

bíologicals

Growing Together

Biological products from Corteva Agriscience are designed to keep farms productive and healthy today, and tomorrow.

Using proven, predictable solutions across all crop stages, our Biologicals portfolio helps to build more productive crops by enabling crops to use nutrients and inputs more effectively, and improve naturally occurring processes to maximize crop potential. We believe healthy farms are productive farms. And this keeps each farming operation strong today, tomorrow, and for generations to come.

What is a Biological?

Biological products are an innovative, sustainable solution to today's biggest farming challenges – they consist of materials that already exist in nature; some are actual living organisms, like beneficial bacteria, while others, like enzymes, are inspired from natural materials.



Why Choose Biologicals?

Optimize **Productivity**

Biologicals can improve plant performance by unleashing their full potential - enhancing physiological processes and minimizing stresses.

als?

Next Level Crop

Management

Biologicals give us the ability to take our crop management to the next level. Giving you the peace of mind to manage unpredictability and control the uncontrollable, helping you unlock new levels of on-farm potential.

Maximize your Acre with Biologicals

Our pipeline is full of exciting new developments. Expect more biological crop protection solutions from Corteva in these categories, coming soon.

Boost Performance

Activate the plant and its environment to maximize the harvest by enhancing the plants' ability to efficiently utilize soil, nutrients, water, and sunlight.

Build Resilience

Empower crop vigour to withstand adversity and stress by enabling crops to thrive in the face of abiotic stresses and unfavourable weather.

Protect Potential

Shield crops from pests and disease to ensure viability by incorporating powerful and flexible solutions in crop protection programs.



Sustainable Production

Biologicals are here to create the highest impact for everyone, and everything involved – the farm, the environment and our planet, government, and society. 4

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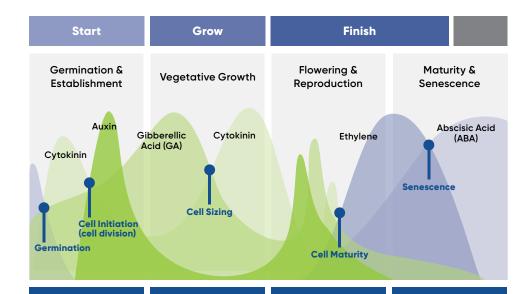
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PLANT HORMONE CYCLE

Plant hormones, nutrients, and hormone co-factors regulate plant growth and reproduction much like hormones, nutrition, and vitamins regulate growth in humans and animals.

Auxin and Cytokinin give birth to new cells. Auxin then directs food movement to the new cells and with Cytokinin, stimulates cell growth. Gibberellic Acid, which is made inside the new cell, controls the rate of movement of food into the new cell and its size.





N, Ca, P, Zn, Mg, K, Mn

Abscisic Acid (ABA):

Keeps the seed dormant before going into the soil.

Gibberellic Acid (GA):

Awakens the seed from its dormant state.

Cytokinin:

Promotes shoot development.

Auxin:

Promotes root development.

Ca, Cu, Mg, B, Mn N, Zn, NO₃

Gibberellic Acid (GA):

Promotes cell elongation and stem growth.

Cytokinin:

Produced in the roots and, along with Auxin, promotes cell division and lateral stem development.

Auxin:

Produced in the shoot and, along with Cytokinin, promotes cell division and influences root development.

Ca, B, Mg, Amine N

Gibberellic Acid (GA), Cytokinin, & Auxin:

Combination of all growth hormones regulate seed set and overall seed development.

Ethylene:

Triggers ripening and initiates senescence.

B, Cu, P, K, Mo, Mg, Amine N

Gibberellic Acid (GA), Cytokinin, & Auxin:

Growth hormone levels are completely depleted.

Abscisic Acid (ABA):

Promotes crop senescence and initiates seed dormancy.

Corteva Agriscience Solutions

Crop Optimization

Fortified Stimulate
Yield Enhancer

Crop Stress Management

Bio-Forge[™] Premier Heat Stress Management



GROWTH HORMONES

Plant growth hormones, also known as phytohormones, are essential chemical messengers that govern various aspects of plant growth and development. These hormones include Auxins, Gibberellins, and Cytokinins, each with its unique functions.

Auxins regulate phototropism, the bending of plant stems and leaves towards light. This response is crucial for optimizing photosynthesis and is controlled by the redistribution of Auxin hormone in response to light.

THE DISPATCHER THE ACTIVATOR THE SIZER Gibberellic Cytokinin Auxin Acid Cytokinin is the Auxin is the dispatcher hormone hormone that Plants produce that signals the activates and Gibberellic acid to hormone events directs new cell encourage cells to controlling cell division division and food size and elongation. and differentiation. movement in a plant.

Cytokinins are involved in regulating many stress-responsive genes in plants, including those related to heat stress. They can help plants adapt to challenging environments and improve their overall stress tolerance.

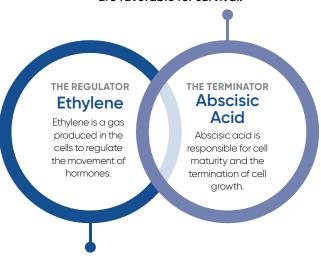
Seed have a natural dormancy period, a protective mechanism that prevents them from germinating in unfavorable conditions. Gibberellic Acid (GA) helps break this dormancy by stimulating the synthesis of enzymes that convert stored nutrients into forms usable for germination.

These hormones work together to coordinate vital processes such as seed germination, flowering, and responses to environmental cues, ensuring that plants adapt and thrive in their surroundings.

STRESS HORMONES

Stress hormones in plants are signaling molecules that play a vital role in helping plants respond and adapt to various environmental stresses. When a plant encounters stress, stress hormones increase, leading to physiological responses like stomatal closure to reduce water loss, the synthesis of stress-related proteins to enhance resilience, and altered root growth patterns to explore for water sources.

Abscisic Acid plays a key role in regulating seed dormancy. It inhibits germination in many seeds, preventing them from sprouting prematurely. This dormancy mechanism ensures that seeds only germinate when environmental conditions are favorable for survival.



Ethylene plays a role in plant responses to various stresses, including mechanical stress, pathogen attack, and environmental stressors like drought and high salinity.

These stress hormones act as critical mediators, allowing plants to survive and thrive in challenging conditions by initiating protective mechanisms and enhancing their overall stress tolerance.

Bio-Forge[™] **Premier**











Dry Beans Soybeans

Bio-Forge[™] Premier enhances plant resilience and protects yield potential by employing three distinct modes of action to support physical stress recovery.

Take Control of Crop Stress

When a physical stress occurs, the stress hormones overpower the growth hormones to put the plant into survival mode, closing its stomata to conserve energy, water and nutrients.

Physical stress can result in delayed plant development, in severe cases, more vulnerable to attacks from pests and pathogens.

By providing the plant with additional growth hormones and key nutrients (Cytokinin, Molybdenum, and Colbalt), Bio-Forge Premier ensures the plant is more equipped to efficiently recover from stress caused by frost, hail, wind, insect, or herbicide damage, and quickly resume growth rather than focus on recovery - leading to greater plant productivity and yield potential.

BIO-FORGE™ PREMIER FEATURES AND BENEFITS

- · Combines three modes of action to deliver the broadest spectrum of physical crop management.
- Enhances crop resilience by aiding in the recovery of stress caused by cold, frost, herbicides, insects, and hail.
- · Increases plant productivity by enabling the plant to quickly resume growth and spend less time recovering, resulting in less days lost during the growing season.
- · Built with the highest quality ingredients, resulting in guaranteed analysis of actives for consistent performance, extensive tank-mix compatibility, and reliable shelf-stability.







BIO-FORGE™ PREMIER **APPLICATION GUIDELINES**

INGREDIENTS

- Cytokinin (0.0075%)
- Nitrogen (3%)
- Soluble Potash (1%)
- Cobalt (1%)
- Molybdenum (1%)

CROPS*

Dry Beans

Canola

Cereals

Soybeans

Corn

FOLIAR RATE

250 mL/ac up to 500 mL/ac following physical damage

TIMING

· Herbicide timing, or for best results, 24-72 hours after physical damage

PRODUCT SIZE

- 1.000 L tote
- 2 x 10 L case

WATER VOLUME

- Ground: 20 L/ac 40 L/ac (5 10 US gal/ac)
- Aerial: 10 L/ac 20 L/ac (3 5 US gal/ac)

^{*}see label for additional crop registrations

Fortified Stimulate

Yield Enhancer











Fortified Stimulate[™] Yield Enhancer contains a combination of critical plant growth hormones, strategically formulated to enhance root development, boost plant growth, and maximize yields.

Optimize the Genetic Potential of Every Plant in Your Field

Strategically formulated to ignite robust plant growth and optimize yield, Fortified Stimulate Yield Enhancer contains a patented formulation of four critical plant growth hormones — Cytokinin, Gibberellic acid (GA), and Auxins (IBA and IAA). Fortified Stimulate Yield Enhancer increases the

levels of these naturally occurring hormones, improving the plants growth potential, and optimizing essential plant functions. As a result, the solution accelerates root development, promotes bigger and more robust plants that will be more resilient to stress – increasing yield potential and plant productivity.

FORTIFIED STIMULATE™ YIELD ENHANCER FEATURES AND BENEFITS

- Fortified Stimulate Yield Enhancer is the only plant growth promoter that contains four plant growth hormones – delivering balanced and improved plant growth.
- Accelerates and increases root and shoot development, improving plant competitiveness to maximize crop potential.
- Built with the highest quality ingredients, resulting in guaranteed analysis of actives for consistent performance, extensive tank-mix compatibility.





FORTIFIED STIMULATE™ YIELD ENHANCER APPLICATION GUIDELINES

INGREDIENTS

- Cytokinin (0.009%)
- Gibberellic Acid (0.005%)
- Indole-3-butyric acid (0.005%)
- Indole-3-acetic acid (0.005%)

CROPS*

Canola

Cereals

Soybeans

Corn

RATE

- Foliar: 125 250 mL/ac
- Seed Treatment: 65 mL/100 lbs of seed

TIMING

Seed treatment and/or herbicide timing

PRODUCT SIZE

- 1,000 L tote
- 2 x 10 L case

WATER VOLUME

- Ground: 20 L/ac 40 L/ac (5 10 US gal/ac)
- Aerial: 10 L/ac 20 L/ac (3 5 US gal/ac)

*see label for additional crop registrations

SUGAR MOVER® PREMIER Plant Biostimulant

Sugar Mover[™] Premier







Sugar Mover™ Premier improves sugar distribution within the plant – promoting larger, more robust seeds and boosting flower production for increased yield potential.

Improved Sugar Distribution

Sugar availability is essential to plant growth, helping to maximize flower production and seed development. By enhancing naturally occurring hormone levels and providing key nutrients to the plant, Sugar Mover Premier accelerates the transport of sugars produced through photosynthesis in the leaves to essential growth areas.

Supplementary Boron helps to ensure that the sugars in the plant get to where they need to go by keeping the transport channels in the plant strong. Additionally, it plays a critical role in delivering pollen for successful fertilization. Cytokinin not only stimulates cell division in the plant, but also promotes flower development and prevents premature senescence. This allows the plant's leaves to photosynthesize longer and prolongs the flower's fertilization period – improving plant productivity and increasing yield potential.

SUGAR MOVER™ PREMIER FEATURES AND BENEFITS

- Promotes uniform seed development by improving sugar distribution from leaves.
- Stimulates cell division and promotes **flower development** for increased yield potential.
- Built with the **highest quality ingredients,** resulting in guaranteed analysis of actives for consistent performance.





SUGAR MOVER™ PREMIER APPLICATION GUIDELINES

INGREDIENTS

- Copper (0.2%)
- Boron (8%)
- Molybdenum (0.004%)
- Cytokinin (0.003%)

RATE

• Foliar: 500 mL - 1 L/acre

TIMING

Fungicide timing

PRODUCT SIZE

- 1,000 L tote
- 2 x 10 L case

WATER VOLUME

- Ground: 20 L/ac 40 L/ac (5 10 US gal/ac)
- Aerial: 10 L/ac 20 L/ac (3 5 US gal/ac)

CROPS*

Canola

Lentils

Peas

^{*}see label for additional crop registrations

UTRISHA™ N Biostimulant | Foliar

Utrisha[™]N















Utrisha $^{\text{m}}$ N nutrient efficiency biostimulant maximizes crop potential – utilizing natural bacteria to capture and supply nitrogen to plants when they need it most.

Give your Crop the Nitrogen It Needs, When It Needs It

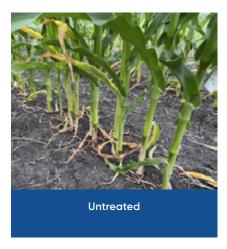
Utrisha™ N is a nutrient efficiency biostimulant. The natural bacteria, methylobacterium symbioticum, fixes nitrogen from the air and converts it for the plant. Utrisha N enters the plant through the stomata and colonizes in the leaf cells. It then converts N₂ from the air into ammonium, resulting in a constant supply of nitrogen to the plant.

No plant energy is required for this process.

Utrisha N provides a sustainable, alternative source of nitrogen that reduces dependency of nitrogen uptake from the soil and ensures the plant has access to nitrogen all season long, without the risk of leaching into water tables or releasing additional greenhouse gasses.

UTRISHA™ N FEATURES AND BENEFITS

- Maximizes crop potential by increasing nitrogen availability, resulting in healthier and more resilient plants.
- Compliments and diversifies a conventional nitrogen fertilizer program by providing nitrogen at critical times during the plant's life cycle.
- The simplest way to provide supplemental nitrogen, giving you the peace of mind that your crop can continue to be its most productive.
- Contains a natural bacteria, providing a sustainable source of nitrogen that reduces dependency of nitrogen uptake from the soil.







UTRISHA™N NUTRIENT EFFICIENCY BIOSTIMULANT APPLICATION GUIDELINES

INGREDIENTS

• Exclusive nitrogen-fixing microbial strain, *Methylobacterium symbioticum*

FOLIAR RATE

135 g/ac (40 ac/bag)

TIMING

- Canola, cereals, corn 4 leaf stage until pre-senescence
- Soybeans 3 leaf stage until pre-senescence
- Potatoes during active growth
- For best results apply in early morning when leaf stomata are open

PRODUCT SIZE

• 1 case – 2 x 5.39 kg bags

WATER VOLUME

• Ground: minimum 40 L/ac (10 US gal/ac)

*see label for additional crop registrations



CROPS*

Canola

Cereals

Soybeans

Potatoes

Corn

UTRISHA™ N SUPPORTED TANK MIX LIST





X-Cyte[™] is designed to increase plant resilience and safeguard yield by proactively protecting crops from heat blast – reducing flower abortion and pod loss caused by heat stress.

Beat the Heat with X-Cyte™

Heat Blast occurs when a combination of hot days (28° C or warmer) and warm nights (16° C or warmer) occurs. When temperatures rise to these levels in your crop, the growth hormone Cytokinin begins to degrade within your plants, often resulting in flower abortion, also known as flower drop, and pod loss.

X-Cyte supplements the plant with additional Cytokinin, a naturally occurring hormone, that boosts cell growth – improving photosynthesis and preventing plant tissues from maturing too quickly. As a result, the plants sustain photosynthetic activity and maintain nutrient and water uptake for continued plant growth and optimized yield potential.

X-CYTE™ FEATURES AND BENEFITS

- Protects yield potential by reducing flower abortion and pod loss during times of excess heat.
- Improves overall crop resilience by delaying premature senescence caused by heat loss.
- Built with the **highest quality ingredients**, resulting in guaranteed analysis of actives for consistent performance, extensive tank-mix compatibility.





X-CYTE™ APPLICATION GUIDELINES

INGREDIENTS

Cytokinin (0.04%)

FOLIAR RATE

• 500 mL/ac

TIMINO

 Fungicide timing, should be applied during 10% - 30% flowering, before the onset of a heat event

PRODUCT SIZE

- 1,000 L tote
- 2 x 10 L case

WATER VOLUME

- Ground: 20 L/ac 40 L/ac (5 10 US gal/ac)
- Aerial: 10 L/ac 20 L/ac (3 5 US gal/ac)

CROPS*

Canola

^{*}see label for additional crop registrations

WHAT IS HEAT BLAST?

Heat blast on crops refers to the damaging effects of prolonged exposure to excessively high temperatures. This stress condition can cause scorched leaves, along with reduced flowering and pollination. In canola, heat stress (a.k.a. heat blast/pod blast) can lead to pod drop and flower abortion.

With the continuation of extremely hot summers and severe heat events, it has become a pressing concern for agriculture. Growers must employ new strategies to mitigate the detrimental impact of heat stress and safeguard crop yields and quality.

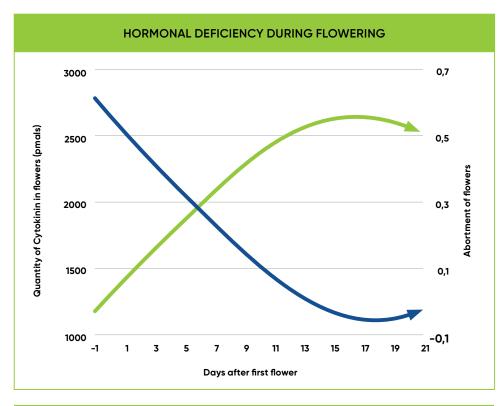


CROP	CRITICAL TEMPERATURE	CRITICAL GROWTH STAGE	RESPONSE TO HEAT STRESS
Canola	>28° C	Flowering & Pollination	Pod Drop & Flower Abortion
Corn	>35° C	Flowering & Pollination	Leaf Roll & Tip Back
Cereals	>27° C	Grain Fill	White or Bleached Awns
Pulse Crops	>32° C	Flowering & Pod Set	Pod Abortion

CYTOKININ TO PROTECT CROPS FROM THE HEAT

Cytokinins help shield plants from heat stress. They do this by boosting cell growth, improving the plant's ability to make food through photosynthesis, and helping the plant handle stress better. They also prevent plant tissues from aging too quickly and help plants use water more wisely. All of these actions work together to help plants bounce back from heat stress, keep their tissues healthy, and continue to function properly. Using Cytokinins is a valuable way to protect our crops from the harmful effects of heat stress.

Cytokinins also play a role in reducing flower abortion in plants. Flower abortion, also known as flower drop, occurs when plants shed their flowers prematurely before they can develop. Cytokinins help reduce flower abortion by promoting the growth and development of flowers, which increases the likelihood that flowers will be successfully pollinated. They can also enhance the overall health and vigour of the plant, making it better able to support the development of its flowers. Additionally, Cytokinins can influence the plant's hormonal balance, helping to prevent the hormonal imbalances that can lead to flower abortion. Overall, Cytokinins contribute improved yield in many crops.



There is a direct correlation between Cytokinin being reduced in the plant and flower abortion.

CORTEVA AGRISCIENCE BIOLOGICALS APPROACH

Corteva takes a distinctive approach to addressing crop challenges that goes beyond traditional agronomic applications. Corteva places a strong emphasis on maintaining hormone balance and plant nutrition to foster the development of robust and healthy crops. This approach not only improves crop health, but also enhances their natural defense mechanisms, making them better equipped to withstand environmental stressors, diseases, and pests. Corteva's commitment to plant health management represents a forward-thinking strategy that promotes sustainable and high-yield agriculture while minimizing the environmental impact of farming practices.

Environmental/Physiological Stresses

Corteva products are at the forefront of addressing environmental and physiological stresses in agriculture. By enhancing nutrient absorption, promoting plant health, and managing plant hormone balance they empower crops to withstand adverse environmental conditions and promote sustainable farming practices.

CHALLENGE	SOLUTION	
Frost Damage	Bio-Forge Premier	
Wind Damage		
Herbicide Damage	Applied 24-72 hours after damage	
Hail Damage	has occurred	
Heat Blast	X-Cyte [™] Applied during flowering, before the onset of heat	

Seeding Challenges

Corteva biological seed treatments optimize seed performance, leading to healthier crops, improved root development for crops seeded in saline soils, and also enable early planting in cold conditions. Corteva innovations are revolutionizing crop production by enhancing yield, sustainability, and resilience.

CHALLENGE	SOLUTION
Cold Soils	Bio-Forge Premier Apply on seed
Poor Germination	Fortified Stimulate Yield Enhancer Apply on seed

Nutrient Efficiency

Nitrogen is essential for plant survival and a key element for optimal crop health. Ensuring nitrogen is available to your crop during key stages of growth is vital for maximizing plant productivity. By increasing nitrogen availability through the use of products such as biostimulants, we can promote healthier plants and help maximize crop potential by providing continuous supplemental nitrogen – ensuring crops have access to it when they need it most.

С	HALLENGE	SOLUTION	
	NUTRIENT EFFICIENCY		
	N Nitrogen	Utrisha ™N //	
N		NUTRIENT EFFICIENCY BIOSTIMULANT	
В	Boron	Sugar Mover	
Zn	Zinc	X-Tra Power [®]	

CORTEVA AGRISCIENCE PRODUCT SOLUTIONS

Corteva offers a comprehensive range of product solutions tailored to various stages of the crop life cycle. With seed treatment solutions that provide an excellent starting point, enhancing seed health and vigour to give crops a robust beginning. In-furrow products are designed to deliver essential nutrients and biostimulants directly to the developing plant roots, ensuring optimal growth from the early stages. Corteva's in-season product solutions offer effective protection to aid in stress mitigation and overall crop health. By promoting a strong start to a strong finish for the growing season, Corteva's solutions contribute to healthier plants, increased yields, and improved agricultural sustainability.



PRODUCTS	SEED TREATMENTS	IN-FURROW	VEGETATIVE GROWTH (HERBICIDE TIMING)	REPRODUCTIVE GROWTH (FUNGICIDE TIMING)	MATURITY
Fortified Stimulate Yield Enhancer	Promote Germination		mote bwth	Improve Seed Set	
Bio-Forge Premier				Crop Stress Management	
Sugar Mover				Fill Pods, H and Ea	
X-Cyte [™]				Heat Blast Protection	
Utrisha" N NUTRIENT EFFICIENCY BIOSTIMULANT				rient iency	

Always read and follow label directions. Conduct a "Jar Test" using all products in proper proportion in order to establish physical compatibility.

HOW PLANT NUTRIENTS WORK TOGETHER

Nitrogen (N), Phosphorus (P), and **Photosynthesis:** Potassium (K) convert light energy to chemical energy (sugars) and provide the building blocks required for the synthesis of chlorophyll and other molecules involved in photosynthesis. Iron (Fe), Manganese (Mn), and Magnesium (Mg) are essential components of chlorophyll, which captures light energy. Nitrogen (N) influences the opening **Nutrient Uptake** and closing of stomata to control water & Transport: and nutrient uptake. Copper (Cu) and **Zinc (Zn)** help regulate the uptake and use of macronutrients, ensuring a balanced nutrient profile within plant tissues. Cell Wall Macronutrients provide the bulk of the materials for plant structure. Calcium (Ca) & Structure: is essential for building strong cell walls. Potassium (K) helps regulate cell turgor pressure. Boron (B) is involved in cell wall formation. Resilience Macronutrients and micronutrients work together to enhance a plant's resilience to Stress: to environmental stressors. For instance, calcium and magnesium help maintain cell membrane stability during drought conditions, while micronutrients like iron and copper are involved in antioxidant defense mechanisms to protect against oxidative stress.

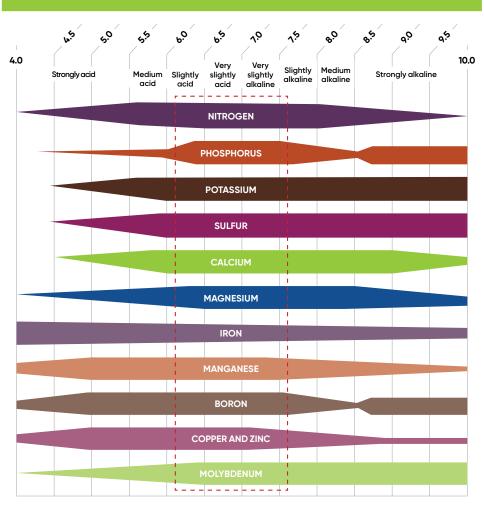
HOW DOES SOIL pH EFFECT THE AVAILABILITY OF NUTRIENTS

Soil pH is a critical factor in determining nutrient availability to plants. The pH scale ranges from acidic (0-6.9) to neutral (7.0) to alkaline (7.1-14.0), with 7.0 being neutral.

When soil pH is too low (acidic) many essential macronutrients like nitrogen, phosphorus, and potassium become less available for plant uptake. This can lead to nutrient deficiencies, even if the nutrients are present in the soil, because they are not in a form that the plant can effectively absorb. Conversely, when soil pH is too high (alkaline), micronutrients like iron, manganese, boron, and zinc may become less available.

The optimal pH range for most plants is slightly acidic to neutral, typically falling between 6.2 to 7.2.

THE INFLUENCE OF SOIL pH ON NUTRIENT AVAILABILITY



KEY MICRONUTRIENTS

Ca

Calcium is crucial for plants as it strengthens cell walls, regulates cell processes, aids enzyme function, enhances nutrient uptake, and boosts plant resilience against environmental stressors.

Mg

Magnesium is vital for plants as it's a core component of chlorophyll, enabling photosynthesis, and activates enzymes essential for energy production, nutrient uptake, and protein synthesis, all of which are critical for plant growth and development.

Mn

Manganese is important for plants because it helps with photosynthesis and nutrient uptake. It acts as a helper, making sure plants have the energy and nutrients they need to grow and stay healthy.

В

Boron is essential for plants as it supports cell wall formation, pollen tube growth, nutrient uptake, sugar transport, enzyme activation, and regulates water uptake through stomatal function, all of which are vital processes for plant growth and development.

Zn

Zinc is important for plants because it helps enzymes work properly. These enzymes are like the workers in a plant's factory, and they help with tasks like making DNA, proteins, and chlorophyll (which plants use for photosynthesis). Zinc also helps control plant growth and development. It's like a plant's regulator, making sure things run smoothly. Overall, zinc is crucial for keeping plants healthy and helping them cope with tough situations.

Cu

Copper is vital for plants as it activates enzymes, aids in photosynthesis through chlorophyll production, regulates iron uptake, contributes to cell wall formation, all essential for plant health and growth.

Мо

Molybdenum is crucial for plants because it plays a central role in nitrogen metabolism. It is an essential component of enzymes that convert nitrogen from the soil into forms that plants can use to make proteins and grow. Without molybdenum, plants cannot efficiently use nitrogen, leading to nitrogen deficiency and poor growth. In essence, molybdenum ensures that plants can access and utilize the nitrogen they need to thrive and develop properly.

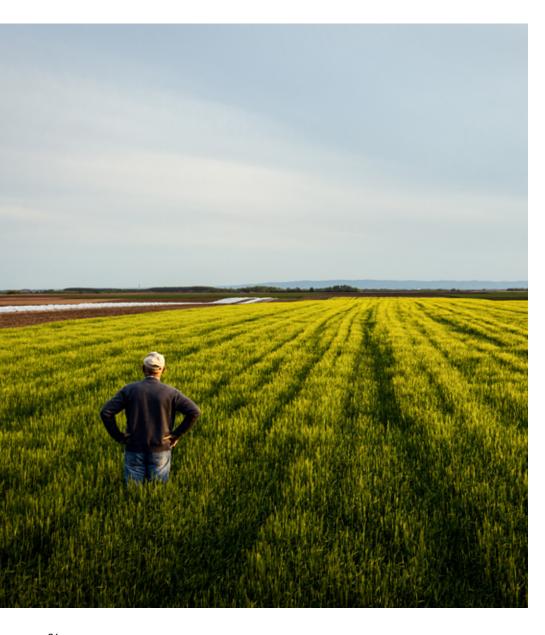


biologicals

The collective success of Corteva Agriscience has been built on working to develop exceptional seed, crop protection and digital products that farmers trust.

Headquartered in Calgary, Alberta, Corteva Agriscience has over 10 cutting-edge research centres and countless industry experts working closely with farmers across the country.

Through sustainable and world-class solutions, we are increasing crop productivity to help farmers get the most out of every acre, while conserving resources and sustaining the land.



BIOLOGICAL INNOVATION MANAGERS



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