO_3 is very mobile in the soil and moves with soil water to root surfaces where plants can absorb it.

Nodulation is extremely important to supply the Nitrogen needed by Atmospheric exchange

Nitrogen (N)

- Soybeans require high amounts of Nitrogen (N) – up to 500 lbs/acre for high yields.
- Essential for plant growth
- N – is essential in photosynthesis and Chlorophyll development.
- Soybean roots form nodules that house bacteria, providing them carbon in exchange for atmospheric Nitrogen, making conventional N fertilizer usually unnecessary.
- While Soybeans take up Soil N, they primarily obtain N (50-60%) through a symbiotic relationship with *Bradyrhizobium japonicum* bacteria, which fix atmospheric N into Ammonium within root nodules.
- N – fixation begins roughly 30 days after planting, with 70-80% of total N eventually moving into the seed.
- Soybean grain contains about 40% protein, creating a high demand for Nitrogen during seed development.
- Soil pH should be managed (ideally above 6.0) to ensure effective nodulation and Nitrogen uptake.

Nitrogen (N)

- NH_4^+ depress uptake of **K**, **Ca**, and **Mg**
- NO_3^- depress uptake of **P**, **S** and **Cl**
- NH_4^+ lowers pH may increase **P**, **Fe** and **Mn**
- NO_3^- reduction in tissue requires **Mo**
- Excess **N** can be offset by **K**
- Excess Commercial fertilizer can completely shut down the Nodulation on the Soybean root



Phosphorus

Role in plant development

7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium	Secondary
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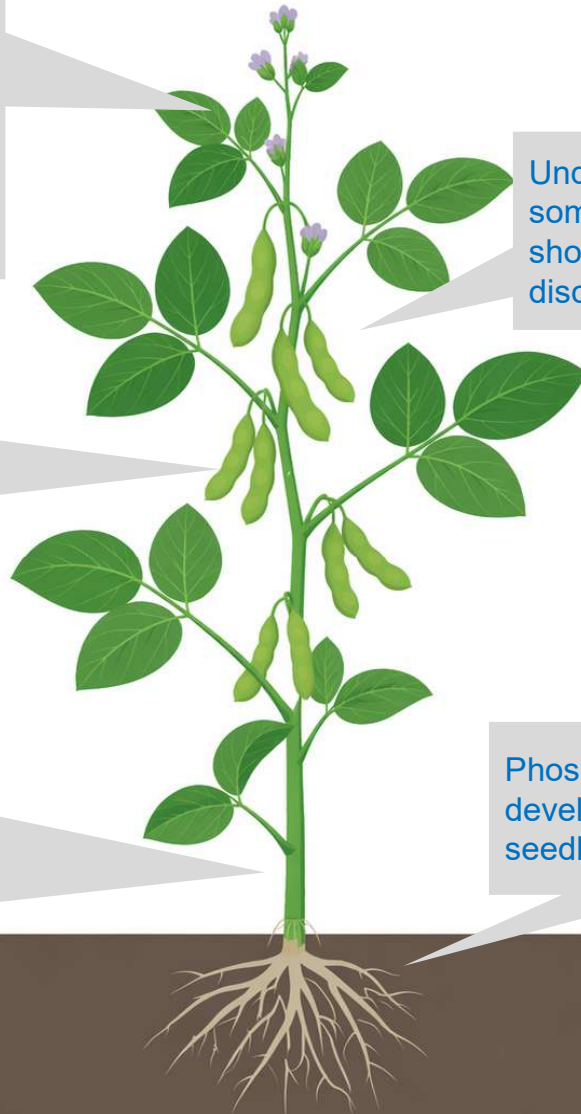


Phosphorus Deficiency in Soybeans

The highest levels of P in young plants are found in tissue at the growing point. As crops mature, most P moves into seeds, fruit, or both.

Phosphorus is noted especially for its role in capturing and converting the sun's energy into useful plant compounds.

Research associates specific growth factors with P, stimulated root development, increased stalk and stem strength, and improved flower formation and seed production.



Under P deficiency, some crops, tend to show abnormal discoloration.

Phosphorus promotes root development and early seedling growth.

Phosphorus (P)

- Plants absorb most of their P as their primary orthophosphate (H_2PO_4) form.
- P – is crucial for the formation and development of nodules on soybean roots, which are necessary for capturing atmospheric nitrogen.
- P – plays a role in photosynthesis, respiration, energy storage and transfer, cell division and enlargement, and several other processes in the living plant.
- P – promotes strong, early roots and seedlings establishment and expansion, enhancing the plant's ability to absorb water and nutrients.
- P – is vital for flower formation and seed filling, as P is highly concentrated in the seed.
- P – improves the quality of fruit, vegetable, and grain crops.
- P – hastens maturity.

Phosphorus (P)

- **N:P** ratio **10:1** often optimum
- **Calcium** increases **Phosphorus** uptake across membranes
- **Magnesium** is activator of many **Phosphorus** enzymes
- **Aluminum** reduces available **Phosphorus**
- **Iron** accompanies **Phosphorus** uptake
- **Zinc** uptake is suppressed by **Phosphorus**



Potassium

Role in plant development

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12 Mg Magnesium	16 S Sulfur	20 Ca Calcium	Secondary
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1 H Hydrogen	6 C Carbon	8 O Oxygen	Non-Fertilizer

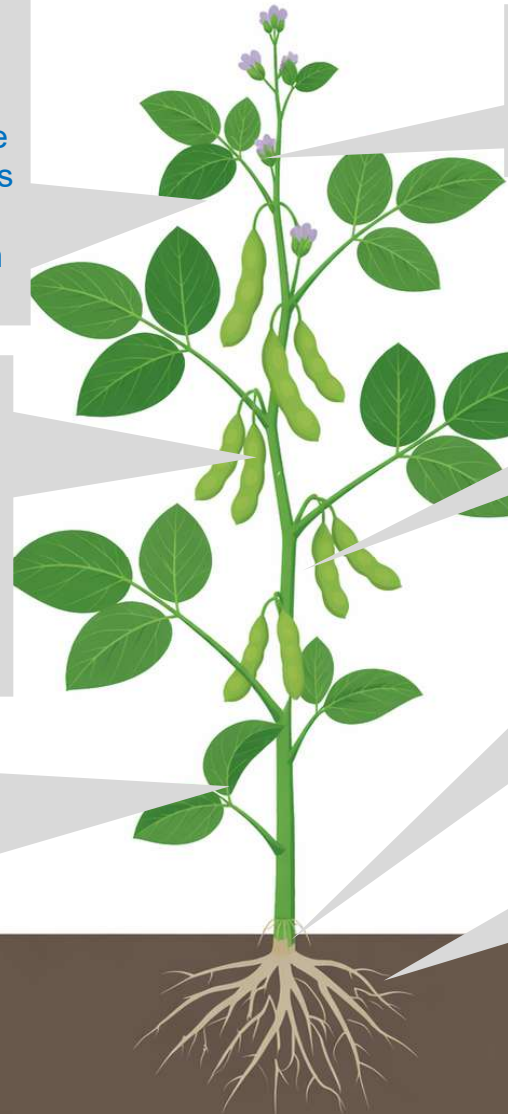


Potassium Deficiency in Soybeans

Potassium enhances many enzyme actions aiding in photosynthesis and food formation. It builds cellulose and helps translocate sugars and starches. Potassium is vital to producing grains rich in starch.

Potassium is known as the “quality nutrient” because of its important effects on factors such as size, shape, color, taste, shelf life, fiber and other quality-related measurements.

Plants deficient in K are less resistant to drought, extreme temperatures and other stresses. Plants lacking K are also more susceptible to pests, diseases and nematode attacks.



Potassium maintains turgor and reduces water loss and wilting

In many high-yielding crops, the K content in the plant is comparable to the Nitrogen (N) content.

Potassium is absorbed by plants in the ionic form, indicated as K

Ample K can increase root growth and improve drought tolerance

Potassium (K)

- K – controls stomatal opening, regulating transpiration and improving tolerance to water stress.
- K – transports sugars and carbohydrates, which is crucial for filling pods and developing high-quality, high-protein seeds.
- K – also is vital component of determining seed weight, seeds per pod, and improved oil content.
- K – influences water-use efficiency and improves drought-tolerance.
- K – activates more than 60 enzyme systems (which regulate the rates of major plant growth reactions).
- K – helps the plant overcome the effects of diseases.
- The demand for K is highest during rapid vegetative growth.

Potassium (K)

- High levels of K can inhibit the plant's ability to absorb Mg and Ca.
- Excessive K can inhibit root nodule development, hindering the soybean plant's nitrogen fixation capability.
- Excess K can antagonize the uptake of micronutrients, including Iron (Fe), Copper (Cu), Manganese (Mn) and Zinc (Zn).
- K is relatively immobile in the soil, making it crucial to manage its availability through proper soil testing.



Magnesium

Role in plant development

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1 H Hydrogen	6 C Carbon	8 O Oxygen	Non-Fertilizer	



Magnesium Deficiency in Soybeans

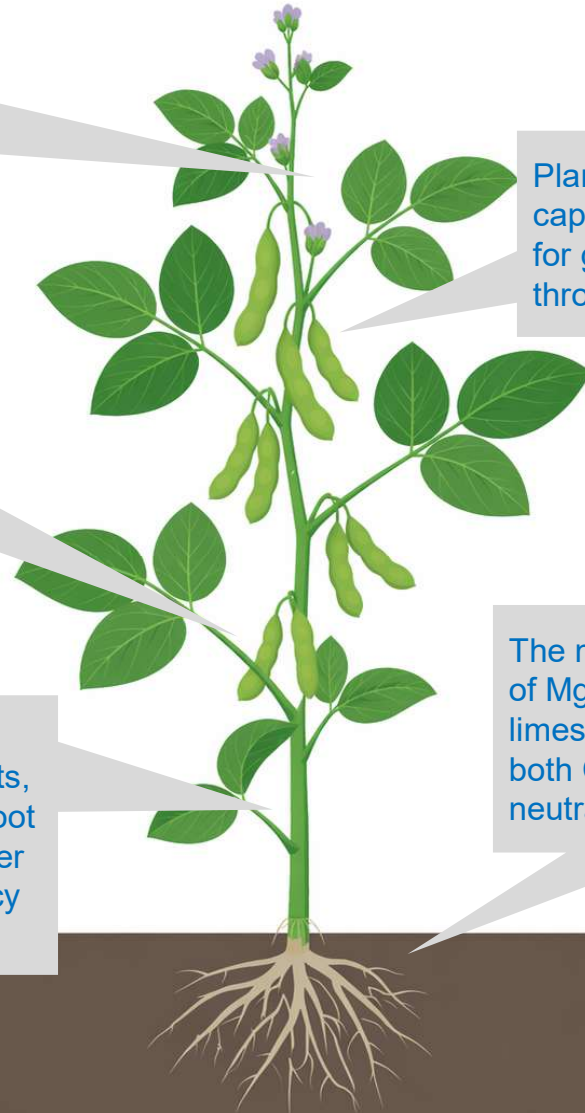
Magnesium is mobile within the plant and moves easily from older to younger tissue.

Plants require Mg to capture the sun's energy for growth and production through photosynthesis.

When Mg deficiencies occur, the lower (older) leaves are affected first.

Magnesium acts as a Phosphorus carrier in plants, and is required for better root formation and thus for better nutrient and water efficiency in plants.

The most common source of Mg is dolomitic limestone, which provides both Calcium and Mg, while neutralizing soil acidity.



Magnesium (Mg)

- Mg – is a core component of chlorophyll through photosynthesis
- Mg – acts as a carrier molecule for phosphorus, aiding in its uptake and movement from older leaves to developing pods.
- Mg – improves water use efficiency (WUE) and carboxylation efficiency, enhancing soybean tolerance to heat and drought stress.
- Mg – acts as a cofactor for enzymes involved in photosynthesis, and aids in sugar and starch synthesis.
- Mg – affects seed development in the pods affecting the seed bean count.

Magnesium (Mg)

- Excess K is the primary inhibitor of Mg uptake.
- Over application of K fertilizer can severely reduce soybean Mg uptake, causing deficiency.
- High levels of Ca, often from using excess lime, can compete with Mg and limit its availability.
- High NH_4^+ fertilizer usage can also restrict Mg absorption.



Sulfur

Role in plant development

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Sulfur Deficiency in Soybeans

Sulfur is also important in photosynthesis and for crop hardiness.

Sulfur aids in Soybean seed production.

Sulfur is present in several Organic compounds that give the characteristic odors to garlic, mustard, and onion.

Sulfur appears in every living cell and is required for synthesis of certain amino acids (Cysteine and methionine) and proteins.

Although Sulfur isn't a constituent of chlorophyll, it's still vital in chlorophyll formation.

Leguminous plants like Soybeans need Sulfur for efficient Nitrogen fixation.



Sulfur (S)

- S – constituents of 2 of the 21 amino acids which form proteins
- S – helps to develop enzymes and vitamins contributing to the overall health of the soybean plant.
- S – is vital for producing amino acids which are essential for high-quality protein in soybean seed production
- S – is crucial for developing nodulation for N fixation by legumes. Without adequate Sulfur, nodulation and nitrogen fixation decrease.
- S – is present in organic compounds
- S – is required throughout vegetative and reproductive stages to promote biomass accumulation and increase seed yield.
- S – helps to avoid thin-stemmed and spindly plants, which can lead to logging.

Sulfur (S)

- **Sulfur** synergy with **Nitrogen**, with foliar ratio 1:15, 1:14 grasses, 1:17 legumes
- **Sulfur** competes with **Boron, Moly, Iron**
- **Sulfur** is mobile in the soil and prone to leaching, making timely application crucial.
- Lack of **Sulfur** inhibits nitrogen fixation in root nodules, severely limiting the plant's ability to use atmospheric nitrogen.
- **Excess Sulfur** can potentially inhibit dry matter accumulation and create imbalances, particularly reducing the availability of Mn.



Calcium

Role in plant development

7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro	
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium		Secondary
5 B Boron	17 Cl Chlorine	25 Mn Manganese		
28 Ni Nickel	29 Cu Copper	30 Zn Zinc	42 Mo Molybdenum	Micro
1 H Hydrogen	6 C Carbon	8 O Oxygen	Non-Fertilizer	



Calcium Deficiency in Soybeans

Calcium is an essential plant nutrient. It has many roles: Participates in metabolic processes of other nutrients uptake. Promotes proper plant cell elongation.

Calcium is an essential part of plant cell wall. It forms calcium pectate compounds which give stability to cell walls and bind cells together. Participates in enzymatic and hormonal processes.

Calcium affects seed quality. Calcium has a role in the regulation of the stomata, regulating transpiration.



Calcium helps in protecting the plant against heat stress – and improves stomata function and participates in induction of heat shock proteins.

Calcium helps in protecting the plant against diseases - numerous fungi and bacteria that secrete enzymes which impair plant cell wall. Stronger Cell walls, induced by calcium, can avoid the invasion.

Calcium (Ca)

- Ca – promotes root division and elongation, which allows for a more robust root system capable of accessing water and nutrients deeper in the soil.
- Ca – acts as a building block for cell walls and membranes, creating strong stems and supporting heavy pod loads preventing collapse.
- Ca – activates several plant enzyme systems.
- Ca – supports the formation of healthy root nodules allowing conversion of nitrogen into a usable form.
- Ca – Improves Nutrient Absorption – N, P, K.
- Ca – helps maintain favorable soil pH, improving soil structure and water penetration.

Calcium (Ca)

- **Calcium** uptake is reduced by **NH₄⁺**, **Mg**, **K** and **Na**
- Foliar ratios **Ca:Mg** 2:1 and **K:Ca** 4:1
- **NO₃⁻** increase **Calcium** uptake (possibly forming organic **Calcium** chelates)
- **Phosphorus** promotes **Ca** uptake below pH 7.0
- **Calcium** binds with **Aluminum** and **Iron** hydroxides in pH <5.0
- **Boron** and **Calcium** have synergy effect together
- Excess **Ca** can create high soil pH, reducing the availability of micronutrients like **Fe**, **Mn**, and **ZN**.
- Excess **Ca** also can inhibit **K** and **Mg** uptake.
- **Ca** is needed throughout development of the Soybean, particularly during flowering and pod fill.



Boron

Role in plant development

7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium	
5 B Boron	17 Cl Chlorine	25 Mn Manganese	
28 Ni Nickel	29 Cu Copper	30 Zn Zinc	
1 H Hydrogen	6 C Carbon	8 O Oxygen	Micro Non-Fertilizer
		42 Mo Molybdenum	



Boron Deficiency in Soybeans

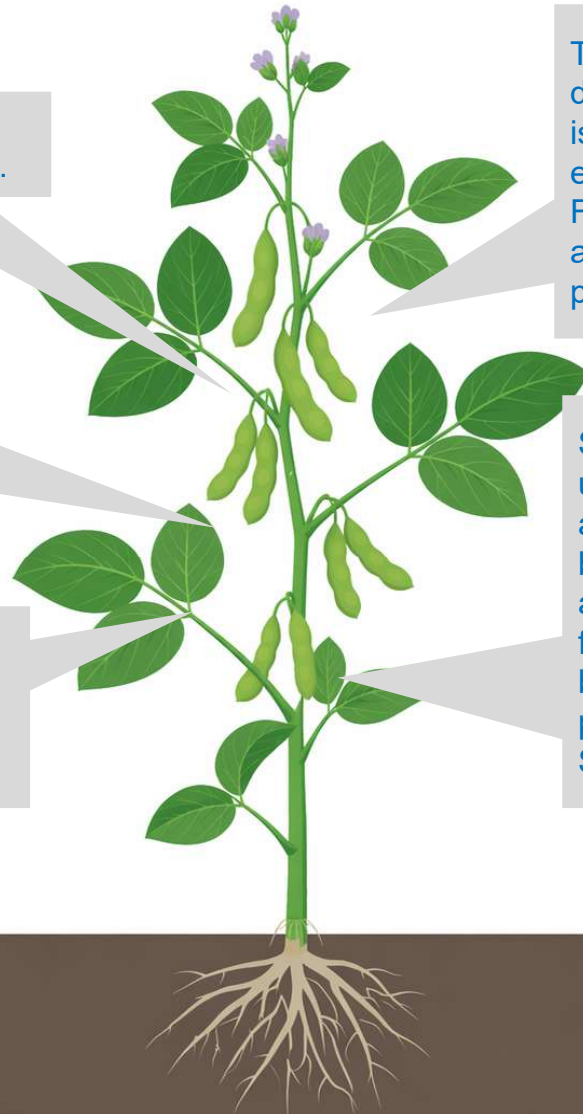
Boron improves seed set under stressful conditions.

Although required in small amounts, Boron is a component of all cell walls in the plant.

Boron deficiencies are more pronounced during drought periods, when root activity is restricted.

The line between deficiency and toxicity is narrower than other essential nutrients. Farmers should apply at proper rate and with proper placement.

Soybeans effectively uses Boron when it's applied through broadcast soil applications. However, foliar application is becoming common place in high yielding Soybeans.



Boron (B)

- B – supports effective root nodule development for nitrogen fixation.
- B – is crucial for Pollen viability and flower retention, reducing flower abortion.
- B – aids in cell wall construction and cell division helping to avoid stunted growth.
- B – boosts node development and pod number, improving overall grain yield.
- B – facilitates the translocation of sugars from leaves to developing pods.
- B – is one of the most important micronutrients affecting membrane stability.
- Supports the structural and functional integrity of plant cell membranes.
- Boron-deficiency symptoms first appear at the growing points.
- Best timing for Boron application is early bloom (R1) through pod development (R3).
- Often applied foliar combined with fungicide passes at R1 or R3.

Boron (B)

- **Boron** needed for **Phosphorus** utilization and uptake
- High **Potassium** decreases **Boron** plant content
- **Boron** and **Calcium** synergy, **Ca:B** tissue ratios range from 50:1 to 500:1
- Soybeans are highly sensitive to excess **Boron**. High rates can lead to leaf scorching and actually reduce yields.
- **Boron** is mostly immobile in the plant.
- Requiring additional applications for best results.

Chlorine

Role in plant development

N Nitrogen	P Phosphorus	K Potassium	Macro	
Mg Magnesium	S Sulfur	Ca Calcium		Secondary
B Boron	Cl Chlorine	Mn Manganese		Micro
Ni Nickel	Cu Copper	Zn Zinc		
H Hydrogen	C Carbon	O Oxygen	Non-Fertilizer	
		Fe Iron		
		Mo Molybdenum		



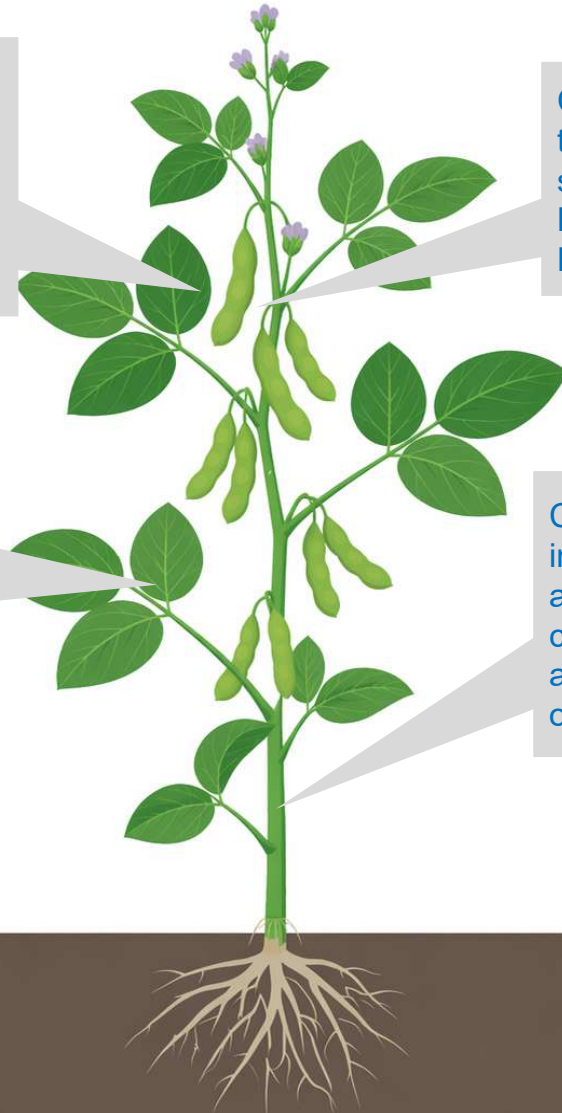
Chlorine Deficiency in Soybeans

Stomata regulate the release of moisture from plants so they can minimize water loss during stressful periods. Chloride is key in stomatal regulation.

Chloride supports the transport of nutrients such as Calcium, Magnesium and Potassium within a plant.

Chloride is involved in the chemical breakdown of water in the presence of sunlight and activates several enzyme systems.

Chloride plays an important role in plants as they acclimate to changing water availability (or make osmotic adjustments)



Chlorine (Cl)

- High **Chlorine** (like muriate of potash) competes for **NO₃⁻** uptake.
- Cl – is essential for the evolution of oxygen during the photosynthesis process.
- Muriate of potash contains 47% Chlorine and is detrimental to soil health and kills microbial activity.
- Cl – is critical for regulating water movement within the Soybean plant.
- Cl – helps control the opening and closing of the **Stomata** for gas exchange.
- Most Cl in soils comes from salt trapped in parent materials and high use of Muriate of Potash.
- Classified as a micronutrient, Cl is required by all plants in small quantities.
- Adequate Cl levels can enhance a plant's ability to resist or tolerate certain diseases.



Manganese

Role in plant development

7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium	Secondary
5 B Boron	17 Cl Chlorine	25 Mn Manganese	Micro
26 Fe Iron	28 Ni Nickel	29 Cu Copper	
30 Zn Zinc	42 Mo Molybdenum		
1 H Hydrogen	6 C Carbon	8 O Oxygen	Non-Fertilizer



Manganese Deficiency in Soybeans

Manganese plays a vital role in photosynthesis by adding in chlorophyll synthesis.

Soybeans and Wheat in particular require more Mn than many crops.

Manganese is very immobile in plants, so deficiency symptoms appear first on younger leaves, with yellowing between the veins. Sometimes a series of brownish-black specks appear.



Although Mn deficiencies are often associated with high soil pH, they may result from an imbalance with other nutrients such as Calcium (Ca), Magnesium (Mg), and Iron (Fe).

Manganese deficiencies are most common in high organic matter soils and in those soils with naturally low Mn content and neutral to alkaline pH.

Manganese (Mn)

- Mn – plays a direct role in photosynthesis by aiding the plant's chlorophyll synthesis
- Mn – accelerates germination and maturity while increasing the availability of Phosphorus and Calcium
- Deficiency symptoms appear on younger leaves
- Deficiencies may result from an imbalance with other nutrients such as Ca, Mg, and Fe
- Mn – functions primarily as a co-factor for over 35 enzymes in the plant.
- Mn – activates several important metabolic reactions and plays a direct role in photosynthesis, specially for splitting water molecules to release O.
- Mn – accelerates germination and maturity while increasing the availability of phosphorus (P) and calcium (Ca).

Manganese (Mn)

- **Manganese** uptake increased by NH_4^+
- **Phosphorus** increases **Manganese** uptake.
- **Magnesium** competes with **Manganese**.
- **Iron** (Fe) and **Manganese** (Mn) are competitive both for uptake and activity in plant, they both compete for the same pathway in the roots.
- High **pH** suppresses uptake. High **P** levels can hinder **Mn** uptake.
- **Ca** and **Mg** compete for uptake at root surface.
- **Excess Mn** can also inhibit the plant's ability to transport **Mg** and **Ca** to the leaves.
- **Excess Zn & Cu** can accentuate a Mn deficiency, interfering with root uptake.



Iron

Role in plant development

7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro	
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium		Secondary
5 B Boron	17 Cl Chlorine	25 Mn Manganese		Micro
28 Ni Nickel	29 Cu Copper	30 Zn Zinc	26 Fe Iron	
1 H Hydrogen	6 C Carbon	8 O Oxygen	42 Mo Molybdenum	
			Non-Fertilizer	

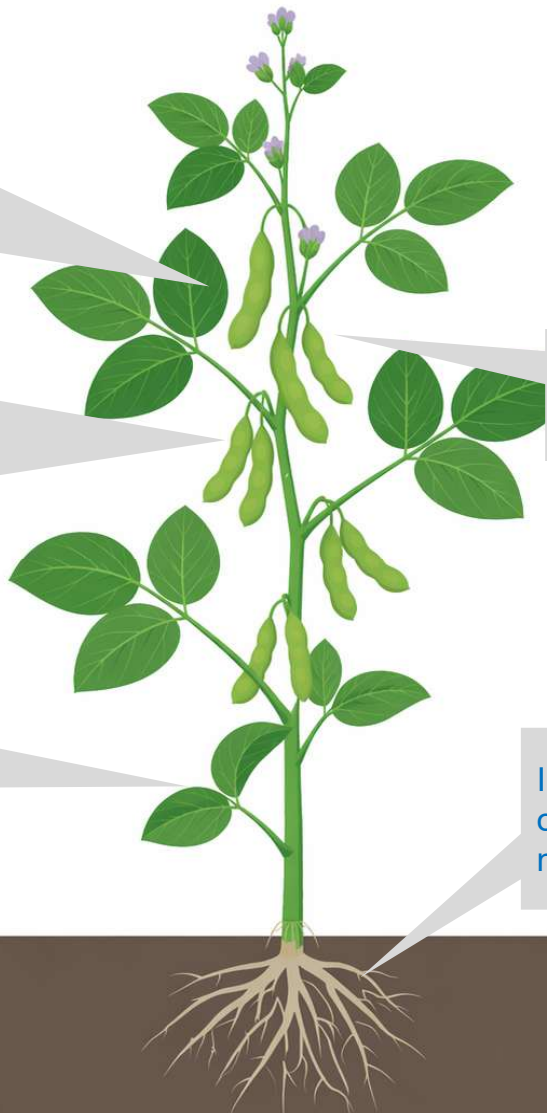


Iron Deficiency in Soybeans

Iron deficiencies may be caused by imbalance with other metals Copper (Cu), Manganese (Mn), and Molybdenum (Mo).

Plants deficient in Fe will often display a pale green color (chlorosis), with sharp distinction between green veins and yellow interveinal tissues.

Most Fe fertilizer sources work best applied as foliar sprays.



Iron (Fe) is a catalyst to chlorophyll formation.

Iron (Fe) acts as an oxygen carrier in the nodules of legume roots.

Iron (Fe)

- Fe - acts as catalyst to chlorophyll formation during photosynthesis.
- Fe - acts as an oxygen carrier
- Fe - helps with certain respiratory enzyme systems
- Fe - is a key component with Nodulation development in Soybeans. Up to 40% of a soybean plant's iron can accumulate in its root nodules.
- Fe - is a component of many enzymes associated with energy transfer, nitrogen reduction and fixation.
- Soybeans often struggle to absorb **Iron** in specific soil conditions, leading to **Iron Deficiency Chlorosis (IDC)**.
- **Iron (Fe) & Moly (Mo)** work together to build the nitrogenase enzyme in root nodules.

Iron (Fe)

- High levels of **Iron (Fe)** can block the uptake of **Mn** and vice versa.
- **Zinc (Zn) & Copper (Cu)** compete for the same absorption sites as **Iron (Fe)** on the roots.
- High levels of **Nitrate (NO₃)** in the soil can increase the **pH** surrounding the roots (the **rhizosphere**). This makes **Iron** less soluble and harder for the soybean plant to absorb, which is why (**IDC**) occurs.
- **Excess P** can lead to the formation of **iron-phosphates** in the soil or even within the plant tissue, which **ties-up** the **iron** and makes it unavailable for use in chlorophyll production.
- **Iron (Fe) & Moly (Mo)** work together to build the nitrogenase enzyme in root nodules. Without both working in tandem, the soybean cannot effectively convert atmospheric nitrogen into a form the plant can use.



Molybdenum

Role in plant development

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1 H Hydrogen	6 C Carbon	8 O Oxygen	Micro
			Non-Fertilizer



Molybdenum Deficiency in Soybeans

Molybdenum-deficiency symptoms show up as a general yellowing and stunting of the plant. A Mo deficiency can also cause marginal scorching and cupping or rolling of leaves.

Several materials supply Mo and can be mixed with nitrogen (N), phosphorus (P) and potassium (K) fertilizers applied as foliar sprays or used as a seed treatment. Seed treatment is the most common way of correcting Mo deficiency because of the very small amounts of the nutrient required.



Excessive Mo is toxic, especially to grazing animals.

Plants take up Moly as the MoO_4^- anionic form containing Molybdenum and Oxygen. It is vital for Nitrogen metabolism. Converting nitrates into amino acids and enabling Nitrogen Fixation in Legumes.

Molybdenum becomes more available as soil pH goes up, the opposite of most other micronutrients.

Molybdenum (Mo)

- Mo – is vital for the process of symbiotic nitrogen (N) fixation by rhizobia bacteria in legume root nodules
- Mo – is needed to convert inorganic P to organic forms in the plant
- Mo – is required for the synthesis and activity of enzymes
- Mo – enhances soybean ability to handle stress tolerance
- Mo – increases overall plant biomass, nodule count, and root length, which can lead to higher yields
- Mo – is a trace element found in the soil
- Mo - It is vital for Nitrogen metabolism. Converting nitrates into amino acids and enabling Nitrogen Fixation in Legumes.

Molybdenum (Mo)

- **Sulfates** inhibits **Moly** uptake if too high of levels.
- **Phosphorus** increases **Moly**, they have a strong positive relationship.
- **Copper** competes with **Moly** if Moly is too high in the plant it can interfere with copper metabolism.
- **Moly (Mo) & Boron (B)** in foliar applications appear to improve the efficiency of nutrient translocation and sugar movement more effectively than either nutrient applied alone.
- **Moly (Mo) & Iron (Fe)** work together as structural partners in the enzymes that build root nodules. If either **Mo** or **Fe** is missing, nodulation will be poor or nodules will be inactive.

Ni

Nickel

Role in plant development

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Nickel Deficiency in Soybeans

No Nickel (Ni) deficiencies have been observed under crop-growing conditions, but in crop research settings, Ag Scientists have reproduced deficiency symptoms such as chlorosis of young leaves and dead meristematic tissue.

Nickel (Ni) deficiency has been observed in some nursery plants and tree crops. Affected trees develop mouse-ear, a condition marked by small, curled leaves and stunted growth.



Nickel (Ni) is a component of urease enzyme and is, therefore, necessary for the conversion of urea to ammonia (NH₃) in plant tissue, making it important in plant nitrogen (N) metabolism.

Nickel (Ni)

- Ni is important in plant N metabolism, it is a component of the urease enzyme, which breaks down urea into useable ammonia and carbon dioxide.
- Without the presence of Ni, urea can accumulate to toxic levels in leaf tips, causing scorching.
- Ni – is required in very small amounts, with the critical level appearing to be about 1.1 ppm.
- **High levels** of other metals – such as **Zn, Cu, Fe, Co and Mg** – compete for root uptake and can induce a “**hidden**” nickel deficiency even if the soil contains nickel.



Copper

Role in plant development

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Copper Deficiency in Soybeans

Copper is the most immobile of the micronutrients.

Many vegetable crops show Cu hunger, with leaves that lose turgor and develop a bluish-green shade before becoming chlorotic and curling.

Copper is necessary to chlorophyll formation in plants and catalyzes several other plant reactions.

Other metals in the soil, such as iron, manganese and aluminum, affect the availability of Cu for plant growth,

Organic soils are the most vulnerable to Cu deficiency; heavy, clay-type soils are vulnerable.



Copper (Cu)

- Cu – is a catalyst for lignin production in cell walls, which strengthens stalks and keeps plants upright.
- Cu – is critical for “seed coat stretch” and resiliency, which prevents seed coats from splitting. Involving grain fill and yield potential.
- Adequate **Copper** levels have been linked to increased tolerance against diseases like **(SDS)** and **Asian Soybean Rust**.
- Cu – activates enzymes and catalyzes reactions in several plant-growth processes.
- Cu – is closely linked to Vitamin A production, and it helps ensure successful protein synthesis.

Copper (Cu)

- **High Cu** levels can inhibit the soil's ability to hold Zinc.
- **Excessive** application of **P & N** can hinder **Copper** uptake
- Applying certain **Copper nanoparticles** has been shown to increase **K** levels in the upper part of the plant.
- **Extreme Copper** toxicity can reduce the concentrations of these essential nutrients **Fe, Mg, and Ca** leading to nutritional imbalances



Zinc

Role in plant development

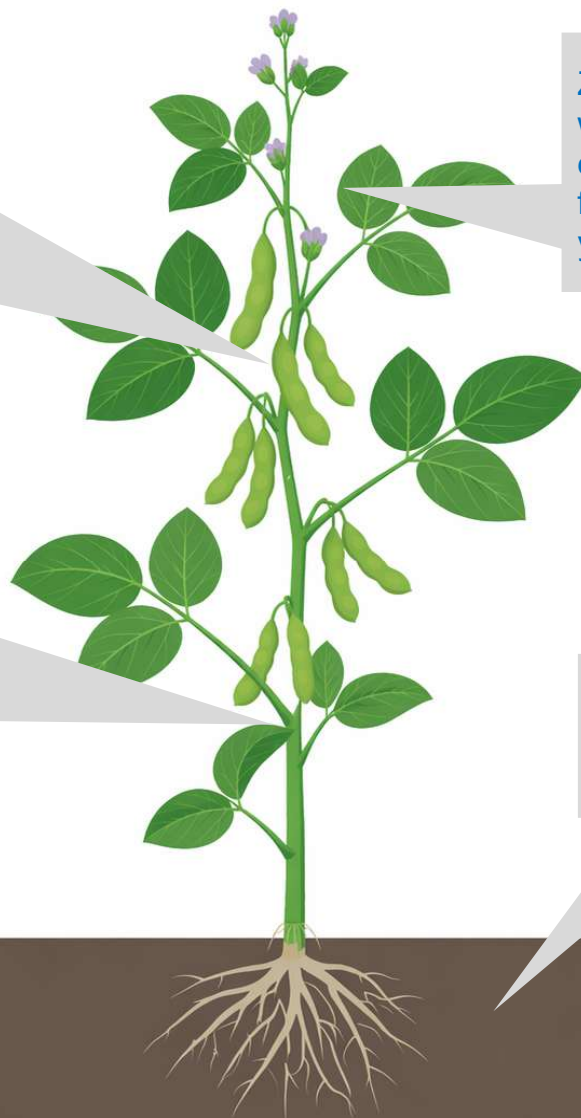
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Zinc Deficiency in Soybeans

Protein synthesis and growth regulation require Zn. Reduced hormone production due to a Zn-deficient plant will cause the shortening of internodes and stunted leaf growth.

Zinc aids synthesis of plant-growth substances and enzyme systems, and is essential for promoting certain metabolic reactions, which are particularly critical in the early growth stages.



Zinc is less mobile within the plant, so deficiency symptoms first appear on the younger leaves.

As soil pH increases, zinc availability decreases.

Zinc (Zn)

- Zn – plays a major role in photosynthesis and DNA transcription
- Zn – aids in the synthesis (production) of growth hormones and proteins.
- Zn – needed in the production of chlorophyll and carbohydrate metabolism.
- Adequate Zinc levels promote more robust and faster early root growth, added to in-furrow planters for quicker response
- Zn – essential for the transportation of calcium throughout the Soybean plant.
- Zn – necessary for cell elongation, the increase in leaf and node size along with pod and seed formation.

Zinc (Zn)

- **Zinc** was one of the first micronutrients recognized as essential for plants and the one most commonly limiting yields.
- Although **Zinc** is required only in small amounts, high yields are impossible without it.
- High P fertilization is a major cause of **Zinc deficiency** in Soybeans
- **Zinc** increases Nitrogen Fixation in Soybeans by enhancing root nodule formation and improving overall root architecture.
- High levels of **Fe and Cu** can interfere with **Zinc uptake** by the roots.
- Zinc works with K to strengthen plant resistance to drought stress.
- Ideal ratio of **Zinc** to Phosphorus in the soil is 10:1.
- Soil application is ideal for early growth, while foliar application is effective during pre-flowering and pod formation (R1-R5)



Cobalt

Role in plant development

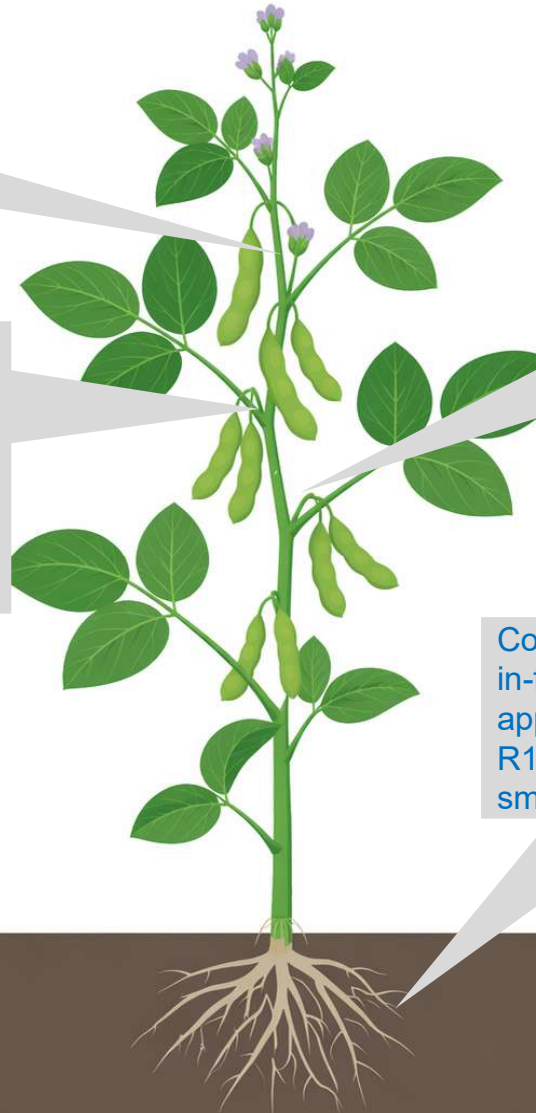
7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium	Secondary
5 B Boron	17 Cl Chlorine	25 Mn Manganese	26 Fe Iron
28 Ni Nickel	29 Cu Copper	30 Zn Zinc	42 Mo Molybdenum
1 H Hydrogen	6 C Carbon	8 O Oxygen	27 Co Cobalt

Cobalt is a crucial beneficial micronutrient for Soybean Production

Cobalt specifically enhances biological nitrogen fixation (BNF) by increasing root nodulation and activating leghemoglobin production

Cobalt works synergistically with Moly (Mo) to improve nitrogen efficiency.

Cobalt may be applied in-furrow as well as foliar applied especially in the R1-R3 Growth stages in small amounts.



Cobalt (Co)

- Co – is a critical component of Vitamin B12, required by Rhizobia bacteria to form leg-hemoglobin, which protects the nitrogenase enzyme from oxygen while allowing it to fix nitrogen.
- Co – acts as an inhibitor of ethylene production, a stress hormone, allowing plants to stay healthier and sustain growth under adverse conditions.
- Co – studies show that applying Cobalt can enhance germination rates, increase seedling vigor, and improve overall yield of Soybean crops.
- Co – helps maintain physiological functions under moisture stress. Providing help with drought tolerance.
- Co – applied to the foliage to correct deficiencies and boost plant health during the reproductive stages.
- Co – using Cobalt particularly in combination with Moly can reduce the need for Nitrogen fertilizers.



Hydrogen

Role in plant development

7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium	Secondary
5 B Boron	17 Cl Chlorine	25 Mn Manganese	26 Fe Iron
28 Ni Nickel	29 Cu Copper	30 Zn Zinc	42 Mo Molybdenum
1 H Hydrogen	6 C Carbon	8 O Oxygen	Micro Non-Fertilizer

Nearly all organic compounds also contain H atoms, which explains why plants need the H they get from water molecules through photosynthesis.

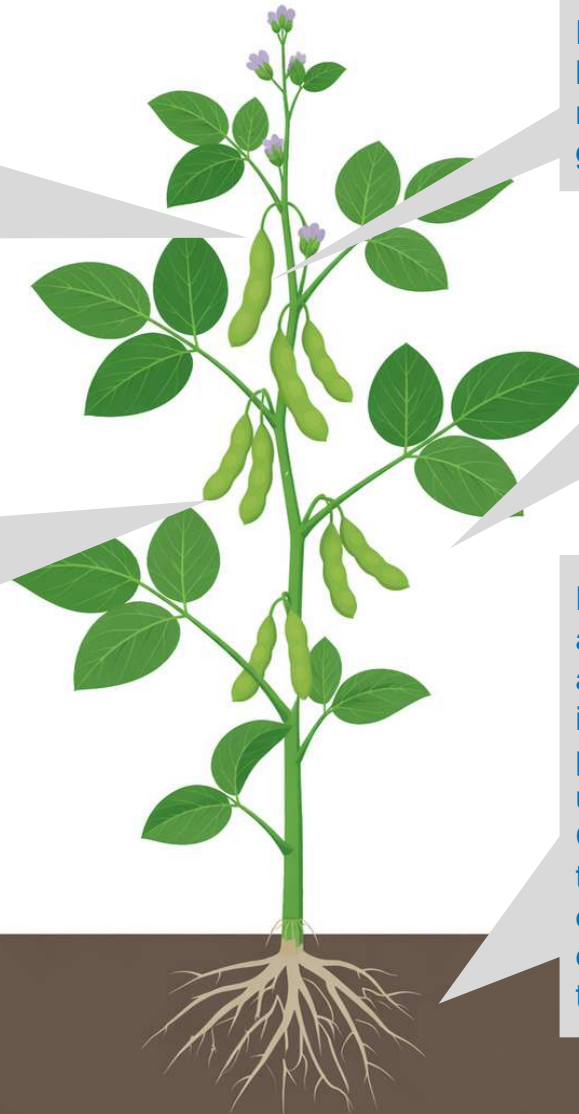
Hydrogen ions are vital in both aiding proton gradients to help drive the electron transport chain in photosynthesis and for the plant respiration.

Hydrogen is rarely a limiting nutrient.

Hydrogen is necessary for building sugars and other molecules to produce glucose for plant energy.

Known as a structural element, H is present in both the atmosphere and the growing environment.

Hydrogen is an element and can be a compound as well. As an element, H is the lightest, with one proton, one electron and usually no neutrons. Compound H forms when two H atoms share an electron pair, creating a covalent bond, which takes the form of a gas.



Hydrogen (H)

Hydrogen plays a critical role in the following systems of all plants:

- Hydrogen in soil regulates pH, unlocks nutrients (like P and micronutrients) for roots, and enhances stress tolerance against drought and salinity
- Hydrogen ions + are crucial in the process of cation exchange, where they help break chemical bonds in the soil to release essential nutrients like Ca, Mg, and K for uptake by plant roots
- The concentration of Hydrogen ions dictates the pH of the soil, which determines how easily plants can absorb nutrients



Carbon

Role in plant development

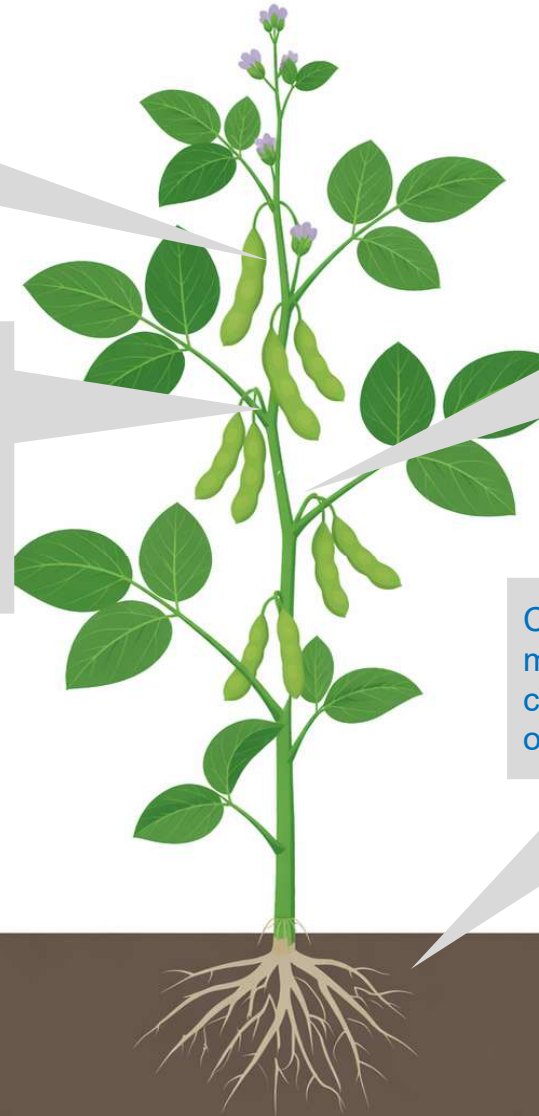
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1 H Hydrogen	6 C Carbon	8 O Oxygen	Micros	

Carbon is the primary energy source and building block for plant tissues.

Converted through photosynthesis into simple sugars. Carbon helps plants build starches, carbohydrates, cellulose, lignin and protein.

Almost half of a plant's dry matter contains Carbon.

Crop residues, green manures and animal wastes can be significant sources of organic Carbon in the soil.



Carbon (C)

Carbon plays a critical role in the following systems of all plants:

- Soil Carbon, primarily in the form of Soil Organic Matter (SOM) and Soil Organic Carbon (SOC), is critical for plant growth
- C – enhances soil structure, increasing nutrient availability, and improving water retention
- C – serves as a nutrient reservoir that boosts microbial activity and root development
- C – acts as a glue for soil particles, creating stable aggregates
- C – reduces compaction and erosion, increases porosity, and allows roots to penetrate the soil more deeply to access nutrients and water

Carbon (C)

Carbon plays a critical role in the following systems of Soybean plants:

- Soybeans are frequently “**carbon-starved**” because they fix significant amounts of nitrogen (N), which upsets the carbon-to-nitrogen (C:N) balance, necessitating an abundance of **soil carbon** to maintain optimal growth.
- Adequate **Carbon** supports beneficial fungi and bacteria leading to better soil structure and better nutrient uptake.
- A “**Carbon Penalty**” or deficit can cause stunting in early growth stages as plants struggle to decompose previous crop residues.
- Soybeans act as a **carbon sink**, taking CO₂ from the air and storing it in the soil through biomass.



Oxygen

Role in plant development

7 N Nitrogen	15 P Phosphorus	19 K Potassium	Macro
12 Mg Magnesium	16 S Sulfur	20 Ca Calcium	Secondary
5 B Boron	17 Cl Chlorine	25 Mn Manganese	26 Fe Iron
28 Ni Nickel	29 Cu Copper	30 Zn Zinc	42 Mo Molybdenum
1 H Hydrogen	6 C Carbon	8 O Oxygen	Micro
			Non-Fertilizer

All Oxygen available to life on Earth comes from plants.

Most of the Oxygen plants take in is expelled as a byproduct. Only a very small amount is actually used by the plant for respiration.

Plants don't absorb Oxygen from the air but instead acquire it during the breakdown of carbon dioxide (CO₂) as part of photosynthesis.

Oxygen interacts with Nitrogen (N) in a process called denitrification, and it affects other elements' oxidation states as well.

Only the leaves and stems of a plant acquire Oxygen through photosynthesis. The roots as a plant are forced to take in Oxygen from the environment through air spaces in the soil.



Oxygen

Oxygen plays a critical role in the following systems of all plants:

- Soybean nodules require **oxygen** for respiration to fuel the nitrogenase enzyme, which fixes nitrogen.
- **Oxygen** enables nutrient uptake, and the survival of beneficial soil microbes
- **Oxygen** facilitates the conversion of sugar into energy (ATP) for active nutrient absorption and root development
- Adequate **oxygen** inhibits the development of anaerobic bacteria that produce harmful toxins, such as methane or sulfides, which can kill roots
- Soil **oxygen** reduction, often caused by waterlogging or flooding, lead to anaerobic conditions that severely inhibit root growth, reduce photosynthesis, and can cause plant death.

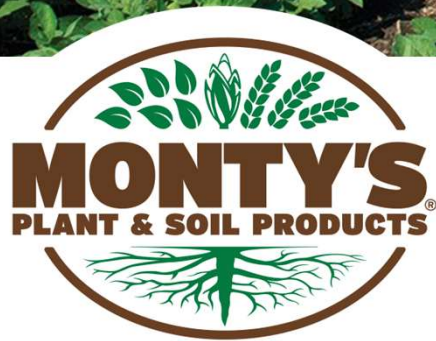


Micronutrients, Plant Health, and Higher ROI

Micronutrients are essential to plant growth and yield, even in small amounts. Deficiencies in elements like iron, zinc, and boron can limit performance, reduce nutrient uptake, and impact overall crop health.

Recognizing and addressing these deficiencies early is key to maximizing productivity. Monty's has solutions designed to support micronutrient availability and uptake, helping growers correct imbalances and drive stronger, more resilient crops.

Healthier crops mean higher yields!



Trusted Advisors. Proven Solutions.

Micronutrient Essentials for Better Soybean Yields