TOTAL GRO

PREMIUM GRADE PLANT FOOD

GROWER'S GUIDE TO PLANT NUTRITION

The Total Solution for Healthier Plants and Profits

Grower's Guide To Plant Nutrition

Written and Compiled

by

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Sixth Edition, Revised

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Grower's Guide To Plant Nutrition

Table of Contents

Introduction

This is our sixth revised edition of the TotalGro "Grower's Guide to Plant Nutrition". It is written for use by professional growers in the cultivation of greenhouse and nursery crops. Included along with technical product data is basic information on plant nutrition and soil science.

Proper nutrient management is the the single most critical factor in a successful growing program. TotalGro formulas are based on scientific research and testing. Highest quality chemicals, perfected manufacturing processes and fail-safe quality control result in a truly premium grade water-soluble plant food - TotalGro. We cannot over emphasize the importance of proper formula selection and application based on sound horticultural principles.

This manual is not intended to be a complete treatise on plant nutrition, but serves as a fundamental starting point from which the professional grower can implement a Total nutrition program.

For the grower requiring more detailed accounts of such topics as soil fertility, plant nutrition, culture, diseases and pests, we recommend the following very excellent texts:

J.W. Boodley's *The Commercial Greenhouse*, 1981 (Delmar Publishers).

R.A. Larson's *Introduction To Horticulture*, 1980 (Academic Press).

P.V. Nelson's *Greenhouse Operation And Management, 3rd Edition*, 1985 (Prentice-Hall).

J.N. Joiner's *Foliage Plant Production*, 1981, (Prentice-Hall).

J.T. Fletcher's *Diseases Of Greenhouse Plants*, 1984 (Longman Publishers).

P.P.Pirone's classic text, *Diseases And Pests Of Ornamental Plants*, 1978 (John Wiley and Sons).

In addition, we encourage our growers to refer to TotalGro's extensive library of technical bulletins covering such topics as plant nutrition, soil fertility, plant culture, and diseases and pests. There are numerous technical bulletins on a wide range of topics currently available free of charge to our valued customers.

A.A. Wolleson, President

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Product Features and Services

Solubility

TotalGro products are completely water soluble and form permanent solutions in 70˚ to 100˚ F water. There are no harmful deposits which might clog or damage injectors, pumps, nozzles, screens or irrigation equipment. Refer to specific solubility maxima for individual products, beginning on page 14.

Micronutrients

All TotalGro formulations include properly proportioned ratios of micronutrients manufactured from high purity chelated iron, manganese, copper and zinc, and sodium borate and molybdate.

Chelated micronutrients are ideal for use in the greenhouse and nursery environment because they remain available over a wide pH range in soils and waters, and because they are resistant to precipitation by phosphates and carbonates.

Our micronutrient systems are designed for use in all soil-less media, including peat-lites, barks, and other organic substrates, as well as rock wool and similar materials.

Purity

TotalGro premium grade plant foods are formulated from the highest purity components and contain no chlorides or fluorides that could damage the sensitive greenhouse or nursery crops.

Potassium nitrate used in our products is virtually sodium-free, unlike the high-sodium lower grades used by many of our competitors. Salt concentrations (E.C. readings) for TotalGro water solutions are the lowest in the industry.

Tracer Dyes

Intense blue-green dyes are included to facilitate easy monitoring of TotalGro products when used in injector and similar irrigation systems. Our dye chemistries are gentle on the environment and will photodecompose and biodegrade under favorable light and aeration conditions.

Quality Assurance

Each lot of TotalGro plant food is routinely sampled and spectroanalyzed prior to shipment to insure a consistently high-quality product.

Custom Blending

We recognize the special needs of our valued customers, and offer custom blending to your cropping requirements and specifications. In addition, all TotalGro products are available in custom lots in dye-free, boron-free or other modified configurations.

Research and Development

TotalGro regularly participates in comparative product trials at major universities. Our products have been tested on a wide range of horticultural crops.

Packaging

Our products are packaged in a 5 mil. multi-wall polyethylene bags to prevent excessive moisture build-up. Free-flowing is easily restored should packing or caking occur.

Concepts in Plant Nutrition

Plants require at least 16-17 essential elements for maintenance of normal, healthy growth. Plant physiologists consider an element "essential" if the need for the element is specific in its effects and cannot be completely replaced by another element, and if vegetative and reproductive growth cannot proceed normally in the absence of that element.

Carbon, hydrogen and oxygen are essential elements accounting for more than 90% of the elemental composition of greenhouse and nursery crops. These elements are obtained from the atmosphere and in water. The balance of essential elements needed for plant growth are derived from nutrients in the soil solution. Where one or more of these elements is in short supply, growth may be severely impaired.

The essential elements are usually grouped into two or three categories based upon their relative abundance in plant tissues and effects upon plant growth. Nitrogen (N), phosphorus (P), and potassium (K) are usually termed major or primary nutrients. Calcium (Ca), magnesium (Mg), and sulfur (S) are commonly known as the secondary elements. The trace elements or micronutrients, include boron (B), iron (Fe), manganese (Mn), Copper (Cu), zinc (Zn), molybdenum (Mo), chlorine (Cl), and cobalt (Co). Sodium (Na) may also be essential in some plant species. There are several non-essential elements that can be taken up by plant roots, and have a significant effect upon plant growth. These include fluorine (F) and aluminum (Al).

Our fertilizers provides completely available water-soluble plant nutrients in formulations tailor-made to suit the physiological needs of all greenhouse and nursery crops. Elemental ratios are carefully balanced to provide optimum, vigorous growth, whether used in a constant or scheduled feeding program.

Following are brief outlines of the functions of primary, secondary, and trace nutrients, as well as their common deficiency and toxicity symptoms in plants. Several non-essential elements are also listed due to their effects on plant growth.

Nitrogen **(Moderate accumulaters: 2 .0-3.0%, Heavy accumulaters: 4.0-6.0% in leaves)**

Vital for protein synthesis and chlorophyll production. Highly mobile in tissues. Deficiency symptoms include small leaves; short, spindly growth; yellowing of older leaves followed by yellowing of all leaves; leaf drop. Excess nitrate nitrogen causes chlorosis and leaf burn in acid-loving plants. Excess ammonium nitrogen causes iron chlorosis and stunted growth in non-acid-loving plants. Toxicity due to ammonia formation in high pH soils, causes root injury and death. Excess N may cause K deficiencies.

Phosphorus **(Normal Range 0.2-0.5% in leaves)**

Used in plants for all metabolic processes, thus is critical to growth and reproduction. Highly mobile in tissues. Deficiency symptoms include purple, red or bronze tint to dull green leaves; shoot growth is short and thin; new growth is weak and stunted; poor flowering and fruiting. New research suggest that P has an important role in cytokinin production and may stimulate shoot and bloom growth, thus potentially increasing bloom counts in some species. Toxicity is indirectly due to tie-up of the micronutrients iron, copper and zinc.

Potassium **(Moderate accumulaters: 1.2-2.5%, Heavy accumulaters: 3.0-5.0% in leaves)**

Critical to normal cell metabolism. Highly mobile in tissues. Deficiency symptoms include leaf margin chlorosis (yellowing), followed by necrosis (tissue death) often termed "firing up". When present in excess, potassium interferes with magnesium utilization, thus it induces a chlorosis of older leaves.

Calcium (Normal range in leaves: 0.50 - 2.00%)

Required by plants for cell division and is a component in cell walls. Poorly mobile in tissues. Deficiency symptoms include chlorosis of new growth followed by terminal bud death; foliage may become distorted with leaf tips hooked back; root systems may be damaged with root tip death. May cause boron or magnesium deficiencies in excess.

Magnesium (Normal range in leaves: 0.20 - 0.50%)

Central component of the chlorophyll molecule. Fairly mobile in tissues. Deficiency symptoms occur on older leaves as an interveinal chlorosis, and in severe cases, followed by interveinal necrosis (tissue death). Excess magnesium can induce potassium deficiency due to interference with K uptake and utilization.

Sulfur (Normal range in leaves: 0.15 - 0.50%)

Constituent of many amino acids, and is critical to protein synthesis. Highly mobile in tissue. Deficiencies cause a uniform yellowing of both old and new growth, but may begin on older foliage similar to N deficiency. Excess sulfur usually does not cause problems. However, research suggests that high S may suppress molybdenum in some plants. If insufficient sulfur is available for protein synthesis, nitrates can accumulate in leaf blades and cause salt burns.

Iron (Normal range in leaves: 25-150+ ppm)

Acts as a catalyst in chlorophyll production and occurs in many enzyme systems. Poorly mobile in tissues. Deficiencies may be induced by poor soil aeration, high soil pH, high soil salts, high bicarbonates, or from anything causing root injury.

Symptoms include interveinal chlorosis of new growth, followed by bleaching of leaves to cream or white in severe cases. Excessive iron can interfere with manganese utilization, causing an interveinal chlorosis of new growth.

Manganese (Normal range in leaves: 20-200 ppm)

Involved with iron in conjunction with chlorophyll synthesis, as well as occurring in enzyme systems. Poorly mobile in tissues. Deficiencies may be induced by the same conditions leading to iron deficiency. Toxicities may be induced by the release of Mn during soil sterilization, or due to acidic soil conditions. Deficiency symptoms include yellow, interveinal chlorosis of new growth, often marked by prominent dark-green veins. Excess Mn causes chlorosis due to interference with iron metabolism. Interveinal areas will often become necrotic.

Copper (Normal range in leaves: 2-20 ppm)

Involved in chlorophyll synthesis and is a component of various enzyme systems. Poorly mobile in tissues. Deficiency symptoms include necrosis and white mottling of new leaves; dwarfing and elongated, distorted new growth. Shoot die-back is common. Excess copper initially causes necrosis on new growth leading to plant death.

Zinc (Normal range in leaves: 15-50 ppm)

Directly involved in synthesis of auxin precursors, thus zinc deficiencies cause auxin deficiencies. Also involved in numerous enzyme systems. Poorly mobile in tissues. Deficiency symptoms include various effects on terminal growth; shortened internodes, small, narrow leaves that form rosette-like whorls. Excess zinc can interfere with iron utilization and causes iron chlorosis.

Molybdenum (Normal range in lvs: 0.5-1.5 ppm)

Used by nitrogen-fixing plants, and is a critical component of the nitrate reductase enzyme system that transforms nitrate nitrogen into protein. Mobility in tissues is moderate. Deficiency symptoms include chlorosis and necrosis on leaf margins on older and finally young growth; linear leaves that do not fully expand; leaf blades with a bluish-green cast; leaf burn due to nitrate accumulation in leaves. Excess molybdenum can induce iron and copper deficiencies.

Boron (Normal range in leaves: 10-50 ppm)

Associated with sugar and carbohydrate translocation, and involved in pollination. Relatively immobile in tissues. Deficiencies cause distortion or thickening or both of young terminal growth; foliage may have chlorotic spots; terminal bud dieback is accompanied by lateral growth which then dies back. May be induced by excessive calcium. Excessive boron is toxic. On older leaves, causes a chlorosis followed by necrosis at tips of leaf serrations or along leaf margins; leaf drop usually follows.

Chlorine (Normal range in leaves: 70-100 ppm)

Required in its ionized form as chloride in very small amounts for photosynthesis. Mobile in tissues. Deficiencies are not likely to occur in greenhouse and nursery crops. Excess chloride causes wilting, marginal and tip necrosis on leaf blades, usually with oldest leaves showing symptoms first.

Free chlorine (Cl_2), used to disinfect drinking water, may be toxic to some seedling plants at levels higher than about 1 to 2 ppm. Geraniums and begonias are especially sensitive.

Nickel (Normal range in leaves: 1 - 10 ppm)

Nickel has only recently been recognized as an essential element in plants. The only known nickel-containing enzyme is urease. This enzyme is used by plants to convert urea to ammonium N.

Nickel deficiency symptoms are not well-established, although Ni-poor seed show poor germination and vigor. Low nickel in leaves may result in leaf burn from foliar-applied urea due to an inability by the plant to process the urea.

An adequate trace level of nickel normally exists as a contaminant in fertilizers containing iron amendments, thus nickel is rarely added to water-soluble fertilizers. The toxicity of nickel has been studied extensively, and tissue levels greater than 10-50 ppm may cause toxicity in sensitive species.

Fluorine (<0.75 ppm in soil extract or water)

Fluorine is not required for plant growth. It occurs in its ionized form as fluoride in natural water supplies, municipal water supplies, perlite and in superphosphate.

Flouride toxicity occurs where media pH is acidic and fluoride is in excessive supply. Symptoms include wilting, marginal necrosis and tip burn not unlike chloride toxicity.

Members of the lily and Amaryllis families and some members of the Palm and Aroid families are particularly sensitive to fluoride injury.

Sodium

(<.5 % in leaves desirable in most species)

Although it may be required in very small amounts by some species, it is not generally considered essential. In excess, it can interfere with utilization of potassium, calcium and magnesium. To some extent, insuring an adequate supply of potassium will help offset the toxic effects of this element.

Many woody ornamentals, in particular members of the azalea family are sensitive to sodium accumulation. Sodium is highly mobile in tissues. In woody plants, sodium accumulates in leaves, causing leaf tip necrosis and chlorosis, particularly on new growth.

Aluminum

(<400 ppm in leaves desirable in most species)

Aluminum has no known physiological function in plants, but will accumulate in root and leaf tissue. Only moderately mobile in tissues. Blue hydrangeas will revert to pink coloration due to reduced solubility of aluminum in alkaline or neutral pH soils.

Aluminum becomes more soluble as pH falls below 5.5. In excess on sensitive plants, causes stunted root systems and chlorosis leading to plant death.

Elemental Interactions

As one might imagine, nutrients often do not work alone in their effects on plant growth and development. Quite often, an excess of one nutrient can cause a deficiency of another. This effect is called nutrient antagonism. For example, an excess of potassium in the soil solution can interfere with magnesium utilization, and in effect causes a physiological magnesium deficiency even where the the soil supply of magnesium has been shown to be adequate. Another common antagonistic relationship is that of excessive phosphorus and its effects on zinc, iron and copper uptake. Some common antagonistic relationships are listed in the following table.

Elements in Excess	Nutrients Usually Affected
Nitrogen	Potassium, Calcium
Potassium	Nitrogen, Calcium, Magnesium
Phosphorus	Zinc, Iron, Copper
Calcium	Boron, Magnesium, Phosphorus
Magnesium	Calcium, Potassium
Iron	Manganese
Manganese	Iron, Molybdenum, Magnesium
Copper	Molybdenum, Iron, Manganese, Zinc
Zinc	Iron, Manganese
Molybdenum	Copper, Iron
Sodium	Potassium, Calcium, Magnesium
Aluminum	Phosphorus
Ammonium Ion	Calcium, Copper
Sulfur	Molybdenum

Fortunately, nutrients often work together in many instances to enhance one another. For example, use of readily available water-soluble phosphorus enhances utilization of nitrogen, and vice versa. Most nutrients are more efficiently utilized when in proper balance in the soil solution.

Using TotalGro water soluble plant foods at rates appropriate for the species being grown allows the grower to maintain the plantings at optimum growth rates for maximum marketability and profit. All plants grow best within their own well-defined nutritional bounderies. These bounderies are species-and-variety-specific, such that when a particular plant is exposed to either the lower or upper limit, plant vigor and performance falter. This property of plant response to nutrient supply is better known as the Principle of Limiting Factors. Basically, this principle says that the level of crop production can never be greater than that allowed by the most limiting essential plant nutrients.

Typical Factors Influencing Nutrient Utilization in Plants

Low or High Soil pH
Inadequate or excessive moisture
Root insects, nematodes
Root pathogens
Stalk insects
Weed competition
Root pruning due to soil compaction
Inadequate or excessive soil fertility
Imbalanced soil nutrient availability
Elemental interactions
Elemental toxicities
Varietal effects
Soil and air temperatures
Light intensity

Common Types of Damage To Plants Due To Nutritional Or Salt Problems

Generally, seven types of damage normally occur on ornamental plants due to nutritional imbalances or excess soil salts. **Leaf Burn** may appear on leaf tips, margins, as spots on the leaves, or over the entire leaf surface. Growing tips or buds may also be killed. **Necrosis** (plant tissue death) is similar to leaf burn, but may occur on any plant part, including leaves, stems, roots, fruits and flowers. **Chlorosis** is yellowing or bleaching of leaves, and may appear as spots, leaf tip yellowing, or as a

generalized chlorosis over the entire leaf. **Interveinal chlorosis** is a yellowing of leaf tissue occurring between veins. **Leaf Distortion** may appear as curling, crinkling, or cupping of leaves, or other deformities. **Stunting or Abnormal Growth** may occur on part of the plant, or on the entire plant. Although nutritional problems or excessive salts can cause any one or several of these symptoms, some insecticides, fungicides, and herbicides may cause identical symptoms, thus the grower should consider **phytotoxic effects** of pesticidal sprays when evaluating any plant growth problem.

Elemental Mobility

The mobility of nutrients and elements, i.e. their ability to be freely translocated within the plant's vascular system, in large part defines where visual symptoms of deficiencies or toxicities will occur. For example, since nitrogen, phosphorus, potassium and sulfur are mobile, where soil supply of these nutrients is low, the plant will tend to remove these nutrients from older leaf blades and translocate them to actively growing tissue. Thus, visual symptoms will most likely occur in older leaves initially. The converse is true for the trace elements iron, copper, zinc and manganese. These elements, once taken into plant tissues, are not readily moved from site to site. Because of this, if any one of these elements is in short supply in the medium, the first visual symptoms will occur in new growth. When attempting to diagnose plant nutritional problems, always note where the symptoms are occurring, as these observations will have a great bearing upon the diagnosis. The table below outlines the relative mobilities of essential plant nutrients, as well as several non-essential elements, within plant tissues.

Freely Mobile	Moderately Mobile	Poorly Mobile
Nitrogen	Magnesium	Iron
Phosphorus	Sulfur	Manganese
Potassium	Molybdenum	Copper
Sodium	Aluminum	Zinc
Chlorine		Calcium
Fluorine		Boron

Nitrogen Source

One of the most important considerations a grower has to make in choosing the proper plant foods for greenhouse and nursery crops is nitrogen source. It is common to use an all-purpose 20-20-20 formula on all plantings. While this formulation works very well for bedding plants, tropical ornamentals, and woody shrubs, a wide variety of popular species cannot grow at their optimum with this high ammonium N formulation.

High ammonium N will lead to a condition known as "ammonium toxicity" in sensitive species. Symptoms include leaf burn, iron-like chlorosis, over-all leaf yellowing, and stunted growth. Plants preferring a 2:1 or higher ratio of nitrate N-to-ammonium N, include cacti, euphorbs including poinsettias, gloxinias, gerbera daisy, Easter lily, and many herbs. Plants which prefer a 1:1 up to 2:1 ratio include mums, geraniums, roses, bedding plants, pink hydrangea, and Christmas cactus.

On the other hand, there are many plants grown in the greenhouse or nursery that cannot tolerate high nitrate N levels, but are better able to assimilate the ammonium form of nitrogen. These include azaleas, camellias, carnations, gardenia, most woody ornamentals, many plants in the seedling stage, blue hydrangeas, ferns, and tropical foliage plants.

Some species, like azaleas, are so sensitive to high nitrates that they can develop nitrogen deficiency symptoms when fed with high nitrate formulations, although the N supply may be adequate for other species. Symptoms of excess nitrate N are very similar to those seen where ammonium N is in excess.

TotalGro has developed formulations specifically suited for the culture of plants sensitive to nitrogen source. The detailed product descriptions beginning on page 14 in this manual will better help you make logical decisions in regard to what formulations to use. Call our technical staff toll free if additional information is required.

Supplying Calcium, Magnesium and Phosphorus

Ca and Mg amendments to unplanted soils

Calcium is seldom deficient as long as the soil pH is above about 5.5. As pH increases, calcium levels increase in most soils. If both calcium and soil pH are low, finely powdered dolomitic limestone should be applied. This will both increase the pH and the available supplies of calcium and magnesium.

If the pH of the mix does not need adjusting upward, gypsum (calcium sulfate) supplied at 1-5 lbs. per cubic yard will supply both a source of calcium as well as sulfur. If the soil pH is high and magnesium is needed, epsom salt (magnesium sulfate) can be applied at 1/2 lb. per 100 sq. ft. of bed or about 4-8 oz. per cubic yard of mix. To supply Ca and Mg to planted soils, refer to table on next page

The truth about magnesium

We are often asked by our growers why most TotalGro products contain little or no magnesium. The answer lies in the chemical properties of soluble salts of magnesium. We could use magnesium sulfate (Epsom Salt) or magnesium nitrate. However, both compounds contain very high levels of water of hydration, i.e. molecularly-bound water.

To obtain a plant food containing therapeutic amounts of magnesium requires addition of large quantities of magnesium salt per ton of fertilizer made. For example, to make a 20% N fertilizer that would contain say 1.5% as magnesium, we must blend in 300 pounds of Epsom Salt per ton. Addition of this amount of Epsom Salt would add 153 pounds or 18 gallons of water of hydration to the formula. This water tends to make some fertilizer formulas unmanageably moist after the bag is opened. At 200 ppm of N, with a 20% N plant food, you would obtain 15 ppm Mg. Unfortunately, in most cases where magnesium is claimed by the manufacturer, the added magnesium falls between 0.05 and 0.15% as Mg. In a 20% N formula, this would amount to between 0.5 to 1.5 ppm as Mg where the plant food is used at 200 ppm N. There is quite often more magnesium present in the grower's source water as background, than is being fed with the fertilizer!

We generally add only small amounts of Epsom Salt to selected formulas, and can thus produce a better quality product with minimal hygroscopicity. The 15-11-29, 14-0-14, 13-2-13, 15-2-20, 14-4-14, and 8-5-16 do have en-hanced levels of Mg.

In general where supplemental Mg is required, the best means of attaining therapeutic levels is simultaneous injection of Epsom Salt (10% Mg) or magnesium nitrate(9% Mg) when using most TotalGro products. For most crops, use a constant feed rate of 25-50 ppm Mg (3-6 ounces Epsom Salt or 4-7 ounces Magnesium Nitrate flakes per 100 gallons).

Using Phosphorus Amendments

Growers often incorporate 1-2 lbs. of superphosphate (20%) or 1/2 to 1 lb. of triple superphosphate per cubic yard of soil mix. Water soluble phosphate used in TotalGro formulations make this practice largely obsolete.

Growers desiring to use some phosphate in mixes prior to planting, can choose from a variety of TotalGro special formulations having low or no phosphate relative to nitrogen and potash. These include our 20-10-20, 15-0-15, 14-0-14, 13-2-13 and others.

When using phosphate amendments, it is recommended that 20% superphosphate be avoided, as it contains fluoride as a contaminate.

Species sensitive to fluoride injury include Chlorophytum, Cordyline, Draceana, Lilies, Maranta, Spathiphyllum, Yucca, Calathea, Dieffenbachia, and several palm species.

If super-phosphate is used on sensitive species, maintain the soil pH above 6 to reduce solubility of fluoride.

Plant Nutrient Sources And Corrective Rates For Common Nutrient Deficiencies

Nutrient In Low Supply	Remedial Recommendations-Established Crops (Single Application Only)
Nitrogen (N)	Soil Drench: In winter 27 oz. calcium nitrate or 20 oz. of 20-10-20 per 100 gals of water OR in summer 12 oz. ammonium nitrate or 13 oz.of 30-10-10 per 100 gals of water OR, Foliar Apply: 1-3 lbs. 30-10-10 or 20-20-20 per 100 gals.
Phosphorus (P)	Soil Drench: 8 oz. 15-50-5 or 13 oz. 15-30-15 per 100 gals.
Potassium (K)	Soil Drench: 9-12 oz. potassium nitrate or 13-18 oz. 15-11-29 or 15-10-30 per 100 gals.
Calcium (Ca)	Soil Drench: 10-12 oz. gypsum (calcium sulfate) per 100 gals of warm water siphon-mixer applied, OR Switch all or part of total N applied to 15-0-15, 14-0-14 or calcium nitrate for 7-14 days.
Magnesium (Mg)	Soil Drench: 16-32 oz. Epsom Salt per 100 gals.
Sulfur (S)	Soil Drench: 16-32 oz. Epsom Salt per 100 gals.
Iron (Fe)	Either Soil Drench or Foliar Apply: 3-4 oz. iron sulfate or 3-6 oz. iron chelate per 100 gals.
Manganese (Mn)	Soil Drench: 2 oz. manganese sulfate per 100 gals, OR Foliar Apply: 6-8 oz manganese sulfate or chelate per 100 gals. Do not mix manganese chelate with iron sulfate!
Zinc (Zn)	Soil Drench or Foliar Apply: 2 oz. zinc sulfate or 1 oz. zinc chelate per 100 gals.
Copper (Cu)	Soil Drench: 1 oz. copper sulfate or copper chelate per 100 gals, OR Foliar Apply: 1/2 to 1 oz. copper chelate per 100 gals.
Boron (B)	Soil Drench: 0.5 oz. Borax or 0.25 oz. Solubor per 100 gals.
Molybdenum (Mo)	Soil Drench: 1 gram sodium or ammonium molybdate per 100 gals, OR Foliar Apply: 2-3 oz. sodium or ammonium molybdate plus a spreader-sticker per 100 gals.

Note: These rates are intended for only one application. Sustained use of these rates may result in plant injury. Further applications should be made based upon subsequent soil or plant tissue tests. We do not recommend use of "shotgun" micronutrient treatments with so-called *"soluble trace element mixes"* for treatment of single element deficiencies. Use of such materials is nutritionally unsound and will often lead to plant injury due to creation of nutritional imbalances and/or toxicities.

When drenching, remember that 100 gallons of water or fertilizer solution will treat approximately 1000 six-inch pots, 2900 four-inch pots or 200 square feet of bench or ground bed.

Importance of pH and Alkalinity in Soils

The acidity or basicity of soil is measured by determining its hydrogen ion concentration or pH scale ranges from very acidic (0-7.0) to very basic (7.0-14), with 7.0 being neutral. Most greenhouse and nursery crops perform well within a pH range between 5.5 to 6.5, although some species have very exacting pH requirements outside this range.

Effects of pH are more pronounced in mixes containing large propertions of mineral soils, and less pronounced in soil-less mixes. This is primarily due to differences in buffering capacities and other properties of mineral and organic soils. The most important effect of pH is its influence upon the availability of plant nutrients and other elements. Because trace elements are particularly affected by pH, careful consideration should be given to adjusting mixes to the proper pH before planting.

TotalGro plant foods utilize combinations of chelated iron, manganese, copper and zinc, as well as sodium salts of boric and molybdic acids. Using chelated trace elements, the pH range within which these elements will be available for plant utilization is greatly extended.

Use of high alkalinity waters in container-grown crops and in plug production may result in significant increases in soil pH. These increases result not from water pH as is commonly thought, but from the accumulation of bicarbonates deposited from repeated applications of irrigation water. Deficiencies of iron, manganese, copper and zinc are common where high alkalinity waters are being used. A water test will give you guidelines for lowering water pH and reducing alkalinity. By reducing water pH, alkalinity is also reduced. Alkalinity, not water pH, causes soil pH increases. Low alkalinity, high pH waters in most cases will not be a problem. Have your water tested often.

pH Preferences of Selected Greenhouse Crops

Crop	pH range	Optimum
African Violet	6.0-7.0	6.5
Ageratum	6.0-7.0	6.5
Alyssum	6.0-7.5	6.5
Anemone	6.0-7.0	6.5
Aster	6.0-7.0	6.5
Azalea	4.5-5.5	5.0
Begonia	5.5-7.0	6.5
Bromeliads	5.5-6.6	6.0
Calceolaria	6.0-7.0	6.5
Calendula	6.0-7.5	6.5
Calla Lily	5.5-7.0	6.5
Carnation	5.5-7.0	6.5
Celosia	6.0-7.5	6.8
Christmas Cactus	5.5-7.0	6.5
Chrysanthemum	6.0-7.0	6.5
Cineraria	6.0-7.0	6.5
Coleus	6.0-7.5	6.5
Cyclamen	5.5-7.0	6.0
Daffodil	5.0-7.5	6.0
Foliage Plants(Most)	5.0-6.5	6.0

Crop	pH Range	Optimum
Fuchsia	5.5-7.5	6.5
Gardenia	4.5-6.5	5.0-5.5
Geranium	6.0-7.5	6.5
Gerbera	6.0-7.0	6.5
Gladiolus	5.5-7.5	6.0-6.5
Gloxinia	5.5-6.5	6.0
Hyacinth	5.5-7.5	6.0
Hydrangea,Blue	5.0-5.5	5.0-5.5
Hydrangea,Pink	6.2-7.0	6.5
Iris	5.0-7.0	5.5-6.5
Lantana	5.5-7.5	6.5
Lilies	6.5-7.2	6.8
Marigold	6.0-7.5	6.8
Petunia	6.0-7.5	6.5
Poinsettia	4.5-7.5	5.0-6.0
Roses	5.5-7.0	6.5
Snapdragon	5.5-7.0	6.0-6.5
Tomatoes/Vegetables	5.5-7.5	6.0-6.5
Tulip	5.5-7.5	6.0-7.0
Zinnia	5.5-7.5	6.5

Constant Versus Scheduled Feeding

Application of a dilute water-soluble plant food solution at every watering is termed "constant" fertilization. Using this approach allows the grower to regulate the supply of nutrients being applied, in relation to plant growth rates. When intermittent fertilization, termed "scheduled" fertilization, is coupled with plain tap water irrigation, higher salt levels are used, and plants are regularly subjected to fertility shock due to feeding and leaching cycles inherent in this method of feeding.

Using the constant feeding approach, plants receive nutrients in relationship to their growth rates because fertilization is linked to watering schedules. Conditions increasing water requirements concurrently result in higher plant growth rates and consequently a greater need for plant food. When greenhouse temperatures and light are low, growth slows down. Plants need less water and less nutrients under these conditions. Scheduled feeding will generally not compensate for this effect. However, using constant feeding, crop quality and yields are invariably higher since plant food is provided at a uniform rate at all growth stages and rates of growth.

There are several obvious advantages to the constant feeding method. From a labor standpoint, both feeding and watering can be accomplished simultaneously, thus labor costs are optimized. In addition, constant feeding makes fertilizer feeding schedule records obsolete, thus another time-consuming step is eliminated. Soil testing, used as a guide for plant food application with scheduled feeding programs, can be used simply to monitor fertility level maintenance.

Where specific crop guidelines are unavailable, constant feeding at about 200 ppm nitrogen and potash will provide very satisfactory growth for a number of crops.

When plants are being maintained on a constant feed program, sufficient diluted fertilizer solution is applied to thoroughly moisten the growing medium, as well as just enough water to drain from the container or bed. This causes displacement of excess salts that might have accumulated between waterings, replacing them with the proper level of nutrients. Irrigation at less water than the container capacity should be avoided.

Traditional constant or scheduled feeding involves overhead fertigation of the crop. Subirrigation of crops through use of capillary matting or ebb-and-flow basins provides a means of feeding greenhouse crops with little or no runoff, and for some crops, may cause a savings in total fertilizer usage. TotalGro water-soluble plant foods are particularly suited for nutrient recycling systems due to the high degree of stability inherent in all of our formulae.

Another fertigation technique - "pulse" feeding- has been developed. Crops are fed by a computer-controlled drip irrigation system. Plants receive "pulses" of low strength fertilizer solutions over the course of the day such that the feed rate is roughly equal to the plant's rate of nutrient uptake. Little leaching occurs under such a system, thus nutrient runoff is virtually eliminated.

Regardless of your feeding technique, whether constant or schedule feeding, overhead or subirrigated, TotalGro has high purity water-soluble plant foods suited for every growing situation.

Rates listed in the table on page 12 are widely used for feeding crops grown in organic media with overhead watering. Use of some types of media, such as those containing hardwood bark, sawdust, or uncomposted pine bark may necessitate increasing liquid feed rate by 25-30% to offset nitrogen demand by the medium. On the other hand, media containing more than 25% by weight of mineral soil should be fed at 25-30% less than rates given on page 12. Most floral crops will benefit from occasional feeding with 15-0-15 or calcium nitrate at the listed nitrogen feed rate at every third to fourth watering under a constant feed regime.

Suggested Liquid Feed Rates and Plant Foods for Greenhouse Crops

Light Feeders-Group I (75-100 ppm N CLF)
Anemone :20-10-20,15-16-17,18-18-18
Blueberry, Container-Grown: 27-9-18
Orchids, Epiphytic In Osmunda: 30-10-10,20-20-20, 18-24-18
Tulips In Pots :15-0-15 or Calcium Nitrate

Light Feeders-Group II (100-150 ppm N CLF)
Azalea: 21-7-7,30-10-10,27-9-18
Bedding Plants (Many): 20-10-20,15-0-15,14-0-14, 13-2-13
Begonia x Reiger Hybrids: 20-10-20,15-0-15, 14-0-14
Bougainvillea (winter months): 20-10-20
Calendula : 20-10-20,15-0-15, 14-0-14
Cineraria: 20-10-20,15-0-15, 14-0-14
Freesia : 20-10-20,15-0-15, 14-0-14
Genista (Cytisus) : 15-11-29,15-0-15,20-10-20
Orchids, Epiphytic In Bark : 30-10-10,24-8-16
Orchids, Terrestrial : 30-10-10,24-8-16
Tropical Foliage (winter months): 20-10-20, 24-8-16

Light Feeders-Group III (125-150 ppm N CLF)
Azalea : 21-7-7,30-10-10,27-9-18
Achimines : 20-10-20,15-0-15, 14-0-14
Begonia semperflorens : 20-10-20,15-0-15,14-0-14
Begonia tuberhybrida : 20-10-20,15-0-15,14-0-14
Caladium : 20-20-20,18-24-18,20-10-20,24-8-16
Cacti & Most Succulents : 15-10-30,20-10-20,14-0-14
Calceolaria : 20-10-20,15-0-15, 14-0-14
China Aster : 20-10-20,18-18-18,15-0-15, 14-0-14
Centaurea : 20-10-20,18-18-18,15-0-15,14-0-14
Chrysanthemum (Finishing) : 15-11-29
Cyclamen : 20-10-20,15-0-15,14-0-14
Episcia & Other Gesneriads : 15-30-15,20-10-20
Gardenia : 30-10-10,27-9-18, 20-10-20
Gerbera (Finishing) : 15-11-29
Primula (Primroses) : 20-10-20,15-0-15,14-0-14
Poinsettia (Finishing) : 15-11-29
Saintpaulia (African Violet) : 15-30-15,15-16-17
Schizanthus : 20-10-20,15-0-15,14-0-14
Snapdragon : 20-10-20,15-0-15, 14-0-14
Stephanotis : 20-10-20,20-20-20,18-18-18,14-0-14
Greenhouse Tomato (Bag Culture) : 2-13-29,15-10-30
Woody Ornamentals : 28-7-14,20-20-20,14-0-14

Moderate Feeders-Group I (150-200 ppm N CLF)
Abutilon : 20-10-20,15-0-15,14-0-14
Anthurium : 20-20-20,18-18-18,24-8-16
Bromeliads (Most) : 18-24-18,24-8-16,20-10-20
Callla: 20-10-20,20-20-20,15-0-15,14-0-14
Christmas & Other Holiday Cacti : 20-10-20,15-0-15
Chrysanthemum (Cut,Bedded,Pre-Bloom): 20-10-20
Bougainvillea (Warm Months): 15-16-17,20-10-20
Christmas Cherry : 20-10-20,15-0-15,14-0-14
Clerodendrum : 20-10-20,20-20-20
Cucumber (Hydroponic) : 8-5-16, 2-13-29, 15-10-30
Dipladenia : 20-10-20,20-20-20,14-0-14
Exacum : 20-10-20,15-0-15,14-0-14,15-16-17
Fuchsia : 20-10-20,15-0-15,14-0-14,15-16-17
Geranium, Ivy : 20-10-20,15-0-15,14-0-14
Gloxinia : 20-10-20,15-0-15,14-0-14,15-16-17
Gerbera (Cut,Bedded) : 20-10-20,15-0-15,14-0-14
Greenhouse Tomato (Hydroponic): 8-5-16
Heliconia : 20-20-20,18-24-18,24-8-16
Hydrangea : 20-10-20,15-30-15,15-0-15
Lettuce (Hydroponic) : 8-5-16
Roses (Cut,Bedded) : 20-20-20,20-10-20,15-0-15

Moderate Feeders-Group II (175-225 ppm N CLF)
Carnation (Cut) : 20-10-20+Potassium Nitrate
Crossandra: 20-10-20,15-0-15, 18-18-18,14-0-14
Cucumber (bag culture): 15-10-30, 2-13-29
Geranium, Regal : 20-10-20,15-0-15,18-18-18
Geranium, Scented : 20-10-20,15-0-15,18-18-18
Hibiscus, Container-Grown : 20-10-20,20-20-20
Lilies, Asian Hybrids: 20-10-20,15-0-15,14-0-14
Mathiola : 20-10-20,15-0-15,15-16-17,14-0-14
Roses, Miniature : 20-10-20,15-30-15,15-0-15,14-0-14

Moderate Feeders-Group III (200-250 ppm N CLF)
Boston Fern: 18-24-18,24-8-16,20-20-20
Chrysanthemum (Pot,Pre-Bloom): 20-10-20,14-0-14
Geranium, Zonal : 20-10-20,15-0-15,18-18-18
Hibiscus, 6" Florist : 20-10-20,15-0-15,14-0-14
Tropical Foliage (Most) : 24-8-16,20-20-20

Heavy Feeders-Group I (200-300 ppm N CLF)
Alstroemeria : 20-10-20,20-20-20,15-0-15,14-0-14
Chrysanthemums (Pot,Pre-Bloom) : 20-10-20,14-0-14
Easter Lilies : 20-10-20,15-0-15,14-0-14
Gerbera (Pot,Pre-Bloom): 20-10-20,15-16-17,14-0-14
Kalanchoe : 20-10-20,15-11-29,15-0-15,14-0-14
Poinsettia (Pre-Bloom): 22-8-20,20-10-20

Heavy Feeders-Group II (250-375 ppm N CLF)
Alstroemeria : 20-10-20,20-20-20,15-0-15,14-0-14
Poinsettia (Pre-Bloom): 22-8-20,20-10-20

* If schedule feeding every 7-10 days, increase the constant liquid feed (CLF) rate by 75-100% more.

**If using sub-irrigation techniques including ebb-and-flow and capillary mat methods, it may be necessary to reduce the constant liquid feed rate by 25-50% or more depending upon crop being grown and frequency of irrigation.

***If using resin-coated, slow-release fertilizer, reduce the constant liquid feed rate by 25-50% based upon amount of resin-coated fertilizer incorporated or top-dressed, as well as crop being grown and irrigation frequency and method.

TotalGro Product Profiles

The Numbers On The Fertilizer Bag

The three numbers on your TotalGro fertilizer bag represent the ratio or relative balance between the primary nutrients nitrogen (N), phosphorus expressed as phosphorus pentoxide (P2O5), and potassium expressed as potash (K2O).

For example, our 20-20-20 General Purpose formulation is composed of a 1:1:1 ratio of N-P2O5-K2O, meaning that the primary nutrients are in an equal balance so that no matter what level of nitrogen you are feeding, the levels of phosphorus and potassium will always be fed at equivalent levels.

Since different plant species have varying requirements for the primary nutrients, TotalGro offers a wide array of plant food formulas designed for the specific requirements of certain crops. Research has shown for example, that azaleas and rhododendrons prefer a 3:1 of N:K, while chrysanthemums prefer a 1:2 ratio of N:K. There are TotalGro formulations tailored to virtually every situation encountered in the greenhouse or nursery.

The labels on TotalGro bags indicate that our formulations are water-soluble. This means **completely water-soluble**. We formulate our plant foods with the finest, purest components. This insures you that you're using the very best plant foods available.

The tables of nutrient percentages listed on all TotalGro plant food bags are called "guaranteed analyses". Fertilizer bag labeling is carefully regulated by state agencies. Samples are periodically analyzed by both regulatory agencies, as well as our own quality assurance staff, to make certain that our labels are correct.

You are always assured of quality in every bag of TotalGro Premium Grade Plant Food!

Potential Acidity and Basicity

Potential acidity as listed on TotalGro labels means the potential amount of acidic residue that can form in one ton of fertilizer applied to the soil. It is expressed in terms of the pounds of pure lime needed to completely neutralize the acid residue. As a general rule, plant foods containing high levels of ammoniacal and urea nitrogen will have high potential acidities. Those containing nitrate salts of calcium, potassium, and sodium, will have low acidities if used in combination with ammonium or urea plant foods, or may have potential basicity. Potential basicity is essentially the liming potential of a fertilizer that is non-acid-forming.

In practical terms potential acidity or basicity can be useful when selecting a plant food formulation for a specific crop. For example, azaleas and gardenias require an acidic medium. It would be desirable to maintain the acidity of such media and provide fertility in a single operation. This can be accomplished easily using TotalGro 30-10-10, a formula ideally suited for such plants because of its nutritional balance and its acidifying effects in soil. However, if the media is sufficiently acidic, and further acidification is undesirable, a high basicity formula such as 15-0-15 or 14-0-14 might be best. Plant foods with high acid potentials are useful where the alkalinity of the irrigation water is high and has been causing iron chlorosis. Plant foods with high potential basicity will, over a period of time, increase soil pH if this is desirable.

Some growers think that by switching from say, a 15% nitrogen formula, to a 20% nitrogen formula, they will be feeding at a higher nitrogen rate. Actually, the only thing a fertilizer nutrient percentage denotes is the percent by weight of that nutrient in the fertilizer. Feeding 17.7 oz/100 gals. of a 15% formula is precisely the same as feeding 13.3 oz/100 gals. of a 20% formula, for in both instances you would be feeding 2.7 ounces of actual nitrogen per 100 gals or about 200 ppm N.

Plug Mix 13-2-13

This is a popular two-part formula designed specifically for use in of all major plug-grown crops. A complete N-P-K plant food, 13-2-13 is formulated to deliver a high calcium and magnesium, high nitrate solution with balanced micronutrients to seedlings. Calcium is needed for young growing tips and formation of strong cell walls. This formula has a 2:1 ratio of calcium to magnesium and will deliver a therapeutic amount of magnesium at every watering. Magnesium is needed by seedlings to promote chlorophyll production to yield rich, deep green healthy young transplants.

Where low pH is a problem, this product has a high potential basicity and is ideal for gradually adjusting pH upward during routine feeding. If using hard water, we recommend an acid pre-treatment for the water source.

Also, 13-2-13 Plug Mix has a over 98 % of its total nitrogen in the nitrate form. Extensive research with plug culture points conclusively to use of high nitrate plant foods on most seedlings. High ammonium nitrogen in early stages of growth often induces distorted leaf growth and yellowing.

This formula is an excellent choice for production of compact, toned plug seedlings ready to transplant to packs.

Maximum solubility of this product in hot water is 3 to 3-1/2 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.41
100	0.82
125	1.02
150	1.22
200	1.63

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 123

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	0.46 ppm B
Calcium as Ca	92.25 ppm Ca
Copper as Cu	0.77 ppm Cu
Iron as Fe	1.54 ppm Fe
Magnesium as Mg	46.13 ppm Mg
Manganese as Mn	0.77 ppm Mn
Molybdenum as Mo	0.15 ppm Mo
Zinc as Zn	0.77 ppm Zn

This product contains 98.5% of its total nitrogen in the nitrate form.

Use of 10-1/4 ounces of **each** component of this product per 100 gallons of water will produce a 200 ppm N and 200 ppm K_2O solution.

Guaranteed Analysis

TOTAL NITROGEN (N).....13%
Nitrate Nitrogen.....12.8%
Ammoniacal Nitrogen.....0.2%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....2%

WATER SOLUBLE POTASH (K_2O).....13%

PRIMARY PLANT FOOD SOURCES: Nitrates of Calcium, Magnesium, Potassium and Ammonium; Ammonium Phosphates.

SECONDARY PLANT FOODS:
Calcium as Ca 6.000%
Magnesium as Mg 3.000%
Boron as B.....0.030%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.010%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES: Sodium Borate, Copper EDTA Chelate, Iron EDTA Chelate, Manganese EDTA Chelate, Sodium Molybdate, Zinc EDTA Chelate.

Potential Basicity 390 lbs. Calcium Carbonate equivalent per ton.

Cal-Mag Special 14-0-14

Our 14-0-14 Cal-Mag Mix is a versatile high calcium, magnesium and nitrate formula that has application in plug culture and in floriculture. This plant is an ideal secondary feed when using 20-10-20 as your primary plant food source. Also, it can be dually injected with a twin head injector to deliver a complete plant food solution to the bench.

Where low pH is a problem, this product has a high potential basicity and is ideal for gradually adjusting pH upward during routine feeding. If using hard water, we recommend an acid pre-treatment for the water source. The high calcium formulation is perfect for growing on young seedlings where strong root and shoot growth are essential. The high magnesium is needed to stimulate chlorophyll production and promote rich green growth.

Extensive research with plug culture and with many floricultural crops points conclusively to use of high nitrate plant foods on many plant species. High ammonium nitrogen induces distorted leaf growth and yellowing in ammonium-sensitive crops. This product has over 91% of its nitrogen in the nitrate form.

Maximum solubility of this product in hot water is 3-1/2 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.39
100	0.79
125	0.98
150	1.18
200	1.58

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 127

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.29 ppm
Calcium	82.7 ppm
Copper as Cu	0.71 ppm
Magnesium	39.9 ppm
Iron as Fe	1.43 ppm
Manganese as Mn	0.71 ppm
Molybdenum as Mo	0.01 ppm
Zinc as Zn	0.71 ppm

This product contains 91.4% of its total nitrogen in the nitrate form.

Use of this product at 19 ounces per 100 gallons will produce a solution containing 200 ppm each of N and K2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....14%
Ammoniacal Nitrogen.....1.2%
Nitrate Nitrogen.....12.8%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....0%

WATER SOLUBLE POTASH (K_2O).....14%

PRIMARY PLANT FOOD SOURCES:
Nitrates of Calcium, Potassium, Magnesium and Ammonium.

SECONDARY PLANT FOODS:
Calcium as Ca 5.800%
Magnesium as Mg 2.800%
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Basicity 345 lbs. Calcium Carbonate equivalent per ton.

Cal-P-Mag Special 14-4-14

Our 14-4-14 Cal-Mag Mix is a versatile and easy to use **two part** high calcium, magnesium and nitrate formula that has the added advantage of being capable of supplying phosphorus. Like our 14-0-14, this formula finds application in plug culture and in floriculture. This formula is an ideal secondary feed when using 20-10-20 as your primary plant food source. Also, it can be twinhead injected to deliver a complete plant food solution to the bench.

Where low pH is a problem, this product has a high potential basicity and is ideal for gradually adjusting pH upward during routine feeding. If using hard water, we recommend an acid pre-treatment for the water source. High calcium formulations are perfect for growing on young seedlings where strong root and shoot growth are essential. High magnesium is needed to stimulate chlorophyll production and promote rich green growth.

Extensive research with plugs and with many floricultural crops points conclusively to use of high nitrate plant foods on many plant species. This product has over 82 % of its nitrogen in the nitrate form, one of our highest nitrate containing formulas.

Maximum solubility of this product in hot water is 3-1/2 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.42
100	0.84
125	1.05
150	1.26
200	1.68

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 119.1

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.29 ppm
Calcium	71.4 ppm
Copper as Cu	0.71 ppm
Magnesium	28.6 ppm
Iron as Fe	1.43 ppm
Manganese as Mn	0.71 ppm
Molybdenum as Mo	0.01 ppm
Zinc as Zn	0.71 ppm

This product contains 82.1% of its total nitrogen in the nitrate form.

Use of this product at 9.5 ounces of **each component** per 100 gallons will produce a solution containing 200 ppm each of N and K2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....14%
Ammoniacal Nitrogen.....2.5%
Nitrate Nitrogen.....11.5

AVAILABLE PHOSPHORIC ACID (P_2O_5).....4%

WATER SOLUBLE POTASH (K_2O).....14%

PRIMARY PLANT FOOD SOURCES:
Nitrates of Calcium, Potassium, Magnesium and Ammonium, Ammonium Phosphate.

SECONDARY PLANT FOODS:
Calcium as Ca 5.000%
Magnesium as Mg 2.000%
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Basicity 106 lbs. Calcium Carbonate equivalent per ton.

High Calcium Special 15-0-15

This formulation has been designed as a substitute for calcium nitrate-potassium nitrate mixtures commonly used for feeding during cool, overcast periods between November and February. It contains 93.3% of its total nitrogen as the nitrate form, thus nitrogen conversion problems associated with the use high-urea plant foods during cool, cloudy periods are eliminated. It is an excellent food for plants sensitive to ammonium toxicity problems.

TotalGro 15-0-15 not only contains calcium and potassium nitrates, but also the same blend of micronutrients found in our other formulations. It has a neutralizing effect on acidic media. It can be used where the media pH is acidic and further reductions in pH are undesirable, or where a soil test indicates a need for high nitrates or readily-available calcium. Since this formulation contains no phosphates, it is recommended that it be used either intermittently with a phosphorus-containing plant food, or used on media containing superphosphate or triple superphosphate as a pre-mix. When using as a dark weather feed, use only during periods of low light and cool temperatures, then revert to your normal feeding program when conditions are more favorable.

Maximum solubility of this product in hot water is 3 1/2 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
100	0.71
150	1.07
200	1.43
250	1.79
300	2.14
350	2.50

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 139.9

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.25 ppm
Calcium	146.85 ppm
Copper as Cu	0.63 ppm
Iron as Fe	1.25 ppm
Manganese as Mn	0.63 ppm
Molybdenum as Mo	0.01 ppm
Zinc as Zn	0.63 ppm

This product contains 93.3% of its total nitrogen in the nitrate form.

Use of this product at 17.8 ounces per 100 gallons will produce a solution containing 200 ppm each of N and K2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Ammonium Nitrogen.....1.0%
Nitrate Nitrogen.....14.0%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....0%

WATER SOLUBLE POTASH (K_2O).....15%

PRIMARY PLANT FOOD SOURCES:
Nitrates of Ammonium, Calcium, and Potassium

SECONDARY PLANT FOODS:
Calcium as Ca 12.000%
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Calcium Nitrate, Manganese EDTA, Iron EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Basicity 405 lbs. Calcium Carbonate equivalent per ton.

Pansy Special 15-2-20

Pansies are becoming a major winter greenhouse crop. An ideal pansy food maintains a desirable rich green foliage color, yet does not promote stretching and weak growth. This unique 2-part formula contains high levels of calcium needed for robust, stocky stem growth and strong roots. It also contains magnesium needed to promote chlorophyll production and deep green leaves. The calcium-to-magnesium ratio is an optimum 2:1. Our 15-2-20 formula is designed to deliver these ideal characteristics and more. The N-P-K ratio promotes blooming while maintaining strong, robust growth. The relatively low phosphorus is designed to produce compact plants and minimize the common problem of stretching. While pansies need some ammonium nitrogen, an excess is known to cause leaf crinkling, bloom distortion and leaf yellowing. The nitrate-to-ammonium ratio of this product is over 6:1 and the nitrate comprises over 87% of the total nitrogen. The high calcium formula helps buffer against drastic pH shifts. It typically yields a solution with a pH of about 6.0, ideal for growing pansies and other crops. The 15-2-20 Pansy Mix also delivers a perfect balance of micronutrients. The extra boron of this plant food formula promotes strong and vigorous growth. The formula can also be used as a finisher for other blooming crops such as lilies, mums and geraniums.

Mix contents of each enclosed 12.5 lb. bag at a 1:1 ratio to achieve proper nutrient levels.

Maximum solubility of this product in hot water is 3 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.35
100	0.70
150	1.05
200	1.40
300	2.10
400	2.80
500	3.50

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 142.9

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	0.40 ppm B
Copper as Cu	0.67 ppm Cu
Iron as Fe	1.33 ppm Fe
Magnesium as Mg	25.00 ppm Mg
Manganese as Mn	0.67 ppm Mn
Molybdenum as Mo	0.13 ppm Mo
Zinc as Zn	0.67 ppm Zn
Calcium as Ca	50 ppm Ca

This product contains 87.0% of its total nitrogen in the nitrate form.

Use of 17.8 ounces of this product per 100 gallons of water will produce a 200 ppm N and 267 ppm K_2O solution.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Nitrate Nitrogen.....13.0%
Ammoniacal Nitrogen.....2.0%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....2%

WATER SOLUBLE POTASH (K_2O).....20%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Nitrates of Potash, Calcium, Magnesium and Ammonium.

SECONDARY PLANT FOODS:
Calcium as Ca 3.750%
Magnesium as Mg 1.875%
Boron as B.....0.030%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES: Sodium Borate, Copper EDTA Chelate, Iron EDTA Chelate, Manganese EDTA Chelate, Sodium Molybdate, Zinc EDTA Chelate.

Potential Basicity 75 lbs. Calcium Carbonate equivalent per ton.

Vegetable Soil-Less Mix Special 15-10-30

TotalGro's 15-10-30 Vegetable Soil-Less Mix Special is specifically formulated for greenhouse culture of tomatoes, cucumbers, melons, and similar crops grown in media such as peatlite, bark-peat, composted sawdust, composted rice hulls,rock wool and similar materials. It is not recommended for use in strictly hydroponic applications such as NFT, or sand or gravel culture.

15-10-30 is a stand-alone plant food when used with media containing amendments of 3-10 pounds dolomitic lime per cubic yard plus gypsum at a rate of 2-5 lbs per cubic yard. Supplemental magnesium may be simultaneously injected with the 15-10-30 by inclusion of Epsom Salt in the stock tank.

Where no lime or gypsum is added to the soil, this formula is typically injected simultaneously with Epsom Salt in one stock tank and calcium nitrate in the other through a dual-head injector system, or the components are mixed as a working solution in a batch tank.

This plant food is ideally suited for crop production in beds, rigid containers, horizontal grow-bags or upright 3-5 gallon poly bags filled with the medium of choice. If the crop being grown has a relatively lower requirement for boron than tomatoes or cucumbers, use 15-11-29.

Maximum solubility of this product in hot water is 2 1/2 to 3 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.48
100	0.97
150	1.45
200	1.93
250	2.42
300	2.90
350	3.38
400	3.87
450	4.35
500	4.83

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 103.5

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	1.12 ppm B
Copper as Cu	0.67 ppm Cu
Iron as Fe	3.36 ppm Fe
Magnesium as Mg	4.00 ppm Mg
Manganese as Mn	1.11 ppm Mn
Molybdenum as Mo	0.13 ppm Mo
Zinc as Zn	0.67 ppm Zn

This product contains 72.7% of its total nitrogen in the nitrate form.

Use of 17.8 ounces of this product per 100 gallons of water will produce a 200 ppm N and 400 ppm K_2O solution.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Nitrate Nitrogen.....10.9%
Ammoniacal Nitrogen.....4.1%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....10%

WATER SOLUBLE POTASH (K_2O).....30%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Potassium Nitrate, Ammonium Nitrate.

SECONDARY PLANT FOODS:
Magnesium as Mg 0.300%
Boron as B.....0.084%
Copper as Cu.....0.050%
Iron as Fe.....0.252%
Manganese as Mn 0.084%
Molybdenum as Mo 0.010%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES: Magnesium Sulfate, Sodium Borate, Copper EDTA Chelate, Iron EDTA Chelate, Manganese EDTA Chelate, Sodium Molybdate, Zinc EDTA Chelate.

Potential Acidity 40 lbs. Calcium Carbonate equivalent per ton.

Poinsettia Finisher 15-11-29

This high-potash finisher compliments our 22-8-20 Poinsettia Special designed for early to mid-season feeding of actively-growing poinsettias.

Use the 15-11-29 Finisher from Late October or early November, through to Christmas season for finishing blooming poinsettias. Once blooming initiates, vegetative growth all but ceases. It is undesirable to continue feeding at high N rates due to potential for nitrate salt to burn leaves and bracts during this period. The 1:2 N-to K2O ratio allows the grower to maintain all other nutrients at pre-bloom levels, while significantly lowering N levels. This has the effect of slowing vegetative growth (stretching), while producing a sturdy, firm finished plant with uniform bract size and color.

The high nitrate content of 15-11-29 Poinsettia Finisher makes it an excellent fertilizer in the cool, overcast periods of late October through the Christmas season.

We have included a higher level of molybdenum in this plant food than in our other formulations to minimize the possibility of molybdenum deficiency during the final production phase. In addition, this product has a high magnesium content (6 ppm at the 300 ppm N concentration) to help prevent magnesium chlorosis that often occurs during the critical final weeks before the Christmas season. If your source water magnesium content is less than 20 ppm, we suggest using 14-0-14 Cal-Mag or an Epsom Salt supplement.

Maximum solubility of this product in hot water is 3 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
150	1.20
200	1.60
250	2.01
300	2.41
350	2.81
400	3.21
450	3.61
500	4.07

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 124.64

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.27 ppm B
Copper as Cu	0.67 ppm Cu
Iron as Fe	1.33 ppm Fe
Magnesium as Mg	4.00 ppm Mg
Manganese as Mn	0.67 ppm Mn
Molybdenum as Mo	0.27 ppm Mo
Zinc as Zn	0.67 ppm Zn

This product contains 56.6% of its total nitrogen in the nitrate form.

Use of 17.8 ounces of this product per 100 gallons of water will produce a 200 ppm N and 387 ppm K_2O solution.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Nitrate Nitrogen.....8.49%
Ammoniacal Nitrogen.....2.21%
Water Soluble Urea Nitrogen....4.30%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....11%

WATER SOLUBLE POTASH (K_2O).....29%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate, Urea.

SECONDARY PLANT FOODS:
Magnesium as Mg 0.300%
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.020%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Magnesium Sulfate, Sodium Borate, Copper EDTA Chelate, Iron EDTA Chelate, Manganese EDTA Chelate, Sodium Molybdate, Zinc EDTA Chelate.

Potential Acidity 90 lbs. Calcium Carbonate equivalent per ton.

Pot Mum Special 15-11-29

A high Nitrogen formulation designed to minimize problems due to ammonia toxicity in potted and standard mums.

Useful in correcting Potash deficiencies in mixes or soils. Where the soil test for potassium is in the low to medium range, a single application of 15-11-29 at 14 - 18 ounces per 100 gallons will usually restore K fertility. It is useful in production of easter lilies, geraniums and gloxinias.

Ideal for floricultural plants at bud set as well as at blooming, and as a finisher for both mums and poinsettias. The potential acidity of this fertilizer is very low.

Maximum solubility of this product in hot water is 3 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.40
100	0.80
150	1.20
200	1.60
250	2.01
300	2.41
350	2.81
400	3.21
450	3.61
500	4.07

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 124.64

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.27 ppm B
Copper as Cu	0.67 ppm Cu
Iron as Fe	1.33 ppm Fe
Magnesium as Mg	4.00 ppm Mg
Manganese as Mn	0.67 ppm Mn
Molybdenum as Mo	0.27 ppm Mo
Zinc as Zn	0.67 ppm Zn

This product contains 56.6% of its total nitrogen in the nitrate form.

Use of 17.8 ounces of this product per 100 gallons of water will produce a 200 ppm N and 387 ppm K_2O solution.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Nitrate Nitrogen.....8.49%
Ammoniacal Nitrogen.....2.21%
Water Soluble Urea Nitrogen....4.30%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....11%

WATER SOLUBLE POTASH (K_2O).....29%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Potassium Nitrate, Urea.

SECONDARY PLANT FOODS:
Magnesium as Mg .....0.300 %
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.020%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES: Iron EDTA Chelate, Magneseum EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 90 lbs. Calcium Carbonate equivalent per ton.

Geranium Special 15-15-15

The 15-15-15 Geranium Special is a popular 1-1-1 ratio plant food for use during vegetative production of geraniums, including zonals, regals, ivies and scented cultivars. This is a neutral reaction fertilizer with roughly 50% of the total nitrogen as nitrate N and the balance as ammoniacal and urea N. Because it possesses a very low potential acidity, it is of utility in any growing application where a balanced 1-1-1 formula is required without the acidifying affects associated with other 1-1-1 formulas such as 20-20-20.

As this formula contains nitrate of soda, in cases where sodium is inherently high in the source water (>50-100 ppm Na), we recommend consideration of our 19-19-19 formula which is sodium-free and possesses precisely 50% nitrate nitrogen and 50% ammoniacal nitrogen in its makeup.

The 15-15-15, while commonly used in geranium production, is also suitable for production of Easter lilies, Asiatic lilies, hydrangeas and other florist-quality potted crops.

The maximum solubility of 15-15-15 in warm water is 4 lbs per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.32
100	0.65
150	0.97
200	1.30
250	1.62
300	1.95
350	2.27
400	2.60
450	2.92
500	3.25

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 153.8

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.27 ppm B
Copper as Cu	0.63 ppm Cu
Iron as Fe	1.25 ppm Fe
Manganese as Mn	0.63 ppm Mn
Molybdenum as Mo	0.01 ppm Mo
Zinc as Zn	0.63 ppm Zn

This product contains 48.2% of its total nitrogen in the nitrate form.

Use of 17.8 ounces of this product per 100 gallons of water will produce a 200 ppm N and 200 ppm K_2O solution.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Nitrate Nitrogen.....7.23%
Ammoniacal Nitrogen.....2.95%
Water Soluble Urea Nitrogen....4.82%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....15%

WATER SOLUBLE POTASH (K_2O).....15%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Potassium Nitrate, Urea, Sodium Nitrate.

SECONDARY PLANT FOODS:
Boron as B.....0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn.....0.050%
Molybdenum as Mo.....0.010%
Zinc as Zn.....0.050%

SECONDARY PLANT FOOD SOURCES: Sodium Borate, Copper EDTA Chelate, Iron EDTA Chelate, Manganese EDTA Chelate, Sodium Molybdate, Zinc EDTA Chelate.

Potential Acidity 260 lbs. Calcium Carbonate equivalent per ton.

Soil-Less Mix Special 15-16-17

This multi-purpose formula was designed for use with peatlite mixes. The high levels of chelated micronutrients insure availability even in high pH situations.

While the name infers peatlite usage, the high nitrate nitrogen content makes this blend suitable for modern bark-containing mixes. A high ratio of nitrate to ammonium nitrogen, ideal for mums and geraniums, is achieved in this formula, while maintaining an equal balance of total nitrogen, phophorus and potash.

This total formula will supply sufficient trace elements to prevent deficiencies associated with peatlite and bark based mixes.

Maximum solubility of this product in hot water is 3 1/2 - 4 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.35
100	0.71
150	1.06
200	1.41
250	1.76
300	2.12
350	2.47
400	2.82
450	3.17
500	3.53

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 141.8

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	0.27 ppm B
Copper as Cu	0.67 ppm Cu
Iron as Fe	1.34 ppm Fe
Manganese as Mn	0.67 ppm Mn
Molybdenum as Mo	0.13 ppm Mo
Zinc as Zn	0.67 ppm Zn

This product contains 70.0% of its total nitrogen in the nitrate form.

Use of this product at 17.8 ounces per 100 gallons will produce a solution containing 200 ppm N and 227 ppm K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Nitrate Nitrogen.....10.5%
Ammoniacal Nitrogen.....4.5%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....16%

WATER SOLUBLE POTASH (K_2O).....17%

PRIMARY PLANT FOOD SOURCES: Potassium Nitrate, Ammonium Phosphate, Sodium Nitrate.

SECONDARY PLANT FOODS:
Boron as B 0.02%
Copper as Cu.....0.05%
Iron as Fe.....0.10%
Manganese as Mn 0.05%
Molybdenum as Mo 0.01%
Zinc as Zn 0.05%

SECONDARY PLANT FOOD SOURCES: Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate, Magnesium Sulfate.

Potential Acidity 165 lbs. Calcium Carbonate equivalent per ton.

Hi-Phos Special 15-30-15

Useful where soil test calls for additional P. Use as plant starter for young plants and transplants and for pink hydrangeas to accentuate color by locking up aluminum. New research suggests that high P may increase cytokinin. This hormone may induce bud set and floral numbers and size in african violets, episcias (flame violets) and other bloomers. **Ideal for bedding plant production in packs based upon recent research at NC State.** May produce stockier plants with high bloom count. Promotes better fruit set on greenhouse tomatoes and for floral plants during blooming phase. This ratio is also available as a custom-blended urea-free, high-nitrate (45%) formula.

Maximum solubility of this product in hot water is 3 1/4 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.22
100	0.44
150	0.66
200	0.88
250	1.10
300	1.32
350	1.54
400	1.76
450	1.98
500	2.20

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 227.3

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.27 ppm B
Copper as Cu	0.67 ppm Cu
Iron as Fe	1.33 ppm Fe
Manganese as Mn	0.67 ppm Mn
Molybdenum as Mo	0.013 ppm Mo
Zinc as Zn	0.67 ppm Zn

This product contains 32.8% of its total nitrogen in the nitrate form.

Use of this product at 17.8 ounces per 100 gallons of water will produce a solution containing 200 ppm each of N and K2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Nitrate Nitrogen.....4.92%
Ammoniacal Nitrogen.....5.46%
Water Soluble Urea Nitrogen....4.62%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....30%

WATER SOLUBLE POTASH (K_2O).....15%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate, Urea.

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 610 lbs. Calcium Carbonate equivalent per ton.

Plant Starter /Bloom Booster 15-50-5

High phosphorus in this formulation promotes root production in seedlings, transplants, and newly rooted cuttings (50-75 ppm N every watering until root mass is well-developed). Also useful as a remedial fertilizer in media where the soil test indicates a need for phosphate (use a single drench of 8-10 ounces 15-50-5 per 100 gallons).

For vegetable transplants, dissolve 3-4 lbs. in 100 gals. water (or 2 1/2-3 oz. per 5 gals. or 1 tbs. per gal.). Apply 1/2 to 1 quart to each planting hole. For post-emergence application to cotton, use at 2 lbs. per acre on 10" band 5-7 days after seedlings are established. Follow with a second application 5-7 days after the first. Second can be applied with insecticides for thrips and other insect control. Two additional applications each at 2 lbs. per acre on 16" band, with third application at square stage and the fourth 5-7 days later may prove beneficial.

Use on vegetable transplants and young seedlings promotes rapid growth in cool soils, allowing earlier crop maturation and increased yields. Ideal for tomato, pepper, sweet potato crops, bedding plants.

Maximum solubility of this product in hot water is 3 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.25
100	0.50
150	0.75
200	1.00
250	1.25
300	1.50
350	1.75
400	2.00
450	2.25
500	2.50

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 200

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.27 ppm B
Copper as Cu	0.67 ppm Cu
Iron as Fe	1.33 ppm Fe
Manganese as Mn	0.67 ppm Mn
Molybdenum as Mo	0.013 ppm Mo
Zinc as Zn	0.67 ppm Zn

This product contains 10% of its total nitrogen in the nitrate form.

Use of this product at 17.8 ounces per 100 gallons of water will produce a solution containing 200 ppm N, 667 ppm P2O5, and 67 ppm K2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....15%
Nitrate Nitrogen.....1.50%
Ammoniacal Nitrogen.....13.50%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....50%

WATER SOLUBLE POTASH (K_2O).....5%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate.

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 1,070 lbs. Calcium Carbonate equivalent per ton.

Floral Crop Special 18-18-18

TotalGro's 18-18-18 Foral Crop Special is a 1-1-1 water-soluble plant food with a bit more than 55% of its total nitrogen as nitrate N and the balance as ammoniacal N. In addition, the product is both urea-free and sodium-free. It is useful in any application where 20-20-20 use is restricted on account of its high urea level, such as in cool, dark weather, or on crops sensitive to urea N, or where fungicides may restrict or inhibit urea conversion.

It finds use as a primary fertilizer in the production of orchids, geraniums, chrysanthemums, roses, hydrangeas, kalanchoes and similar materials. It can be used in all seasons, irrespective of light availability and air temperatures. All nitrogen applied is immediately available for plant utilization.

It is a moderately acidifying plant food and thus can be utilized in a variety of soil types Because it it sodium-free, the 18-18-18 formula is recommended as an equivalent substitute for such plant foods as 15-15-15 and 15-16-17 where source water sodium may restrict their use.

Because this is a 18% nutrient formula, usage rates for 20% formulas such as 20-20-20 and 20-10-20 are virtually identical for 18-18-18.

The maximum solubility of 18-18-18 in warm water is 3 to 3 1/2 lbs per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.31
100	0.62
150	0.92
200	1.24
250	1.55
300	1.86
350	2.17
400	2.48
450	2.79
500	3.10

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 161.3

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	0.22 ppm B
Copper as Cu	0.55 ppm Cu
Iron as Fe	1.11 ppm Fe
Magnesium as Mg	3.10 ppm Mg
Manganese as Mn	0.55 ppm Mn
Molybdenum as Mo	0.01 ppm Mo
Zinc as Zn	0.55 ppm Zn

This product contains 55.5% of its total nitrogen in the nitrate form.

Use of 14.8 ounces of this product per 100 gallons of water will produce a 200 ppm N and 200 ppm K_2O solution.

Guaranteed Analysis

TOTAL NITROGEN (N).....18%
Nitrate Nitrogen.....10%
Ammoniacal Nitrogen.....8%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....18%

WATER SOLUBLE POTASH (K_2O).....18%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Potassium Nitrate, Ammonium Nitrate.

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Magnesium as Mg 0.280%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES: Magnesium Sulfate, Sodium Borate, Copper EDTA Chelate, Iron EDTA Chelate, Manganese EDTA Chelate, Sodium Molybdate, Zinc EDTA Chelate.

Potential Acidity 495 lbs. Calcium Carbonate equivalent per ton.

Fern Special 18-24-18

This formula specifically meets the high ammonium, nitrogen, and phosphorus requirements of Boston ferns and similar plants. The nutrient balance promotes strong root growth, coupled with uniformly green, compact foliage. Chelated trace elements prevent deficiencies that are common in the well-drained soils used in fern production.

This is an acid-forming plant food, and is designed to help maintain the low pH favored by Boston ferns and relatives.

Maximum solubility of this product in hot water is 3 1/2 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.20
100	0.40
150	0.60
200	0.80
250	1.00
300	1.20
350	1.40
400	1.60
450	1.80
500	2.00

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 250

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	0.22 ppm B
Copper as Cu	0.56 ppm Cu
Iron as Fe	1.11 ppm Fe
Manganese as Mn	0.56 ppm Mn
Molybdenum as Mo	0.011 ppm Mo
Zinc as Zn	0.56 ppm Zn

This product contains 31.7% of its total nitrogen in the nitrate form.

Use of this product at 14.8 ounces per 100 gallons of water will produce a solution containing 200 ppm each of N and K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....18%
Nitrate Nitrogen.....5.71%
Ammoniacal Nitrogen.....5.82%
Water Soluble Urea Nitrogen....6.47%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....24%

WATER SOLUBLE POTASH (K_2O).....18%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate, Urea.

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 570 lbs. Calcium Carbonate equivalent per ton.

Acid Special 20-6-20

The 20-6-20 Acid Mix is an ideal alternative to 20-10-20 for growers using alkaline irrigation water. High alkalinity waters, combined with high hardness (high calcium and/or magnesium),may cause media to increase in pH over time. Micronutrient deficiencies of iron, manganese and zinc are common where media pH increases above 6.5. This product contains ammonium sulfate, an effective acidifying nutrient amendment for controlling alkalinization of growing media. Unlike formulas containing urea phosphate that has inherent initial acidity, our product has high potential acidity that controls pH after fertilization. Use the formula as you would the 20-10-20 General Purpose blend. The nitrate-to-ammonium ratio is identical to its 20-10-20 counterpart, thus it is perfect for use as a winter feed. Recommended for all phases of bedding plant production, and for production of most potted flowering plants such as poinsettia, chrysanthemums, geraniums, gloxinia, gerbera, and others requiring a high nitrate feed. Use as a primary feed for plugs where 20-10-20 is recommended and acidification is needed to counteract hard, alkaline water effects.

Maximum solubility of this product in hot water is 4 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.29
100	0.58
150	0.87
200	1.15
300	1.73
400	2.30
500	2.88

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 173.9

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Sulfur as S	16.32 ppm S
Boron as B	.19 ppm B
Copper as Cu	.48 ppm Cu
Iron as Fe	.95 ppm Fe
Manganese as Mn	.48 ppm Mn
Molybdenum as Mo	0.10 ppm Mo
Zinc as Zn	.48 ppm Zn

This product contains 60% of its total nitrogen in the nitrate form.

Use of this product at 12.7 ounces per 100 gallons will produce a solution containing 200 ppm N and 200 ppm K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....20%
Nitrate Nitrogen.....12%
Ammoniacal Nitrogen.....8%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....6%

WATER SOLUBLE POTASH (K_2O).....20%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate, Ammonium Nitrate, Ammonium Sulfate

SECONDARY PLANT FOODS:
Sulfur as S 1.63%
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.010%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 481 lbs. Calcium Carbonate equivalent per ton.

General Purpose 20-10-20

This general purpose formula serves a wide variety of needs in all growing conditions, and meets the specific nutritional needs of many floricultural and other greenhouse crops. Use in any situation where 20-20-20 would be applicable, particularly where super-phosphate has been pre-blended into the soil. It is more economical to use because of its lower phosphorus level, and is ideal where additional phosphate might tie-up micronutrients. This formulation contains 60% nitrate nitrogen, and as such, is perfect for use under fluctuating light and temperature conditions in the winter months. It is the fertilizer of choice during extended cool, overcast periods. Recommended for all phases of bedding plant production, and most potted flowering crops including poinsettia, chrysanthemum, geraniums, gloxinia, gerbera, and many others.

Maximum solubility of this product in hot water is 4 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.30
100	0.60
150	0.90
200	1.20
250	1.50
300	1.80
350	2.10
400	2.40
450	2.70
500	3.00

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 166.7

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.2 ppm B
Copper as Cu	0.5 ppm Cu
Iron as Fe	1.0 ppm Fe
Manganese as Mn	0.5 ppm Mn
Molybdenum as Mo	0.10 ppm Mo
Zinc as Zn	0.5 ppm Zn

This product contains 60% of its total nitrogen in the nitrate form.

Use of this product at 13.3 ounces per 100 gallons of water will produce a solution containing 200 ppm each of N and K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....20%
Nitrate Nitrogen.....12%
Ammoniacal Nitrogen.....8%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....10%

WATER SOLUBLE POTASH (K_2O).....20%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Potassium Nitrate, Ammonium Nitrate.

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.010%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES: Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 425 lbs. Calcium Carbonate equivalent per ton.

Soil-Less Mix Special 20-19-18

Ideal formulation for mixes where little or no trace elements have been added. This plant food has higher levels of trace elements than other formulations, and in addition contains soluble magnesium. This is an excellent food for bedding plants, foliage plants, and nursery stock where no trace elements have been added to the pre-plant soil mix. This formulation is particularly well-suited for peat-based mixes. The relatively high levels of both ammonium and urea nitrogen make this formulation ideal for lowering the pH of high pH mixes.

Maximum solubility of this product in hot water is 3 1/2 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.17
100	0.33
150	0.50
200	0.66
250	0.83
300	0.99
350	1.16
400	1.32
450	1.49
500	1.65

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 303

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Magnesium as Mg	1.5 ppm Mg
Boron as B	.20 ppm B
Copper as Cu	0.5 ppm Cu
Iron as Fe	2.52 ppm Fe
Manganese as Mn	.83 ppm Mn
Molybdenum as Mo	.100 ppm Mo
Zinc as Zn	0.5 ppm Zn

This product contains 26.9% of its total nitrogen in the nitrate form.

Use of this product at 13.3 ounces per 100 gallons will produce a solution containing 200 ppm N and 180 ppm K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....20%
Nitrate Nitrogen.....5.39%
Ammoniacal Nitrogen.....3.78%
Water Soluble Urea Nitrogen..10.83%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....19%

WATER SOLUBLE POTASH (K_2O).....18%

PRIMARY PLANT FOOD SOURCES:
Potassium Nitrate, Ammonium Phosphate, Urea.

SECONDARY PLANT FOODS:
Magnesium as Mg 0.1500%
Boron as B 0.0200%
Copper as Cu.....0.0500%
Iron as Fe.....0.2520%
Manganese as Mn 0.0836%
Molybdenum as Mo 0.0100%
Zinc as Zn 0.0500%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate, Magnesium Sulfate.

Potential Acidity 610 lbs. Calcium Carbonate equivalent per ton.

All Purpose 20-20-20

This is an ideal general purpose plant food formulation designed for routine fertilization for a wide variety of greenhouse crops, turf, ornamental trees, shrubs and fruit trees.

20-20-20 All Purpose can be used where the fertility state of the soil is not known, or where nutrients are at a medium (optimum) level where no special fertility correction is necessary.

Because of its acid-forming potential, it is useful to correct high pH and build-up of alkalinity in media and soils. The balanced nitrogen forms in this product promote the optimum production of crops including tropical foliage plants and container-grown azaleas, camellias, gardenias and other ornamental shrubs. This formulation can be foliar-applied to provide quick green-up.

Maximum solubility of this product in hot water is 3 1/2 lbs./gallon.

It is recommended that our higher nitrate general purpose formula 20-10-20 be used in low light conditions or cool weather periods to avoid ammonium conversion problems. We do not recommend the use of this formula on poinsettias, gloxinias, easter lily, mums, geraniums and other flower crops that specifically require a higher nitrate ratio. The 20-10-20 and other specialty fertilizers are superior in these instances.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
150	0.60
200	0.80
250	1.00
400	1.60
450	1.80

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 250

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	0.2 ppm B
Copper as Cu	0.5 ppm Cu
Iron as Fe	1.0 ppm Fe
Manganese as Mn	0.5 ppm Mn
Molybdenum as Mo	.01 ppm Mo
Zinc as Zn	0.5 ppm Zn

This product contains 29.9% of its total nitrogen in the nitrate form.

Use of this product at 13.3 ounces per 100 gallons will produce a solution containing 200 ppm each of N and K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....20%
Nitrate Nitrogen.....5.98%
Ammoniacal Nitrogen.....5.58%
Water Soluble Urea Nitrogen....8.44%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....20%

WATER SOLUBLE POTASH (K_2O).....20%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate, Urea, Potassium Phosphate.

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 550 lbs. Calcium Carbonate equivalent per ton.

Azalea - Acid 21-7-7

This formula contains ammonium sulfate and thus has a very high acid potential favorable for routine fertilization of azaleas, rhododendrons, heathers and other acid-loving crops. Its best application is where the source water shows a high bicarbonate alkalinity, and where repeated use of such water tends to cause undesirable increases in media pH over time. This formula is chloride-free, unlike 21-7-7 acid formulas manufactured by others.

This formula is useful as a temporary feed for lowering the pH of plantings having an excessive soil pH. This formula is not recommended for continuous application to soils with a pre-existing optimum or below optimum pH.

Maximum solubility of this product in hot water is 3 1/2 to 3 3/4 lbs per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.30
100	0.61
150	0.91
200	1.22
250	1.52
300	1.82
350	2.13
400	2.43
450	2.74
500	3.04

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 163.9

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Magnesium as Mg	1.5 ppm Mg
Boron as B	.19 ppm B
Copper as Cu	.48 ppm Cu
Iron as Fe	.95 ppm Fe
Manganese as Mn	.48 ppm Mn
Molybdenum as Mo	.0095 ppm Mo
Zinc as Zn	.48 ppm Zn

This product contains 10.0% of its total nitrogen in the nitrate form.

Use of this product at 12.7 ounces per 100 gallons will produce a solution containing 200 ppm N and 67 ppm K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....21%
Nitrate Nitrogen.....2.1%
Ammoniacal Nitrogen.....14.1%
Water Soluble Urea Nitrogen.....4.8%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....7%

WATER SOLUBLE POTASH (K_2O).....7%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate, Ammonium Sulfate, Urea.

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Magneseum as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 1576 lbs. Calcium Carbonate equivalent per ton.

Poinsettia Special 22-8-20

Designed for production of poinsettias, especially in early to mid production. Use TotalGro 15-11-29 or 15-5-25 for a high quality finished plant. High nitrate level reduces potential for ammonium toxicity resulting in leaf burn and leaf curl. Excellent plant food for dark weather situations and all situations where soil phosphorus is adequate or where phosphorus has been pre-incorporated into the mix prior to planting.

The additional molybdenum in 22-8-20 meets the high molybdenum requirement of poinsettias, and prevents chlorosis and leaf margin burn associated with nitrate accumulation arising from molybdenum deficiency.

Maximum solubility of this product in hot water is 4 1/4 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.22
100	0.44
150	0.66
200	0.88
250	1.10
300	1.32
350	1.54
400	1.76
450	1.98
500	2.20

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 227.3

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.18 ppm B
Copper as Cu	.45 ppm Cu
Iron as Fe	.91 ppm Fe
Manganese as Mn	.45 ppm Mn
Molybdenum as Mo	0.18 ppm Mo
Zinc as Zn	.45 ppm Zn

This product contains 60.9% of its total nitrogen in the nitrate form.

Use of this product at 12.1 ounces per 100 gallons will produce a solution containing 200 ppm N and 182 ppm K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....22%
Nitrate Nitrogen.....13.4%
Ammoniacal Nitrogen.....8.6%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....8%

WATER SOLUBLE POTASH (K_2O).....20%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate, Ammonium Nitrate.

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.020%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 450 lbs. Calcium Carbonate equivalent per ton.

Foliage Plant Special 24-8-16

Research conducted by Conover, Poole, Joiner and others in Florida, has indicated that tropical foliage plants grown in containers in high organic media, produce highest quality when fed with either a 1-1-1 or 3-1-2 plant food. While our TotalGro 20-20-20 formulation is ideally suited for soils having little or no pre-incorporated phosphorus, or on soils where phosphorus fixation is a problem, a low phosphate foliage food is better suited to where a slow-release phosphate has been added in the mix at planting. TotalGro 24-8-16 is specifically formulated for tropical foliage plantings, and is ideal for general use because of its very low salt index. We developed this formulation to meet the requirements of growers using peat-lite and bark-sand mixes for growing foliage plants, and have combined the desirable 3-1-2 ratio of N-P_2O_5-K_2O with our blend of chelated micronutrients. Due to the formulation's high urea content, it can be used in foliar fertilization programs. Plants are better able to absorb nitrogen from the urea form, than any other N form. The phosphorus in 24-8-16 is derived from high purity ammonium phosphate, and thus contains no harmful fluorides that commonly occur as a contaminant in some 3-1-2 formulations. This product is available in two custom blends: dye-free blend where the presence of tracer dye is undesirable, and "winter feed" blend.

The maximum solubility of this product in hot water is 3 1/4-4 lbs/gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
100	0.40
150	0.60
200	0.80
250	1.00
300	1.20

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 250

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Magnesium	0.8 ppm Mg
Boron as B	0.2 ppm B
Copper as Cu	0.4 ppm Cu
Iron as Fe	0.8 ppm Fe
Manganese as Mn	0.4 ppm Mn
Molybdenum as Mo	.01 ppm Mo
Zinc as Zn	0.4 ppm Zn

This product contains 21.7% of its total nitrogen in the nitrate form.

Use of this product at 11.1 ounces per 100 gallons will produce a solution containing 200 ppm of N and 133 ppm K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....24%
Nitrate Nitrogen.....4.8%
Ammoniacal Nitrogen.....5.2%
Water Soluble Urea Nitrogen....14.0%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....8%

WATER SOLUBLE POTASH (K_2O).....16%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Potassium Nitrate, Ammonium Nitrate, Ammonium Sulfate, Urea.

SECONDARY PLANT FOODS:
Magnesium as Mg 0.100%
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES: Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate, Magnesium Sulfate.

Potential Acidity 620 lbs. Calcium Carbonate equivalent per ton.

Blueberry Special 27-9-18

TotalGro's 27-9-18 Blueberry Special meets the requirement for a true 3-1-2 ratio water-soluble small fruit plant food for the fertigation of rabbiteye and highbush blueberries, as well as vinyard crops such as grapes and muscadines, and cane crops such as blackberries. This plant food is an acidifying formula containing a high level of urea and ammonium N, plus adequate levels of sulfur and iron needed for optimum fertigation of small fruit crops. In the field, the normal rate of application will range from 2-5 lbs total fertilizer per acre per week, and will vary depending upon crop being grown, plant age, soil type and other factors. Detailed usage rates are outlined in our small fruit technical bulletin series.

The maximum solubility of this product in hot water is 3 1/2 to 4 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.15
100	0.29
150	0.44
200	0.58
250	0.73
300	0.87
350	1.02
400	1.16
450	1.31
500	1.45

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 344.7

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.15 ppm B
Copper as Cu	.37 ppm Cu
Manganese as Mn	.37 ppm Mn
Iron as Fe	2.22 ppm Fe
Molybdenum as Mo	.007 ppm Mo
Zinc as Zn	0.37 ppm Zn

This product contains 20.0% of its total nitrogen in the nitrate form, and 80.0% in the ammoniacal form.

Use of this product at 9.9 ounces per 100 gallons will produce a solution containing 200 ppm N and 104 ppm K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....27%
Nitrate Nitrogen.....5.4%
Ammoniacal Nitrogen.....4.3%
Water Soluble Urea Nitrogen.....17.3%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....9%

WATER SOLUBLE POTASH (K_2O)....18%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Potassium Nitrate, Ammonium Nitrate, Urea.

SECONDARY PLANT FOODS:
Boron as B.....0.020%
Copper as C.....050%
Iron as Fe.....0.300%
Manganese as Mn.....0.050%
Molybdenum as Mo.....0.001%
Zinc as Zn.....0.050%

SECONDARY PLANT FOOD SOURCES: Iron DTPA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 720 lbs. Calcium Carbonate equivalent per ton.

Bark Media/Tree Special 28-7-14

This is an ideal formulation for bark-based media as an all-purpose plant food where phosphate has been pre-blended in the soil mix. It is designed specifically for production of container-grown woody plants in pine bark and similar media. The high nitrogen content helps offset nitrogen demand from "green" bark or sawdust in bark-based mixes.

This 4-1-2 N-P-K formula is also especially suited for fertilization of field-grown trees by both drip irrigation and soil injection techniques. The high nitrogen provides rapid and uniform growth in indeterminate tree species, i.e., those with continual shoot and foliage growth throughout the growing season, and boost growth when needed for those species with indeterminate growth or intermittent growth.

The formula is also favored by greenskeepers and park managers for turfgrass fertilization on most turfgrass species.

The formula is acid-forming and the nitrogen is primarily in the urea form, thus the product is useful as a foliar spray for rapid correction of nutrition problems in a variety of crops.

Maximum solubility of this product in hot water is 4 to 4.5 lbs. per gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.09
100	0.18
150	0.27
200	0.36
300	0.54
400	0.72
500	0.90

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 555.6

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.14 ppm B
Copper as Cu	.36 ppm Cu
Iron as Fe	.72 ppm Fe
Manganese as Mn	.36 ppm Mn
Molybdenum as Mo	.01 ppm Mo
Zinc as Zn	.36 ppm Zn

This product contains 20% of its total nitrogen in the nitrate form.

Use of this product at 9.5 ounces per 100 gallons will produce a solution containing 200 ppm N and 100 ppm K_2O.

Guaranteed Analysis

TOTAL NITROGEN (N).....28%
Nitrate Nitrogen.....5.6%
Ammoniacal Nitrogen.....2.9%
Urea Nitrogen 19.5%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....7%

WATER SOLUBLE POTASH (K_2O).....14%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Nitrate, Ammonium Nitrate, Urea

SECONDARY PLANT FOODS:
Boron as B 0.020%
Copper as Cu.....0.050%
Iron as Fe.....0.100%
Manganese as Mn 0.050%
Molybdenum as Mo 0.001%
Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 852 lbs. Calcium Carbonate equivalent per ton.

Acid-Azalea-Foliar Special 30-10-10

Very high N formulation for orchids grown in fir bark or for any crops needing a nitrogen boost. It is ideal for feeding tropical foliage plants during production, for container azaleas and nursery stock, by promoting dark green, rapid growth, and strong root systems. Its high ammoniacal nitrogen content makes it an excellent warm weather, sunny month plant food.

Because of its high acid potential, this formulation works well when used in high alkalinity water or where it is desirable to reduce media pH.

This formulation is well-suited for foliar-application due to the high urea content. This product is available in a custom dye-free blend where the presence of tracer dye is undesirable. See Page 38 for details on foliar nutrient application.

The maximum solubility of this product in hot water is 4 1/4 lbs/gallon.

Estimating Nitrogen PPM Using Electrical Conductivity

Nitrogen PPM	EC, mmhos/cm*
50	0.07
100	0.14
150	0.21
200	0.28
250	0.35
300	0.42
350	0.49
400	0.56
450	0.63
500	0.70

For values not listed, use the following equation:

N,ppm = EC, mmhos/cm X 714.3

Note: Subtract the EC of plain water from EC of fertilizer solution before using tables.

Use of this product at 8.9 ounces per 100 gallons will produce a solution containing 200 ppm N and 67 ppm K_2O.

Trace Element Concentration At 200 PPM Nitrogen

ELEMENT	PPM
Boron as B	.13 ppm B
Copper as Cu	.33 ppm Cu
Manganese as Mn	.33 ppm Mn
Iron as Fe	0.67 ppm Fe
Molybdenum as Mo	.0067 ppm Mo
Zinc as Zn	0.33 ppm Zn

This product contains 11.3% of its total nitrogen in the nitrate form.

Trace Element Concentration At Foliar Feed Rate of 5 lbs/100Gallons

ELEMENT	PPM
Boron as B	1.2 ppm B
Copper as Cu	3.0 ppm Cu
Manganese as Mn	3.0 ppm Mn
Iron as Fe	6.0 ppm Fe
Molybdenum as Mo	0.06ppm Mo
Zinc as Zn	3.0 ppm Zn

Guaranteed Analysis

TOTAL NITROGEN (N).....30%
- Nitrate Nitrogen.....3.38%
- Ammoniacal Nitrogen.....2.14%
- Water Soluble Urea Nitrogen....24.48%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....10%

WATER SOLUBLE POTASH (K_2O).....10%

PRIMARY PLANT FOOD SOURCES: Ammonium Phosphate, Potassium Nitrate, Urea.

SECONDARY PLANT FOODS:
- Boron as B 0.020%
- Copper as Cu.....0.050%
- Iron as Fe.....0.100%
- Manganese as Mn 0.050%
- Molybdenum as Mo 0.001%
- Zinc as Zn 0.050%

SECONDARY PLANT FOOD SOURCES: Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Acidity 1,010 lbs. Calcium Carbonate equivalent per ton.

Bag Culture Tomato Special 3-13-29

This formula was designed based upon greenhouse tomato research by Dr. Rick Snyder at Mississippi State University and Dr. Pat Hegwood, Louisiana State University. It is specifically designed for use by growers of greenhouse tomatoes in bags using pine bark media. The formula yields the same micronutrient ratios found in the Steiner solution developed by Abram Steiner in the 1960s in Europe. The main difference is simplicity of use and flexibility in nitrogen control. Research using the popular bag culture method suggests that lower nitrogen feed rates are best. The total nitrogen feed normally used in bag culture today is around 100 ppm of total nitrogen. When calcium nitrate is added from a separate injector while feeding 3-13-29, essential nutrients are fed in a balanced solution to tomatoes. Although the N feed rate is lower, concentrations of all other nutrients provided by the 3-13-29 mix fall within the ratios recommended by Steiner for hydroponic culture of greenhouse vegetables. The 3-13-29 formula can also be adapted for use in bag culture of cucumbers, peppers, herbs and cut flowers. Call or write for a brochure on 3-13-29 application rates and grower tips.

Conc. (ppm) of Nutrients When Used w/Calcium Nitrate To Feed 110 ppm Total Nitrogen

Plant Nutrient	Nutrient PPM
Nitrate (N)	110 ppm
Phosphorus (P)	49 ppm
Potassium (K)	240 ppm
Calcium (Ca)	100 ppm
Magnesium (Mg)	54 ppm
Sulfur (S)	110 ppm
Iron (Fe)	3.40 ppm
Manganese (Mn)	1.00 ppm
Copper (Cu)	1.00 ppm
Zinc (Zn)	0.45 ppm
Boron (B)	1.00 ppm
Molybdenum (Mo)	0.10 ppm

Normal Mixing Schedule For 100 Gals. Working Solution @ 110 ppm N

Oz Fertilizer/100 gal	ppm N	EC,mmhos/cm
13.3 oz 3-13-29	30	1.26
7 oz Calcium Nitrate	80	0.60

The total EC at the hose for this solution will be 1.86 mmhos/cm.

Call 1-800-433-3055 for additional information on use of this product for production of greenhouse tomatoes in bag culture.

Guaranteed Analysis

TOTAL NITROGEN (N).....3%
Nitrate Nitrogen.....3%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....13%

WATER SOLUBLE POTASH (K_2O).....29%

PRIMARY PLANT FOOD SOURCES:
Ammonium Phosphate, Potassium Sulfate, Potassium Phosphate, Magnesium Sulfate

SECONDARY PLANT FOODS:
Boron as B 0.100%
Copper as Cu.....0.100%
Iron as Fe.....0.340%
Magnesium as Mg 5.400%
Manganese as Mn 0.100%
Molybdenum as Mo 0.010%
Sulfur as S 11.000%
Zinc as Zn 0.045%

SECONDARY PLANT FOOD SOURCES:
Iron EDTA Chelate, Manganese EDTA Chelate, Copper EDTA Chelate, Zinc EDTA Chelate, Sodium Borate, Sodium Molybdate.

Potential Basicity 80 lbs. Calcium Carbonate equivalent per ton.

Hydroponic Special/Steiner Formula 8-5-16

The 8-5-16 is one of the most widely researched hydroponic plant foods available on the market today. The development of a stable blended 8-5-16 resulted largely from extensive greenhouse tomato production research conducted by Dr. John Larsen, Professor Emeritus In Horticulture, Texas A&M.

Essentially, TotalGro's 8-5-16 formula is a Steiner Ratio plant food modified to fulfill the growing requirements for conditions in North America. When mixed in equal proportions, the two components of the 8-5-16 formula produce a complete plant food solution containing all essential major, secondary and trace nutrients required for production of tomatoes, cucumbers, lettuce and other hydroponically-grown crops. It is suitable for use in all nutrient flow technique (NFT) applications, nutrient troughs, ponds, aeroponic systems, as well as in bag or container culture of crops in sand, perlite, rockwool and other relatively inert substrates.

This formula can also be used in container-culture with organic media, although our 15-10-30 formulas may provide more flexibility in these substrates.

This product is available in a standard formula with boron suitable for tomato and cucumber culture, as well as in a low-boron custom blend. The 8-5-16 formula can be prepared in batch tanks of dilute solution, or injected through a dual-head injection system.

Consult our technical department regarding detailed instructions in use of 8-5-16 hydroponic plant foods.

Estimating Nitrogen PPM Using Electrical Conductivity

Fertilizer Solution Strength	Nitrogen, PPM	EC, mmhos/cm*
40%	68	0.83
60%	102	1.25
80%	136	1.67
100%	170	2.08
120%	204	2.50

N, ppm = EC, mmhos/km x 81.9 =
EC, mmhos x 700 = TOTAL DISSOLVED SALTS (TDS), PPM

NOTE: The maximum solubility of the Part1 (white mix) is 5 lbs./gallon. The maximum solubility of the part 2 (blue mix) is 2 1/2 lbs./gallon.

Elemental Concentrations At 170 PPM Nitrogen (100% strength)

ELEMENT	PPM
Nitrogen (NO3N)	170 ppm
Phosphorus (P)	46 ppm
Potassium (K)	281 ppm
Calcium (Ca)	180 ppm
Magnesium (Mg)	44 ppm
Sulfate (S)	180 ppm
Boron as B	1.02 ppm B
Copper as Cu	0.60 ppm Cu
Iron as Fe	2.97 ppm Fe
Manganese as Mn	1.02 ppm Mn
Molybdenum as Mo	0.10 ppm Mo
Zinc as Zn	0.42 ppm Zn

Use of 14.2 oz. each of Part 1 (White Mix) and Part 2 (Blue Mix) dissolved in 100 gals of water will produce a solution containing 170 ppm N and 281 ppm K (340 ppm K2O), and will be a 100% Steiner feed solution.

Guaranteed Analysis

TOTAL NITROGEN (N).....8%
Nitrate Nitrogen.....8.0%

AVAILABLE PHOSPHORIC ACID (P_2O_5).....5%

WATER SOLUBLE POTASH (K_2O).....16%

PRIMARY PLANT FOOD SOURCES:
Calcium Nitrate, Potassium Nitrate, Mono-Potassium Phosphate, Potassium Sulfate.

SECONDARY PLANT FOODS:
Calcium as Ca 8.50%
Magnesium as Mg 2.08%
Sulfur as S 8.50%
Boron as B 0.048%
Copper as Cu.....0.028%
Iron as Fe.....0.140%
Manganese as Mn 0.048%
Molybdenum as Mo 0.0048%
Zinc as Zn 0.020%

SECONDARY PLANT FOOD SOURCES:
Magnesium Sulfate, Sodium Borate, Copper EDTA Chelate, Iron EDTA Chelate, Manganese EDTA Chelate, Sodium Molybdate, Zinc EDTA Chelate.

Foliar Application Using TotalGro Formulations

Foliar feeding is a fertilization method in which water-soluble fertilizer solutions are sprayed directly on plant leaf surfaces so that the plant nutrients are rapidly absorbed for quick green-up and temporary correction of nutritional deficiencies. It is not intended as a replacement for soil-applied fertilizers, but is useful for "finishing" plants before shipping, for correcting mild or beginning symptoms of nutrient deficiencies, for feeding plants under stress where root uptake of nutrients may be impaired, and for overall improved plant quality in regular feeding programs.

Two TotalGro formulations are especially well-suited for foliar application. Our 30-10-10 and 20-20-20 water solubles are formulated with high urea N and are thus ideal for foliar use due to their low salt indices. Since chelated micronutrients are included, every foliar application will add micronutrients in the proper physiological balance needed for producing lush, green foliage.

To use for foliar application, prepare spray solutions with the fertilizer of choice according to the tables below. Include a wetting agent (surfactant) according to the label directions for maximum wetting of leaf surfaces, especially where waxy leaves are involved. The best effects from foliar applications occur during active growth phases for plants, with frequency of application being every 1-2 weeks. Cool, overcast weather presents an ideal situation for foliar feeding. **Do not apply foliar fertilizers during very hot, bright-light conditions, or where plants are under severe drought stress or wilting.** While water-soluble fertilizers may as a rule be used in conjunction with many pesticides and fungicides, the user is advised to conduct trial tests in jars before using in general application. Do no use TotalGro fertilizers in mixture with highly alkaline sprays, dormant oils, dinitro compounds, lime-sulfur mixes, or other similar materials.

The time of day is important in using foliar fertilizers. It is best to spray in early morning, preferably between 6 to 10 A.M. when temperatures are cooler and favorable drying conditions are present. We cannot over-emphasize that foliar spraying not be conducted on drought-stressed plants, as leaf burn will likely occur. Do not apply after 12 noon or under situations where plant foliage will remain moist for extended periods. Apply foliar solution until run-off occurs so that entire leaf surface is wetted.

Whether using in conjunction with pesticide or fungicide applications or alone, the grower should conduct trial applications before general use on the entire planting.

Caution: Do not apply using sprayers that have previously been used for herbicide application, or with other substances that may be phytotoxic.

For recommendations for single element foliar application guidelines, refer to page 9 in this manual.

Suggested Application Rates (lbs. TotalGro per 100 gals. water)

TotalGro Formulation	Greenhouse Plants	Outdoor Woody Ornamentals	Vegetables & Herbaceous Plants	Fruit Trees
30-10-10	1-3	3-5	2-5*	2-5*
20-20-20	1 1/2 - 4	4-6	3-6*	3-6*

*Maximum recommended fertilizer per acre per application.

Factors Causing Salt Accumulation

While TotalGro premium plant foods have very low salt indices, environmental conditions and cultural practices may sometimes lead to excessive salt accumulations in soils. Salt build-up may occur simply due to the soil mix being used, watering and feeding schedules, accidental over-feeding, soil and air temperatures, or water quality, to name a few situations causing soil salt accumulation.

Slow-release fertilizers, particularly those of the resin-coated type, require special consideration where salt build-up is concerned. These products have a specified release period, usually listed as a range of 2 to 4, 3 to 4, or 8 to 9 months or more.

The release rates for resin-coated products are normally calibrated for an average soil temperature of between 68-72 F. During growing periods when the soil temperature falls to near 65 F or lower, the rate of nutrient release will be slower. Conversely, as the soil temperature ascends into the 80˚-90˚ F range, the release rate will be accelerated, often with disastrous results.

Problems with resin-coated fertilizers are typically associated with late spring, summer and early autumn when release rates may exceed the label claims. We caution growers to be mindful of the critical link between temperature and salt release from resin-coated fertilizers.

While water-soluble and slow-release fertilizers can be safely used together, the optimum period for use of slow-release prills is during the cool months where the day temperatures are never likely to exceed about 70˚ to 80˚ F.

Symptoms of High Salts

Effects of excessive soluble salts are variable with crop being grown, as well as the salts involved. Generally, if salt damage is allowed to go unchecked, plant death will occur. Early symptoms of salt damage often mimic nutritional deficiencies, and include stunting and lack of growth and vigor, yellowing of all leaves or chlorosis of older leaves, leaf tip burn, bud die-back, and leaf drop.

Salt damage to root tips and root hairs may be sufficient to cause wilting due to restricted water uptake. Seed germination may be reduced or inhibited as salt levels increase. In general, seedlings, cuttings, and young plants are more sensitive to salt damage than older or mature plants.

Alleviating High Salt Accumulations

If a salt build-up occurs in peat-lite or pine-bark mixes, several approaches can be taken to diminish salt effects.

Culturally, if the constant feeding technique is used, salt build-up will normally be insignificant because high salts will be displaced by the new irrigation solution applied at every watering. Even with this system however, occasionally salts will accumulate. Intermittent watering with plain water, for example, every three waterings with fertilizer, should keep salt levels moderate.

If salt levels are very high, water with plain water to leach containers so that the water drains freely out of the containers. Repeat this procedure in several hours. Extremely high salt levels may require an additional leaching 2-3 days after the first leachings.

After leaching, if severe root and shoot damage have not yet occurred, resume a normal feeding program. If root damage has occurred, reduce the feeding rate to about 1/3 to 1/2 of normal until a new root system has established.

Leaching may not be effective if the medium is poorly drained, and excessive watering could significantly diminish soil aeration.

Using Electrical Conductivity To Monitor Fertilizer Solutions

Using an electrical conductivity (EC) meter, a grower can routinely monitor proper functioning of injector or proportioner systems. EC readings of fertilizer solutions can be used both to monitor your dilution system, as well as monitor the adequacy of your feeding program for a specific crop. This procedure works best using freshly prepared solutions

After you start injecting fertilizer solution concentrate into the water supply, allow the hose to discharge for several minutes or as long as necessary to obtain a consistent EC reading. Measure the EC of the fertilized water, then subtract the EC of the plain tap water from that of the fertilized water. This is the **corrected EC** for the fertilizer solution.

Using the tables in this section, find the TotalGro formulation being used, then go across the table and find the EC that is closest to your reading. Go up that column to determine the approximate nitrogen concentration in parts per million (ppm).

If your EC reading is not on the tables, you can easily determine the N concentration using the EC Factor in the last column. Each formulation has a specific EC Factor. Multiply the **corrected EC** by the appropriate EC Factor. For example, suppose your solution of 20-20-20 had a corrected EC reading of 1.75 mmhos/cm. Using the EC Factor 250.0 for 20-20-20,

1.75 mmhos/cm x 250.0 = 437.5 ppm nitrogen

	EC Reading, mmhos/cm At A Given Nitrogen Concentration:										
Total/Gro Plant Food Formulation	50 PPM	100 PPM	150 PPM	200 PPM	250 PPM	300 PPM	350 PPM	400 PPM	450 PPM	500 PPM	EC FACTOR*
13-2-13 Plug Mix	0.41	0.82	1.22	1.63	2.03	2.44	2.85	3.25	3.66	4.07	123.0
14-0-14 Cal-Mag	0.37	0.73	1.10	1.47	1.83	2.20	2.57	2.93	3.30	3.67	136.4
14-4-14 Cal-P-Mag	0.42	0.84	1.26	1.68	2.10	2.52	2.94	3.36	3.78	4.20	119.1
15-0-15 Hi-Calcium	0.36	0.71	1.07	1.43	1.79	2.14	2.50	2.86	3.22	3.57	139.9
15-2-20 Pansy	0.35	0.70	1.05	1.40	1.75	2.10	2.45	2.80	3.15	3.50	142.9
15-11-29 Mum/Poins	0.33	0.67	1.00	1.33	1.66	1.99	2.33	2.66	2.99	3.33	150.4
15-15-15 Geranium	0.32	0.65	0.98	1.30	1.63	1.95	2.28	2.60	2.93	3.25	153.8
15-16-17 High NO3	0.35	0.71	1.06	1.41	1.76	2.12	2.47	2.82	3.17	3.53	141.8
15-30-15 High Phos	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	227.3
15-50-5 Starter	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	200.0
18-24-18 Fern Special	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	250.0
18-18-18 Floral	0.31	0.62	0.93	1.24	1.55	1.86	2.17	2.48	2.79	3.10	161.3
20-6-20 Acid Special	0.29	0.58	0.86	1.15	1.44	1.75	2.01	2.30	2.59	2.88	173.9
20-10-20 General	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	166.7
20-19-18 Peat-Lite	0.17	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.65	303.0
20-20-20 All Purpose	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	250.0
21-7-7 Azalea-Acid	0.30	0.61	0.91	1.22	1.52	1.82	2.13	2.43	2.74	3.04	163.9
22-8-20 Poinsettia	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	227.3
24-8-16 Foliage	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	250.0
27-9-18 Blueberry	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25	400.0
28-7-14 Bark-Tree	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.90	555.6
30-10-10 Acid-Azal-Fol	0.07	0.14	0.21	0.28	0.35	0.42	0.40	0.56	0.63	0.70	714.3
Ammonium Nitrate	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30	217.4
Calcium Nitrate	0.37	0.74	1.11	1.48	1.85	2.22	2.59	2.96	3.33	3.70	135.1
Potassium Nitrate	0.47	0.95	1.42	1.90	2.37	2.85	3.32	3.80	4.27	4.75	105.3
Magnesium Nitrate	**5 ppm Mg (6 ppm nitrogen) = 0.043 mmhos; 50 ppm Mg (60 ppm N)= 0.44 mmhos**										
Magnesium Sulfate	**5 ppm Mg = 0.038 mmhos; 25 ppm Mg = 0.19 mmhos; 50 ppm Mg = 0.38 mmhos**										

*To estimate N concentrations using EC values not listed on this table, subtract the EC of the plain water from the EC of the fertilized water, then multiply the EC reading times the EC Factor to get nitrogen in parts per million(PPM).

Calculations Based Upon The PPM System

Nutrient concentrations in water-soluble plant food solutions are normally expressed in terms of **parts per million** (ppm), usually of total nitrogen. This expression gives the number of parts of a nutrient element contained in one million parts of water. Parts per million is equivalent to the metric expression, milligrams per liter (mg/L).

The ppm of a nutrient element contained in 1 ounce of fertilizer per 100 gallons of water can be easily determined by multiplying the decimal percentage of nutrient in the fertilizer times 75.

From this relationship, a number of useful calculations can be made:

Eq. 1) To obtain a desired nutrient level in ppm at hose, use the following to prepare stock solutions:

Oz/Gal. of Stock =

$$\frac{\text{Proportioner Ratio:1}}{\%\text{Nutrient}} \times \frac{\text{Desired ppm at hose}}{100} \times 1.333$$

Eq. 2) To obtain the ppm at water hose when adding a known amount of fertilizer to one gallon of stock solution:

ppm at Hose =

$$\frac{\%\text{Nutrient}}{\text{Proportioner Ratio}} \times \frac{\text{Oz/Gal-Stock Sol.}}{1.333} \times 100$$

Eq. 3) To obtain the ppm of nutrient when ounces of fertilizer per 100 gallons of water is known:

ppm in Solution =

0.75 x (% nutrient) x (oz. of fertilizer/100 gals.)

Eq. 4) To calculate the ounces of fertilizer per 100 gallons of water needed to prepare a solution of a specific ppm concentration:

Oz/100 gals =

$$\frac{\text{ppm needed x 1.333}}{\%\text{ nutrient}}$$

Eq. 5) To compute the nutrient in ppm at the hose when the oz/gal of stock, % nutrient and injector ratio are known:

Nutrient ppm @ hose =

$$\frac{(75 \times \text{oz/gal. of stock} \times \%\text{Nutrient})}{\text{proportioner ratio:1}}$$

Eq. 6) A shortened version of a formula for calculating the ounces of plant food per gallon of stock solution for injector feeding:

Oz/Gal. of stock =

$$\frac{(0.01333 \times \text{ppm needed} \times \text{proportioner ratio:1})}{\%\text{Nutrient}}$$

Equation # 6 will probably be the most useful when using an injector feeding system.

As an example, suppose you have your injector set at 100:1, i.e. 1 gallon of stock diluted to 100 gallons with water. You are using 20-20-20 fertilizer and wish to prepare a 200 ppm nitrogen solution for constant feeding.

To determine the ounces per gallon needed to prepare a stock solution:

Oz/Gal. of Stock =

$$\frac{(0.01333 \times 200 \text{ ppm needed} \times 100\text{:1 Ratio})}{20\% \text{ nitrogen in 20-20-20}}$$

= 266/20

= 13.3 ounces/gallon needed to prepare stock for a 100:1 injector at a 200 ppm nitrogen rate.

Preparation of Stock Solutions For Injector/Proportioner Feeding

These tables allow you to prepare stock solutions of TotalGro water soluble plant foods for use at specified nitrogen concentrations in parts per million (ppm) at the hose, and with injector or proportioning systems. For ratios or N concentrations not listed here, refer to the simple equations given on page 42. The practical limits of solubility of most TotalGro plant food range from 2.5 - 5 pounds per gallon of water.

15-16% NITROGEN FORMULATIONS DESIRED NITROGEN PARTS PER MILLION (PPM)

Injector Ratio	50	100	150	200	250	300	350	400	450	500	550	650
	OUNCES OF TOTALGRO PER GALLON OF WATER											
12	0.5	1.1	1.6	2.2	2.7	3.2	3.8	4.3	4.9	5.4	5.9	7.0
15	0.7	1.4	2.0	2.7	3.4	4.1	4.7	5.4	6.1	6.8	7.4	8.8
24	1.1	2.2	3.2	4.3	5.4	6.5	7.6	8.6	9.7	10.8	11.9	14.0
30	1.4	2.7	4.1	5.4	6.8	8.1	9.5	10.8	12.2	13.5	14.9	17.6
50	2.3	4.5	6.8	9.0	11.3	13.5	15.8	18.0	20.3	22.5	24.8	29.3
100	4.5	9.0	13.5	18.0	22.5	27.0	31.5	36.0	40.5	45.0	49.5	58.5
128	5.8	11.5	17.3	23.0	28.8	34.6	40.3	46.1	51.8	57.6	63.4	74.9
150	6.8	13.5	20.3	27.0	33.8	40.5	47.3	54.0	60.8	67.5	74.3	NR*
200	9.0	18.0	27.0	36.0	45.0	54.0	63.0	72.0	81.0	NR*	NR*	NR*
300	13.5	27.0	40.5	54.0	67.5	81.0	NR*	NR*	NR*	NR*	NR*	NR*
400	18.0	36.0	54.0	72.0	NR*	NR*	NR*	NR*	NR*	NR*	NR*	NR*

18-22% NITROGEN FORMULATIONS DESIRED NITROGEN PARTS PER MILLION (PPM)

Injector Ratio	50	100	150	200	250	300	350	400	450	500	550	650
	OUNCES OF TOTALGRO PER GALLON OF WATER											
12	0.4	0.8	1.2	1.6	2.0	2.5	2.8	3.2	3.6	4.1	4.9	5.3
15	0.5	1.2	1.5	2.0	2.5	3.0	3.5	4.1	4.6	5.1	6.1	6.6
24	0.8	1.6	2.4	3.2	4.1	4.9	5.7	6.5	7.3	8.1	9.7	10.5
30	1.0	2.0	3.4	4.1	5.1	6.1	7.1	8.1	9.1	10.1	12.2	13.2
50	1.7	3.4	5.1	6.8	8.4	10.1	11.8	13.5	15.2	16.9	18.6	21.9
100	3.4	6.8	10.1	13.5	16.9	20.3	23.6	27.0	30.4	33.8	40.5	43.9
128	4.3	8.6	13.0	17.3	21.6	25.9	30.2	34.6	38.9	43.2	51.8	56.2
150	5.1	10.1	15.2	20.3	25.3	30.4	35.4	40.5	45.6	50.6	60.8	65.8
200	6.8	13.5	20.3	27.0	33.8	40.5	47.3	54.0	60.8	67.5	74.3	NR*
300	10.1	20.3	36.4	46.5	50.6	60.8	70.9	81.0	NR*	NR*	NR*	NR*
400	13.5	27.0	40.5	54.0	67.5	81.0	NR*	NR*	NR*	NR*	NR*	NR*

25% NITROGEN FORMULATIONS DESIRED NITROGEN PARTS PER MILLION (PPM)

Injector Ratio	50	100	150	200	250	300	350	400	450	500	550	650
	OUNCES OF TOTALGRO PER GALLON OF WATER											
12	0.3	0.6	1.0	1.3	1.6	1.9	2.3	2.6	2.9	3.2	3.6	4.2
15	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.1	4.5	5.3
24	0.6	1.3	1.9	2.6	3.2	3.9	4.5	5.2	5.8	6.5	7.1	8.4
30	0.8	1.6	2.4	3.2	4.1	4.9	5.7	6.5	7.3	8.1	8.9	10.5
50	1.4	2.7	4.1	5.4	6.0	8.1	9.5	10.5	12.2	13.5	14.9	17.6
100	2.7	5.4	8.1	10.8	13.5	16.2	18.9	21.6	24.3	27.0	29.7	35.1
128	3.5	6.9	10.4	13.8	17.3	20.7	24.2	27.6	31.1	34.6	38.0	44.9
150	4.1	8.1	12.2	16.2	20.3	24.3	28.4	32.4	36.5	40.5	44.6	52.7
200	5.4	10.8	16.2	21.6	27.0	32.4	37.8	43.2	48.6	54.0	59.4	70.2
300	8.1	16.2	24.3	32.4	40.5	48.6	56.7	64.8	72.9	81.0	NR*	NR*
400	10.8	21.6	32.4	43.2	54.0	64.8	75.6	NR*	NR*	NR*	NR*	NR*

28-30% NITROGEN FORMULATIONS DESIRED NITROGEN PARTS PER MILLION (PPM)

Injector Ratio	50	100	150	200	250	300	350	400	450	500	550	650
	OUNCES OF TOTALGRO PER GALLON OF WATER											
12	0.3	0.5	0.8	1.1	1.4	1.6	1.9	2.2	2.4	2.7	3.0	3.5
15	0.3	0.7	1.0	1.4	1.7	2.0	2.4	2.7	3.0	3.4	3.7	4.4
24	0.5	1.1	1.6	2.2	2.7	3.2	3.8	4.3	4.9	5.4	5.9	7.0
30	0.7	1.4	2.0	2.7	3.4	4.1	4.7	5.4	6.1	6.8	7.4	8.8
50	1.1	2.3	3.4	4.5	5.6	6.8	7.9	9.0	10.1	11.3	12.4	14.6
100	2.3	4.5	6.8	9.0	11.3	13.5	15.8	18.0	20.3	22.5	24.8	29.3
128	2.9	5.8	8.6	11.5	14.4	17.3	20.2	23.0	25.9	28.8	31.7	37.4
150	3.4	6.8	10.1	13.5	16.9	20.3	23.6	27.0	30.4	33.8	37.1	43.9
200	4.5	9.0	13.5	18.0	22.5	27.0	31.5	36.0	40.5	45.0	49.5	58.5
300	6.8	13.5	20.3	27.0	33.8	40.5	47.3	54.0	60.8	67.5	74.3	NR*
400	9.0	18.0	27.0	36.0	45.0	54.0	63.0	72.0	81.0	NR*	NR*	NR*

*NR = not recommended. The limits of solubility of TotalGro plant foods range between 2.5 to 5 lbs. plant food per gallon of water. Before attempting to prepare stock solutions at concentrations in the upper ranges, refer to solubility limits for individual products listed elsewhere in this manual.

Plant Analysis As A Diagnostic Tool

Plant analysis, often called "tissue testing", can be useful in determining the causes of nutritional problems in advanced stages, as well as in identifying "hidden hunger" before problems are serious enough to cause physical symptoms.

Plant analysis can also be used as a means of determining whether current feeding programs are adequate. Plant analysis is superior to soil or media testing for diagnosis of micronutrient and secondary nutrient problems.

When making a plant analysis, select the correct plant part and handle it carefully (see table below). If specific instructions for a particular species are unavailable, as a rule of thumb, sample recently matured leaves generally about 3-5 leaves down from the growing tips.

It is useful to sample healthy plants as well as plants with problems, so that comparisons can be made.

After you have collected the samples, ship them in either bags provided by TotalGro or in plain manila envelopes. Do not ship in plastic bags unless a disease diagnosis is required.

Provide as much information as possible to the Laboratory in regard to growing conditions and possible environmental factors that may be exerting an influence upon your plantings. Remember - the more information you provide, the more reliable the interpretation will be. Include at least the following:

1. watering and feeding program,
2. media composition,
3. water quality (if known),
4. light conditions
5. growth regulators,
6. pesticide program, other chemicals.

Sampling site and minimum sample size for foliar analysis of various crops

Crop	Sampling Site	Minimum sample size
Azalea	Topmost 2 fully expanded leaves	75 leaves for small leaf types 60 leaves for medium leaf types 30 leaves for big leathery types
Carnations	Fifth and 6th leaf pairs on non-blooming shoots.	20 pairs of leaves
Chrysanthemums	Topmost 2 fully expanded leaves	25-30 leaves
Geraniums	Topmost 2 fully expanded leaves	20-25 leaves
Poinsettias	Topmost 2 fully expanded leaves after establishment in finishing pot	20-25 leaves
Roses	Topmost 2 fully expanded leaves on shoot with flower bud showing color	20-25 leaves
Tomato	Leaf and petiole just below clusters of 1-1 1/2" dia. fruit	15-20 leaves
Other crops	Topmost 2 fully expanded leaves	20-60 leaves, depending on size

Soil Analysis For Monitoring Your Fertilization Programs

TotalGro provides complete testing services for greenhouse and nursery operators, whether routine or specialized testing is required. Normally, soil is tested in one of two ways. We routinely utilize the Michigan Saturation Extract Procedure for soil-less mixes, including Peat-Lites and Bark mixes, and we use the traditional Spurway Procedure for media having significant quantities of mineral soil. We can also test leachattes from containers where growers prefer to use the so-called "pour-through" technique widely being used for woody ornamentals in containers. TotalGro provides soil bags and bottles for shipping samples.

Please provide as much information as possible regarding the soil mix's composition and fertilization history. Indicate whether the soil is "planted" or "unplanted" - the recommendations will be based upon this information. If planted, indicate the crop (and cultivar if known) being grown. If unplanted, indicate the crop(s) to be grown.

For test results to be meaningful, use extreme care in sampling. Test results cannot be any more accurate than the sample submitted to the lab. Sample before watering benches or pots. Avoid sampling if the soil is extremely wet. When sampling benches, use a clean trowel or sampling tube and take 8-10 cores or slices of soil per 100 feet of bench, doing so in a random fashion. Scrape away any mulch and the top 1/4" of soil and sample to the full depth of the bench. Thoroughly blend all cores from the bench to make a single composite. Sample ground beds in the same manner, except remove cores to a depth of 6-7". For unplanted soil in bins, remove 8-10 cores per bin to make a composite sample. For growing plants, remove one core of soil from 8-10 pots and mix to make one composite sample. If slow-release or controlled-release fertilizer has been surface-applied, remove both the fertilizer and top 1-2" of soil before taking core samples. After thoroughly mixing your sample, fill the TotalGro white soil sample bag to approximately 1/2 to 2/3 full, then seal and ship to TotalGro. Your test results will arrive within 3-7 days of receipt.

Our routine analysis will include pH, soluble salt, nitrate and ammonium nitrogen, potassium, calcium, sodium, iron, phosphorus, chloride, nitrite and sulfate. We recommend using plant analysis for examining micronutrient status of plantings.

Water Quality And Fertilizer Solution Testing

Water Quality is one of the most overlooked factors that may influence ornamental plant nutrition. We often take for granted that our water quality is good if we can drink it with no harm. However, what may be healthy for humans, may not be healthy for plants. TotalGro provides one of the most complete and easy-to-understand water reports available. We recognize the importance of water quality in plant nutrition and in producing high-quality, marketable plants.

Although feeding solutions exiting injectors can be monitored routinely using a conductivity meter, it is desirable from time to time to have a complete analysis performed to check the proper functioning of your system. TotalGro technical services can provide both testing of unfertilized water for use in you operation, and a complete analysis of diluted feed solutions.

For sampling water or fertilizer solutions, let the water or solution run for several minutes so that the sample will be representative of what the system normally produces. Collect the sample in the polyethylene bottle provide by TotalGro, then promptly mail. Fill the bottle so that most or all of the air is excluded upon closing. Ship as soon as possible to TotalGro. The TotalGro water test includes pH, alkalinity, sodium. calcium, magnesium, and a variety of other important water quality indicators. Your report will be provided with a complete interpretation and recommendations.

Sampling frequency for irrigation water should be about once every 1-2 years, or when a new water source has been obtained.

Useful Information and Conversion Factors:

Yield or Rate

Ounces per acre x 0.07 = kilograms/hectare (ha)
Tons per acre x 2240 = kilograms/ha
Tons per acre x 2.24 = metric tons/ha
Pounds per acre x 1.12 = kilograms/ha
Pounds per cubic foot x 16.23 = kilograms/cubic meter (m^3)
Pounds per gallon x 0.12 = kilograms per liter
Pounds per ton x 0.50 = kilograms per metric ton
Gallons per acre x 9.42 = liters per hectare
Gallons per ton x 4.16 = liters per metric ton
Pounds per 100 sq. ft. x 2 = lbs. per 100 gal. water (assumes that 100 gals will saturate 200 sq. ft. of soil)
Pounds per acre / 43.56 = lbs. per 1000 sq. ft.

Volumes and Liquids

1 teaspoon = 1/3 tablespoon = 1/16 oz.
1 tablespoon = 3 teaspoons = 1/2 oz.
1 fluid oz. = 2 tablespoons = 6 teaspoons
1 pint per 100 gals = 1 teaspoon per gal.
1 quart per 100 gals = 2 tablespoons per gal.
3 teaspoons = 1 tablespoon = 14.8 mL (cc)
2 tablespoons = 1 fluid oz. = 29.6 mL
8 fluid oz. = 16 tablespoons = 1 cup = 236.6 mL
2 cups = 32 tablespoons = 1 pint = 473.1 mL
2 pints = 64 tablespoons = 1 quart = 946.2 mL
1 liter = 1000 mL = 1000 cc = 0.264 gals = 33.81 oz.
4 quarts = 256 tablespoons = 1 gal = 3785 mL
1 gallon = 128 oz. = 3.785 L

Elemental Conversions

P_2O_5 x 0.437 = Elemental P
Elemental P x 2.29 = P_2O_5
K_2O x 0.826 = Elemental K
Elemental K x 1.21 = K_2O
CaO x 0.71 = Elemental Ca
Elemental Ca x 1.40 =CaO
MgO x 0.60 = Elemental Mg
Elemental Mg x 1.67 = MgO
$CaCO_3$ x 0.40 = Elemental Ca

Weight/Mass

1 ounce = 28.35 grams
16 ounces = 1 pound = 453.6 grams
1 kilogram = 1000 grams = 2.205 pounds
1 gal water = 8.34 pounds = 3.8 kilograms
1 cubuc foot of water = 62.4 pounds = 28.3 kilograms
1 kilogram of water = 33.81 ounces
1 ton = 2000 pounds = 907 kilograms
1 metric ton = 1000 kilograms = 2205 pounds

Volume Equivalents

1 gal in 100 gals = 1 1/4 oz. in 1 gal.
1 quart in 100 gals = 5/16 oz. in 1 gal
1 pint in 100 gals = 3/16 oz. in 1 gal
8 oz. in 100 gals = 1/2 teaspoon in 1 gal
4 oz. in 100 gals = 1/4 teaspoon in 1 gal

Temperature

Degrees F = (Degrees C + 17.78) x 1.8
Degrees C = (Degrees F -32) x 0.556

Length

Inches x 2.54 = centimeters (cm)
Feet x 30.48 = centimeters
Feet x 3.048 = Meters (m)
Feet x 12 = inches
Feet x 0.3333 = yards

Light Intensity

Footcandles (fc) x 10.7 = Lux
Footcandles x 0.0107 = Kilolux

Soil Mix Calculations and Conversions

1 Ton Per Acre=2-1/2 Lbs Per Cubic Yard = 5 Lbs Per 100 Square Feet = 0.3 Grams Per 3" Pot= 0.8 Grams Per 4" Pot=1-1/2 Grams Per 5" Pot=2-1/2 Grams Per 6" Pot.

1 Lb = 16 Ounces = 453.6 Grams.

1 Bushel = 1.25 Cubic Feet = 25.7 Quarts.

1 Cubic Yard = 22 Bushels = 27 Cubic Feet = 202 Gallons = 40.4 Five Gallon Buckets.

100 Square Feet Of Bench @ 6" Depth = 50 Cubic Feet or 40 Bushels Or Slightly Less Than 2 Cubic Yards.

100 Gallons Of Water, Fertilizer Solution Or Fungicide Drench Will Treat Approximately 1000 6" Pots, 2900 4" Pots Or 200 Square Feet Of Bench Or Ground Bed.

5 Lbs Per 100 Square Feet = 2.9 Lbs Per Cubic Yard = 2 Ounces Per Bushel.

Lbs Per Acre x 0.0198 = Ounces Per Cubic Yard.

Addition Of Contents Of A 3" Pot To 12 Bushels = 1/2 Lb Per 100 Square Feet.

1 Large Bale Of Compressed Peat And Most Compressed Bags Of Commercial Soil Mixes Will Expand To Roughly 1-1/2 to 2 Times Their Original Volume When Loosened.

Standard nutrient charge for floricultural crops: per cubic yard, incorporate 1 to 2 lbs. gypsum, 1 to 1 1/2 lbs. 15-0-15, 2 lbs. 0-20-0 (or 1 lb. 0-46-0), 6 to 8 oz. Epsom salt, 1 to 2 oz. iron sulfate.

Container Filling Calculations For Peat-Lite & Bark Mixes

Container Type & Size	Approx. No. Per Cubic Foot Mix	Container Type & Size	Approx. No. Per Cubic Foot Mix
2-1/2 Standard Round	250-260	4" Azalea	50-60
3" Standard Round	100-120	6" Azalea	15-20
4" Standard Round	40-50	8" Hanging Basket	9-10
5" Standard Round	25-30	10" Hanging Basket	5-6
6" Standard Round	12-15	Standard 11x21" Flat	3-4
7" Standard Round	7-9	Inserts (6 per Flat)	3-4
8" Standard Round	5-6	Inserts (36 per Flat)	4-5
5" Bulb Pan	35-40	Inserts (8 per Flat)	3-4
6" Bulb Pan	25-30	Inserts (48 per Flat)	5-6
7" Bulb Pan	12-15	1 Gallon Container	9-10
3" Square	120-140	2 Gallon Container	4-5
4" Square	35-40	3 Gallon Container	2-3
4-1/2" Geranium	30-40	5 Gallon Container	1-2

Practical Greenhouse Math: Calculating Areas & Volumes

How Big Is It?

Calculating the size of areas such as beds, benches, and other spaces is a critical skill needed by every greenhouse worker or landscaper. Determining square footage of spaces, even oddly-shaped ones, provides information needed for determining broadcast fertilization and lime rates, seeding rates, bedding plant spacings, bulb spacings and so on. Listed below are some common shapes and calculations needed to estimate their areas. Note that the dimensions of measurement must be in the same units for all measurements taken!

Squares & Rectangles

Area = Length x Width

Example: You have a bed of 12 feet by 10 feet. How many square feet of bed do you have?

12 ft x 10 ft = 120 square feet

Perfect or Near Perfect Circles (with about 5 % accuracy)

Area = 0.8 x Diameter^2

Example: You have a circle with a diameter of 50 feet.

0.8 x 50 ft x 50 ft = 2000 square feet

Perfect Circle

Area = 3.14 x Radius^2

Example: You have a circle with a radius of 25 feet.

3.14 x 25 ft x 25 ft = 1962.5 square feet

Elliptical or Egg-Shaped Spaces (with about 5 % accuracy)

Area = 0.8 x Length x mid-Width

Example: You have an egg-shaped area with a mid-width of 10 feet and a length of 20 feet.

0.8 x 20 ft x 10 ft = 160 square feet

Irregular or Polygonal Shapes (This calculation will get you in the "ballpark" and is adequate for most applications)

Find the approximate center of the space. Take a number of measurements in feet from this center. Add these, take the average, square that number and multiply x 3.14.

Note that the more measurements you take, the closer your estimate. will be.

Simple Triangles

Area = 0.5 x Base Width x Height

Example: Your triangle has a base width of 10 feet. The height from the center of the base to the other side is 20 feet.

0.5 x 10 ft x 20 ft = 100 square feet

How Much Is In It?

How often have you had a tank and you need to know how much it will hold? Use these formulas to first compute the cubic volume. ***If you measure in cubic feet, you can then convert to gallons by multiplying the cubic feet times 7.5.***

Cubic and Rectangular Solids:

Volume = Length x Width x Height

Cylinders:

Volume = 3.14 x Radius^2 x Height

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For technical assistance or to order, call toll free: 1-800-433-3055