

MicroMix™

Complete by AGRIGUARDIAN



Micronutrients for All Crops

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AGRIGUARDIAN™

AgriGuardian™ is dedicated to helping growers to be more successful. The company was founded in 2005 by Dr. David Sasseville, who has decades of field and research experience in plant nutrition in over 30 countries. In partnership with Casey Staloch, AgriGuardian™ works with growers across North America and internationally. The AgriGuardian™ team desires to help growers achieve maximum return on their investment, while sustaining agricultural soils. To achieve this, AgriGuardian MicroMix Complete™ and other AgriGuardian™ products are designed to meet the nutritional needs of all crops. In addition to soil and foliar application, these products also incorporate seed treatments, beneficial microbiology, natural growth promoting compounds and defense mechanisms.

What is MicroMix Complete™?

AgriGuardian MicroMix Complete™ is a proprietary plant nutrient formulation containing all essential plant micronutrients required by every crop. The product is formulated using compounds that are readily absorbed through plant leaves, shoots, roots and reproductive structures. The balanced nutrient composition is based on the needs of most crops. MicroMix Complete™ is highly concentrated and only a small amount is needed. When properly used it promotes higher yields wherever micronutrients are limiting crop performance.

Why use MicroMix Complete™?

Before the advent of modern agriculture, crop yield and demand for nutrients were relatively low. Many soils contained most of the nutrients that were required by crops, except N-P-K. To this day, so-called “complete fertilizers” contain only N-P-K. Growers everywhere are now trying to push yields to their maximum. Higher yielding crops place greater demands on the soil to deliver nutrients. Since micronutrients have been largely ignored for generations, micronutrient deficiencies are commonplace in agricultural soils. Micronutrients are often the first nutrient deficiencies to limit a crop’s potential performance. MicroMix Complete™ is an economical and efficient way to increase yields and profits, by providing the essential micronutrients needed by all crops.

How to use MicroMix Complete™

MicroMix Complete’s™ micronutrients are chelated or complexed with sugar-based organic compounds. This allows rapid absorption of the nutrients by the plant, making the nutrients immediately available for plant use. MicroMix Complete™ can be applied many ways to crops:

- **Foliar Spray**, used alone or tank mixed with most other fertilizers and pesticides (including with glyphosate to prevent micronutrient tie-up and “yellow flash” - see *Glyphosate and Micronutrients*).
- **Irrigation Systems**, used alone or mixed with most other fertilizers and pesticides.
- **Starter Solutions** or root dips at planting or transplanting, used alone or mixed with most other fertilizers and chemicals.
- **Soil Application or Media Drench** for transplant or seedling production, used alone or mixed with most other fertilizers and chemicals.
- **Nutrient Solutions** for hydroponics and greenhouse house production, used alone or mixed with most other fertilizers and chemicals.

GUARANTEED ANALYSIS

Boron	0.20%
Chlorine	0.05%
Cobalt	0.005%
Copper	0.80%
Iron	1.20%
Manganese	1.20%
Molybdenum	0.04%
Nickel	0.04%
Zinc	1.20%

DERIVED FROM: Sodium Borate, Ferric Chloride, Cobalt Sulfate, Copper Glucoheptonate, Iron Glucoheptonate, Manganese Glucoheptonate, Sodium Molybdate, Nickel Nitrate, and Zinc Glucoheptonate.



AgriGuardian™: A Leader in Micronutrient Technology

The scientists, chemists and formulators that developed MicroMix Complete™ have over a 100 years experience working with micronutrients to meet the nutritional needs of plants and crops. The product was built from the ground up to ensure that the micronutrients are properly balance, readily available, quickly absorbed, and immediately usable by the plants and crops. The product was also designed to be compatible in tank mixes with most chemistries including glyphosate. When it comes to meeting the nutritional needs of crops and increasing yields, MicroMix Complete™ is one of the most cost effective and efficient complete micronutrient products on the market today.

MicroMix[™]
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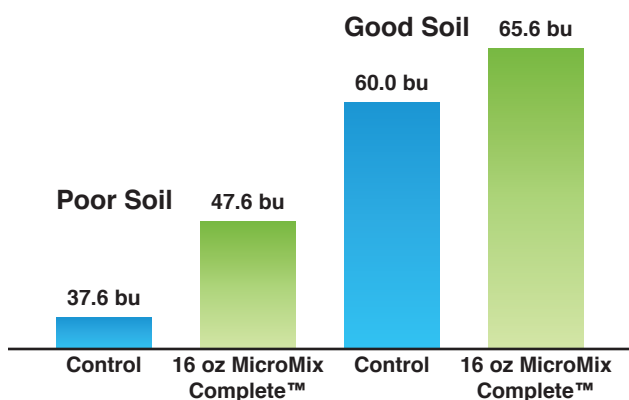
Micronutrients

Need for Micronutrients in Crops

The nutrients in MicroMix Complete™ are required by all crops to grow properly, produce high yields and quality products. The vast majority of agricultural soils are low in one or more of the micronutrients found in MicroMix Complete™. Micronutrient deficiencies can limit crop performance just as much as a deficiency of N, P or K. Even though a crop may need a very small amount of an essential micronutrient, they are just as important as N, P or K in crop performance.

Micronutrients are the keys that allow the biochemical engines in plants to operate properly. They are required for photosynthesis, formation of carbohydrates and proteins, cell division and growth, reproduction, defenses against diseases and environmental stresses, and the utilization of macronutrients (N, P, K, Ca, Mg and S). Without essential micronutrients, these biochemical pathways don't work. As plants grow, they need a continuous supply of micronutrients to keep the many biochemical engines inside the plant running properly. Only when these engines are working properly are plants able to produce an abundance of vegetative growth, fruit and seed. With perennial crops, adequate micronutrients are needed for them to remain healthy and strong to produce good yields for many years. All of these processes regulate the quality and quantity of crop yields.

Soybean Yields using MicroMix Complete™



Nutritional Value of Micronutrients

Yield is not the only important factor with crops. The nutritional value or “nutrient density” of crops is vitally important. The food we eat...grains, vegetables, fruits, nuts...provides the bulk of the nutrients we require to grow and survive. It also impacts our health and the health of future generations. It is not only important for the crops to have good nutrition for the plant-based foods we eat, but also in the feed and forage for animals that provide us with meat, milk, eggs and other animal based foods. To have good nutrition, we need foods that provide the nutrients that our bodies need. These nutrients primarily come from soil that crops grow in and from fertilizers that we apply to the crops. The micronutrients that are needed by plants are just as important in a balanced nutrition for us as human beings.



▲ Corn crop in northern Missouri where MicroMix Complete™ was used. Ears were completely filled out with little tipback and shallow kernel denting. *Photo by Bob Streit*

◀ Data by Dr. Robert Kremer, University of Missouri-Columbia and USDA-ARS.

Micronutrients play several important roles that benefit the harvested crop. When MicroMix Complete™ is used, corn growers routinely report increased yields, earlier maturity, dryer grain, kernels filled to tip of ear, and higher test weights.

Improves Disease Resistance

MicroMix Complete™ improves disease resistance in most crops. MicroMix Complete™ stimulates plants' natural defenses (e.g. formation of salicylic acid) to prevent or reduce the severity of many diseases. The text *Mineral Nutrition and Plant Disease* (2007) by Lawrence Datnoff, Wade Elmer and Don Huber lists over 250 diseases of crops that are reduced when adequate micronutrient nutrition is available. Also, several fungicides, such as Kocide®, Zineb®, Maneb®, Mancozeb®, contain micronutrients such as copper, manganese and zinc. All of these nutrients play a key role in helping to control diseases in crops.

The effect of micronutrients on disease suppression is not only inside the plant, but also on the surface of the plant's tissues and in the root zone. For example, soybeans with MicroMix Complete™ applied as a foliar spray resulted in reduction of *Fusarium* spp. pathogens in the root zone by 63%. This is partly explained by the increased formation of organic acids by the roots from the use of MicroMix Complete™. These organic acids also help increase the uptake of essential plant nutrients, including micronutrients, from the soil. Thus, the application of MicroMix Complete™ has a two-way effect of increasing micronutrients to plants.



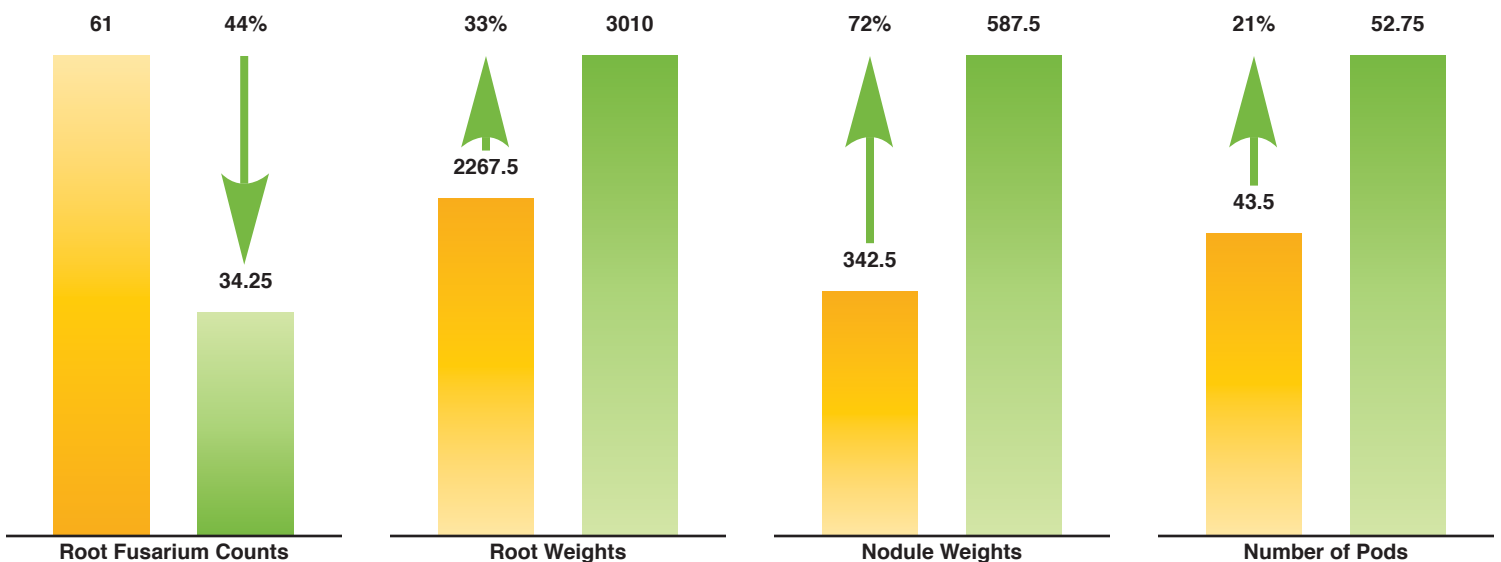
With
MicroMix Complete™



Without
MicroMix Complete™

Photos and data by Dr. Robert Kremer, University of Missouri-Columbia and USDA-ARS.

Without MicroMix Complete™ | With MicroMix Complete™



Crop Maturity



Having adequate available micronutrients has an overall effect on the plant's physiology. It can help increase the overall speed of maturity of a crop, that is, plant development can progress at a faster pace. This is particularly important in colder climates that have short growing seasons, and to help reach harvestable maturity quickly to achieve maximum yields. An example is the use of MicroMix Complete™ in Western Canada. MicroMix Complete™ helped canola to reach harvestable maturity up to 5 days earlier, and increased yields by an average of 3 bu/ac.



Enhanced Weed Kill with Herbicides

Numerous growers have reported improved weed kill using MicroMix Complete™ in their tank mix with herbicides, especially glyphosate and glufosinate. Herbicides that are used to kill more difficult weeds, such as waterhemp, are more effective when MicroMix Complete™ is used in the tank mix. The apparent reason is that the ingredients in MicroMix Complete™ help with the absorption of the herbicide into the plant, causing the herbicides to be more effective, that is, to increase their efficacy.



Without MicroMix Complete™



With MicroMix Complete™



MicroMix[™]
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Benefits

The micronutrients in MicroMix Complete™ can be beneficial to every crop grown. Here are some of the ways that MicroMix Complete™ can increase yields and crop performance.

Needed by All Crops

- Provides all essential micronutrients required by every crop.
- Provides balanced concentrations of these nutrients to meet the needs of most agronomic and horticulture crops.
- Provides non-essential, but beneficial micronutrients needed by certain crops.
- Improves overall nutrient uptake from soil (both macronutrients and micronutrients) by stimulating the release of organic acids by roots into soil.

Application and Uptake

- Provides micronutrients that are rapidly taken up through leaves, stems and roots to quickly correct deficiencies.
- Can be applied as a foliar application, through irrigation systems, in starter solutions, either alone or mixed with most other fertilizers and chemicals.
- Foliar application bypasses soil conditions that reduce the uptake of micronutrients (e.g. high pH, high levels of P, Ca or Mg, excessively wet or dry soil), or when roots have been damaged by diseases, nematodes or mechanical injury.

Improves Plant Health and Quality

- Increases vigor, health, size and quality of crops and yield.
- Provides micronutrients reported to reduce the severity of over 250 crop diseases, by increasing plant disease resistance and reducing soil borne diseases, such as Fusarium spp.
- Improves the efficiency of applied nitrogen in all crops.
- Improves nitrogen fixation by legumes.
- Increases protein content in wheat and other grains.

Use with Other Products

- Tank mix compatible with most fertilizers and chemicals, including glyphosate and glufosinate.
- Replenishes micronutrients tied up by glyphosate use, and prevents “yellow flash” in all Roundup Ready® crops.
- Greatly improves efficacy of certain herbicides (including glyphosate) to kill weeds, such as waterhemp.

In tests of MicroMix Complete™ on wheat, baseline protein content of 12% was increased on average to 12.5% with no additional applied nitrogen.

The Science Behind MicroMix Complete™

Roles of Micronutrients in Crops

Micronutrients are essential to plant growth and development. Without adequate micronutrients, crops will not grow properly to achieve their yield potential. Micronutrients are involved in every major biochemical pathway in plants.

Important systems that require micronutrients are:

- Photosynthesis
- Carbohydrate and protein formation
- Energy transformation and utilization
- Regulation of cell division, cell wall formation and plant growth
- Flowering, pollination, fruit and seed development
- Nitrogen fixation
- Water uptake and movement within the plant
- Utilization of all macronutrients - N, P, K, Ca, Mg, S



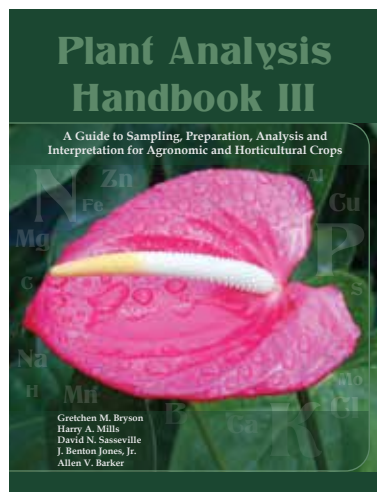
Deficiency symptoms in new chlorotic (yellow) growth.

Symptoms of micronutrients deficiencies include:

- Low yields
- Overall stunted or poor plant growth
- Yellowing or discolored leaves – whole leaves, stripping, interveinal chlorosis, and splotchiness
- Small or deformed leaves and stems
- Poor flowering and/or flower abortion
- Poor fruit or grain set
- Low test weights in grains
- Shoot tip dieback
- Increased severity of diseases
- Accumulation of nitrate in plant tissues
- Poor nodulation and nitrogen fixation



Interveinal chlorosis deficiency symptom.



To learn more about micronutrients and plant nutrition, obtain a copy of their book *Plant Analysis Handbook III* from your AgriGuardian™ distributor.

Without MicroMix Complete™ | With MicroMix Complete™



Glyphosate and Micronutrients

Recent agriculture technologies have played havoc with micronutrients in crops, most notably glyphosate. Glyphosate is a strong chelating agent that ties up many micronutrients inside glyphosate tolerant crops. It also reduces the availability and uptake of micronutrients to all crops where glyphosate has been applied to the soil to control weeds, such as in preplant burn down of weeds. This applies to when glyphosate is used under the canopies of fruit and nut trees and vines. AgriGuardian™ originally developed the MicroMix Complete™ line of products to replenish nutrient deficiencies resulting from glyphosate use on crops. The most often observed problem from using glyphosate is “yellow flash”, most noticeable in Roundup Ready® soybeans. This occurs when glyphosate is applied to the crop and glyphosate ties up micronutrients inside the growing crop. The use of MicroMix Complete™ prevents “yellow flash”, and results in increased yields of soybean and other glyphosate tolerant crops. However, even when “yellow flash” is not readily observable, such as when glyphosate is applied to Roundup Ready® corn or alfalfa, the tie up of micronutrients still occurs. Glyphosate application causes binding of micronutrients in plants, resulting in a micronutrient deficiency in Roundup Ready® crops was not immediately understood. When glyphosate binds micronutrients in Roundup Ready® crops, the nutrients are still in the plant (and are included in tissue nutrient analysis results), but these micronutrients are not “bioavailable” so that the plant can use them. However, because the need for balanced micronutrients is so widespread with all crops, MicroMix Complete™ is now used as an all-purpose micronutrient product for use on all crops and all production environments.

Soybeans with and without glyphosate. Glyphosate causes “yellow flash” by tying up five or more micronutrients inside crop (not just manganese). MicroMix Complete™ prevents or reduces “yellow flash” by replenishing crops with micronutrients tied up in Roundup Ready® crops.

Photo by Dr. Don Huber



Micronutrients and Nitrogen Fixation

Nitrogen fixation is an important source of nitrogen for many crops, such as soybeans, beans, peas, peanuts, alfalfa, garbanzo beans, lentils, southern peas, to name only a few. Three micronutrients - molybdenum, iron and cobalt - are needed to get maximum benefit of nitrogen fixation. Molybdenum and iron are both required for the formation of the enzyme that fixes nitrogen in the nodules of soybeans and other nitrogen fixing crops. These micronutrients are what give the pink-to-red color inside of nitrogen fixing nodules on the roots of these crops. Without these nutrients, nitrogen fixation cannot occur.

Molybdenum is not routinely included in soil and tissue tests, and has been ignored with the assumption that adequate amounts are available in the soil, particularly since only a small amount is needed. Molybdenum levels should be included in all soil and tissue tests. Because molybdenum is more available at higher pH's, some recommendations are simply to apply lime to raise the soil pH to make molybdenum more available to the plant. However, this assumes that adequate molybdenum exists in the soil, which is routinely not the case. The foliar application of MicroMix Complete™ bypasses the issue of low soil pH tying up molybdenum. In cases where soil pH is very low or the soil is highly deficient in molybdenum, foliar application of AgriGuardian Moly™ may also be required in addition to MicroMix Complete™.

Cobalt is another nutrient required for getting the full benefit of nitrogen fixation. Nitrogen fixation produces a form of nitrogen (ureides) that must be broken down to make the nitrogen compound that the plant can use. The enzyme that does this contains cobalt. Cobalt is included in MicroMix Complete™ for this reason. Cobalt is not an essential plant nutrient required by all crops, but it is critical for nitrogen fixing crops such as soybeans, dry beans, peas and alfalfa.

The Science Behind MicroMix Complete™

Micronutrient Availability and Uptake - A single early season application is not enough.

The availability of micronutrients for uptake in the soil is heavily dependent on conditions at the root surface where the nutrients are actually taken into the plant. Organic acids, pH changes, nutrient balances and several other factors can change the quantity of micronutrients that plant roots can take up.

With some soils, it is possible to make a heavy application of N-P-K fertilizers that will last the crop for the entire season. With micronutrients, this is seldom the case. Most micronutrients are poorly mobile inside the plant. This means that once the nutrients are within the plant cells as part of the leaves, stems and roots, they do not readily move from these cells to new growth. This is why micronutrient deficiency symptoms most often occur in new leaves, and not in older leaves. This is in contrast to N-P-K which are highly mobile, and their nutrient deficiencies occur in older leaves first.

To prevent micronutrient deficiencies, a regular supply of micronutrients must be available from the soil or growing media, or additional applications of the micronutrients

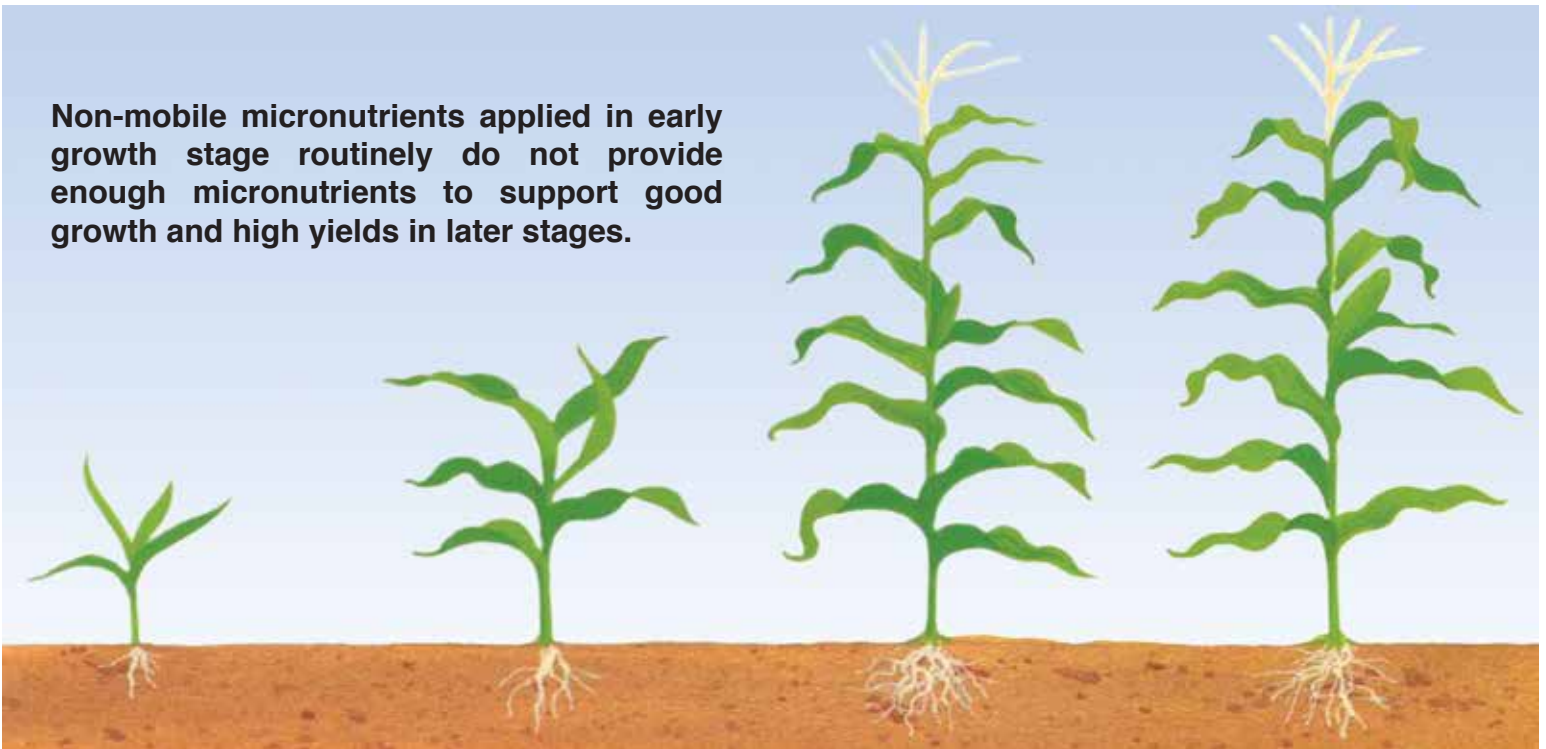
must be made to the crop, such as by foliar application. However, even when large amounts of micronutrients are applied to the soil early in the growing season, the availability and uptake of these micronutrients by the crop can change dramatically during the growing season. This is the result of the interaction of soil temperature, soil chemistry, microbiology, and plant physiology.

Even with soils high in micronutrients, the availability of the micronutrients diminishes during the growing season. The most effective way of getting micronutrients into a growing plant beginning in late spring and throughout the summer is to foliar apply nutrients in a readily absorbed form as found in AgriGuardian MicroMix Complete™. Foliar application bypasses the effects of root surface, soil pH and other biological and chemical factors that reduce micronutrient uptake. This assures that a continuous supply micronutrients is taken up by the plant to meet its needs and to promote good growth and high yields.



Science Based Products

Non-mobile micronutrients applied in early growth stage routinely do not provide enough micronutrients to support good growth and high yields in later stages.



to Help Feed the World

Application Guidelines for Crops

Always use adequate water (typically 5-10 gallons or more per acre) for foliar application to ensure good cover. For most crops, two applications of 16 oz per acre are better than one application of 32 oz per acre. For highest yields, 32 oz per acre applications may be required. If only one application is made, apply when crop has high levels of foliage, but during vegetative or early reproductive stage. If mixing with other chemicals or fertilizers, always do jar test to determine compatibility, and also do test application on a small portion of field to ensure no toxic effects occur before applying to all of crop.

Apply with Glyphosate to Roundup® Ready Crops

MicroMix Complete™ helps offset the negative effects of glyphosate application when applied to glyphosate resistant crops. MicroMix Complete™ does this by supplying micronutrients to the plant in a form that glyphosate cannot tie-up. Use MicroMix Complete™ in tank mix with glyphosate whenever glyphosate is applied to growing glyphosate-resistant crops to prevent micronutrient deficiencies.

Alfalfa • Hay • Forage Crops

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ in spring when early growth is 4-6" tall. Apply an additional 8-16 oz. per acre after each cutting when crop has regrown to 4-6" tall.

Canola

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ during mid-late rosette stage when good foliage is present. Apply an additional 16-32 oz. per acre at flowering.

Corn

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ at V4-V5 stage. Apply an additional 16-32 oz. per acre at V9-V12. A third application of 16-32 oz. per acre may be applied at silking.

Cotton

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. Apply a second foliar application of 16-32 oz. per acre at pinhead square, and a third application of 16-32 oz. per acre at early bloom.

Fruit and Nut Trees

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. Apply 16-32 oz. per acre every 4-6 weeks throughout growing season, especially during and after reproductive stages of development.

Grain Sorghum

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption, typically 5-7 leaf stage. Apply a second application of 16-32 oz. per acre at boot initiation.

Pasture

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ in spring when early growth is 4-6" tall. Apply 8-16 oz. per acre every 4-6 weeks throughout season.

Peanuts

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. A second foliar application of 16-32 oz. per acre may be applied between pegging and beginning pod development. Note: Peanuts and other nitrogen fixing legumes need higher molybdenum levels for nitrogen fixation. AgriGuardian Moly™ may be needed for increased nitrogen fixation. Do soil and tissue tests for molybdenum to determine if needed.

Potatoes

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ per acre approximately 3-4 weeks after crop emergence when a good canopy has formed. Apply a second foliar application of 16-32 oz. per acre 3-4 weeks later when tubers are forming.

Rice

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. Apply a second foliar application of 16-32 oz. per acre after internode elongation or joint movement.

Small Fruits • Grapes • Strawberries • Blueberries • Brambles

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. Apply 16-32 oz. per acre every 4-6 weeks throughout growing season.

Soybeans • Beans • Peas

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. Apply a second foliar application of 16-32 oz. per acre at the beginning pod development. Note: Soybeans and other nitrogen fixing legumes need higher molybdenum levels for nitrogen fixation. AgriGuardian Moly™ may be needed for increased nitrogen fixation. Do soil and tissue tests for molybdenum to determine if needed.

Sugar Beets

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. Apply 16-32 oz. per acre approximately 3-4 weeks after initial application.

Sunflower

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. Apply a second foliar application of 16-32 oz. per acre at flower initiation.

Turf • Ornamentals

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ as soon as adequate foliage is present for good absorption. Apply 8-16 oz. per acre every 3-4 weeks throughout growing season.

Vegetables

Vegetables include a wide variety of crops. With short season vegetable crops one application of 16-32 oz. per acre MicroMix Complete™ is applied as soon as crop has adequate foliage for good absorption. For long season crops or perennial crops, apply 16-32 oz. per acre MicroMix Complete™ every 3-4 weeks during growing season.

Wheat • Small Grains

Apply foliar application of 16-32 oz. per acre MicroMix Complete™ during early tillering when good foliage is present. Apply a second foliar application of 16-32 oz. per acre after first flag leaf stage.

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A Product of
AGRIGUARDIAN™

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about our products and services,
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