MICROBIAL SCIENCE LABORATORIES

MICROBE-REMEDY

Nutrient Solubilization & Nutrient Mineralization

* Most soils contain an abundance of P and K problem is its usually in an insoluble form and cannot be assimilated by the plant.
* Select beneficial soil organisms have the capacity to convert insoluble phosphatic and potassium based compounds into plant available forms.
* Beneficial soil bacteria & soil fungi produce secondary metabolites such as organic acids & enzymes.
* These secondary metabolites are responsible for the conversion of insoluble phosphorus and potassium into plant available forms.
* In acidic soils P tends to bind with Aluminum (Al) and Iron (Fe) to form insoluble Aluminum Phosphate & Iron Phosphate.
* In alkaline soils P tends to bind with Calcium (Ca) & Magnesium (Mg) to form insoluble Calcium Phosphate & Magnesium Phosphate.
* Inorganic mineral such as calcium phosphate and iron phosphate are solubilized by low molecular weight organic acids into plant available P
* Inorganic minerals such as muscovite, orthoclase, biotite, mica are solubilized by organic acids into plant available K
* Hydroxyl and carboxyl groups of organic acids chelate the cations bound to P & K which in turn converts them in to soluble P & K.
* Organic Acids include but are not limited to gluconic acid, 2-ketogluconic acid, lactic acid valeric, succinic, isovaleric acid & acetic acid.
* The solubilization process results in increased phosphorous and potassium availability to the plant.
* Organic phosphates such as phytic acid and mono-esters are mineralized by enzymes released by the soil bacteria and fungi.
* Release of organic anions, siderphores & phophatases hydrolyze organic P & K or split the P & K from organic residues.
* Phosphate & Potassium Mineralizing Enzymes include but are not limited to phytase, acid phosphatase, alkaline phosphatase & D-glycerophosphatase.
* The solubilization and mineralization processes results in increased P, K, Ca, Mg, S, Fe, Mn & Zn availability to the plant.
* Increased phosphorous availability enhances flowering - fruiting process, promotes root growth, root architecture, plant establishment
* Increased potassium availability activates enzyme systems, promotes translocation of nutrients & assimilates, facilitates N uptake & assimilation for protein synthesis, regulates turgor pressure during periods of drought & maintains water balance

Contains Plant Growth Promoting Rhizo-Bacteria

* Stimulating plant growth was once entirely attributed to supplemental applications of N, P, K fertilizers
* The emphasis for stimulating plant growth has shifted to the use of Plant Growth Hormones produced by soil organisms
* Plant Growth Hormones are secondary metabolites produced by beneficial soil bacteria
* Collectively these organisms are referred to as Plant Growth Promoting Rhizo-Bacteria or PGPRB
* Plant Growth Promoting Rhizo-Bacteria produce plant growth hormones such as auxins, cytokinins & gibberellins
* Auxins stimulate flowering, root architecture, issue differentiation, lateral root initiation, polar root hair positioning & root gravitropism
* Gibberillins control cell elongation, cell division, cell differentiation & stress reduction
* Cytokinins stimulate flowering, control cell division in roots & shoots, increased resistance to drought, enhances chlorophyll synthesis
* Hormones produced by bacteria increase yields independent of supplemental fertilizer applications

Contains Free Living Nitrogen Fixing Bacteria

* Convert atmospheric di-nitrogen (N_2) into plant available ammonia (NH_3)
* Process is mediated by nitrogenase enzyme (secondary metabolite) produced by the organisms themselves
* Paenibacillus are mesophilic, facultative anaerobes, function in both aerobic & anaerobic soil environments
* Paenibacillus form endospores to overcome adverse environmental factors such as drought, lack of nutrients, high salinity
* Paenibacillus are particularly efficient at colonizing rhizosphere of grass plants
* Azospirillum are classified as free living but prefer to colonize soil in close proximity to plant roots (rhizosphere) in lieu of open soil
* Azospirillum colonize surface of plant roots via attachment (glycoprotein) & anchoring (polysaccharide)
* Azospirillum are found in the rhizospheres of a wide variety of agricultural crops & also adapts well to pH swings
* Azotobacter are aerobic free living nitrogen fixing organisms
* Azotobacter form tough cysts to protect themselves from environmental extremes (heat, drought, salinity, lack of food, dessication)
* Nitrogen fixation increases plant available nitrogen reducing need for supplemental N

Contains Extracellular Enzyme Producing Bacteria - Fungi

* Includes cellulases, hemi-cellulases, xylanases, chitinases, proteases, amylases, lipases, chitinases
* Extracellular enzymes promote the decomposition, transformation and cycling of nutrients in soil profile
* Decomposition liberates carbon and nutrients from complex materials in soil profile
* In particular cellulase producing bacteria promote the degradation of cellulose residues in soil profile
* Cellulose is a complex polysaccharide comprised of thousands of d-glucose subunits (Six Carbon Sugar)
* Cellulose is the structural component of primary cell wall in plants, most abundant organic compound on earth
* Cellulolysis is a biological process mediated by a select group of extracellular enzymes called cellulases
* Three specific cellulase enzymes (secondary metabolites) mediate cellulolysis (conversion of cellulose > glucose)
* 1, 4-β-endoglucanase (cleaves of β-1, 4-glycosidic bonds along a cellulose chain)

* 1, 4-β-exoglucanase (cleaves non-reducing portion of chain & splits fibrils from crystalline cellulose)
* β-glucosidase (hydrolyzes cellobiose and water-soluble cellodextrin to glucose)
* Glucose released during degradation of cellulose is utilized by organisms as food source (drives metabolic functions)
* Glucose released during degradation of cellulose is utilized by plants as a precursor to structural carbohydrates

Reduction In Nitrogen Loss / Leaching

* Beneficial soil bacteria significantly reduce the incidence of nitrogen leaching in the soil profile
* Nitrogen (particularly nitrate) is very mobile in the soil profile and it often leaches past the root system before it has a chance to sequester it
* Soil bacteria temporarily incorporate free nitrogen into their bodies utilizing it to satiate their metabolic functions.
* This storehouse of nitrogen is then given back to the plant through a complex process known as nutrient mineralization.
* Nutrient mineralization occurs when protozoa consume soil bacteria in order to satiate their own carbon & nitrogen requirements.
* Soil bacteria contain more N than the protozoa require therefore the protozoa essentially spit this excess nitrogen back into the rhizosphere (soil influenced by roots) where it is then absorbed by the plant roots.

ACC - Deaminase Producing Bacteria and Ethylene Stress

* 1-Aminocyclopropane-1-carboxylate (ACC) is a cyclic alpha amino acid essential for the bio-synthesis of ethylene.
* 1-Aminocyclopropane-1-carboxylate (ACC) is the immediate precursor of the plant growth hormone ethylene.
* When plants are exposed to abiotic stress (temp extremes, salinity, drought) ACC is rapidly converted to ethylene in plant roots.
* Low ethylene levels are advantages to plant growth stimulating adventitious root growth, root hair formation and seed germination.
* At high levels ethylene inhibits root growth which puts plants at a serious disadvantage especially during periods of stress (ethylene stress) .
* In response to high ethylene levels select Plant Growth Promoting Rhizobacteria release ACC - deaminase an enzyme capable of cleaving & deactivating 1-Aminocyclopropane-1-carboxylate (ACC).
* Once deactivated ethylene levels are reduced thereby limiting its inhibitory effect on plant roots.
* In essence Plant Growth Promoting Rhizobacteria control ethylene levels through the production of ACC-deaminase during periods of abiotic stress to mitigate the deleterious effects of ethylene stress.

Microbial Synergists

* Contains full spectrum of targeted microbial synergists and growth factors to promote microbial growth & proliferation
* Provides them with energy during critical lag phase of development when metabolic requirements drastically increase
* Contains organic protein source to satiate nitrogen requirements of beneficial bacteria & fungi
* Contains multiple carbon sources (simple & recalcitrant) which serves as food source for beneficial bacteria & fungi
* Each organism in formula has a preferred carbon source, by targeting carbon source to organism you optimize microbial growth
* Inoculants absent microbial synergists exhibit limited growth potential in soil microclimates

CONTAINS NON PLANT FOOD INGREDIENTS

Active Ingredients

Azotobacter chroococcum 150,000,000 CFU per gram, Saccharomyces cerevisiae 150,000,000 CFU per gram, Bacillus firmus 100,000,000 CFU per gram, Bacillus amyloliquefaciens 100,000,000 CFU per gram, Bacillus subtilis 100,000,000 CFU per gram, Bacillus licheniformis 100,000,000 CFU per gram, Bacillus megaterium 100,000,000 CFU per gram, Bacillus pumilus 100,000,000 CFU per gram, Bacillus azotoformans 100,000,000 CFU per gram, Bacillus coagulans 100,000,000 CFU per gram, Paenibacillus polymyxa 100,000,000 CFU per gram, Paenibacillus durum 100,000,000 CFU per gram, Azospirillum amazonense 50,000,000 CFU per gram, Azospirillum lipoferum 50,000,000 CFU per gram, Pseudomonas aureofaciens 20,000,000 CFU per gram, Pseudomonas fluorescens 20,000,000 CFU per gram, Pseudomonas putida 20,000,000 CFU per gram, Streptomyces coelicolor 20,000,000 CFU per gram, Streptomyces lydicus 20,000,000 CFU per gram, Streptomyces griseus 20,000,000 CFU per gram, Trichoderma harzianum 20,000,000 CFU per gram, Trichoderma reesei 20,000,000 CFU per gram, Trichoderma koningii 20,000,000 CFU per gram,

INERT INGREDIENTS

55.00 % Dextrose , 20.00 % Sucrose, 14.95 % Non Calcined DE, 3.00 % Hydrolyzed Soy Protein, 3.00 % Brewers Yeast Extract, 2.00 % Humic Acid (leonardite) 1.25 % Kelp, 0.75 % Hydrated Sodium Calcium Aluminosilicate (Drying Agent)

84.30 % Water Soluble By Weight

GENERAL INFORMATION

* May be tank mixed with fertilizers, biostimulants and microbial foods (sugars, humic acids, kelp)
* It is advisable not to co-apply product with pesticides (fungicides, herbicides, insecticides, nematicides, fumigants) as they can compromise integrity of or kill the beneficial organisms herein contained. If required tank mix the product with pesticide and apply immediately (within 60 minutes).
* When applied in rotation with pesticides its advisable to allow 5 - 7 days between application of pesticide and this product.
* Never apply product mixture just prior to a pesticide application
* Never tank mix with pesticides that contain imazilil, propiconazole, tebuconazole and triflumizole.
* Do not mix product and store, apply all tank mixes within 3 - 4 hours of preparation.
* Agitate tank while adding product and during entire application process
* Always perform jar test when mixing product with other inputs to test for physical compatibility
* To facilitate mixing process you may create slurry (1 lb in 2 gal / 0.45 kg in 7.6 liters of water) and add slurry while agitating

TURFGRASS RATES

* Begin applications once turf breaks dormancy or when soil temperatures reach 50° F
* Continue applications throughout growing season until turf reaches dormancy
* Irrigate turf immediately after application with a minimum of 1/4 - 1/2 inch of water in order to bring product mixture into root zone (rhizosphere)
* Utilize a minimum of 1.5 gal / 5.68 liter of water per 1000 sq ft / 92 sq meters to facilitate root colonization
* Use higher rate on turf exposed to or species susceptible to abiotic stress (heat, cold, drought, humidity)
* Apply as soil drench through low pressure watering nozzles such as fan nozzles, drench watering systems, hydraulic sprayers, handheld or backpack sprayers.

APPLICATION	AMOUNT / DILUTION	COVERAGE	FREQUENCY
Golf Course Greens	1 – 1 ½ oz 30 – 45 grams	1000 sq ft 100 sq meters	Every 2 – 4 weeks throughout growing season. Irrigate 1/4 - 1/2"
Fairways	0.75 – 1 oz 22.5 – 30 grams	1000 sq ft 100 sq meters	Every 4 weeks throughout growing season. Irrigate 1/4 - 1/2"
Residential	0.50 – 1 oz 15 – 30 grams	1000 sq ft 100 sq meters	Every 4 - 6 weeks throughout growing season. Irrigate1/4 - 1/2"
Sod Farms	0.75 – 1 oz 22.5 – 30 grams	1000 sq ft 100 sq meters	Apply prior to seeding - sprigging after soil has been prepared. Apply at 3 - 4 week intervals throughout growth cycle
Seeding	1 – 1 ½ oz 30 – 45 grams	1000 sq ft 100 sq meters	Apply after seeding and irrigate with 1/8 inch of water after application
Sodding	1 – 1 ½ oz 30 – 45 grams	1000 sq ft 100 sq meters	Apply prior to laying sod and irrigate with 1/4 inch of water after sod has been laid. Lay sod immediately after application

Ornamental Trees, Shrubs, Herbaceous Perennials, Annuals, Roses - Pre Plant

* Utilize as plant starter to promote establishment and enhance root architecture
* Dissolve product at the rate of 1 tablespoon per gal of potable water
* Drench root ball or bare roots with product mixture prior to backfilling hole
* Utilize product mixture volumes as outlined below then back fill hole

PLANT SIZE	VOLUME
5 gal	16 - 32 oz
10 gal	32 - 48 oz
15 gal	48 - 64 oz
Per 1 inch caliper	1 gal

Ornamental Trees, Shrubs, Herbaceous Perennials, Annuals, Roses - Post Plant

* Begin applications once ornamentals break dormancy or when soil temperatures reach 50° F / 10° C
* Apply at the rate of 1.5 - 2 oz per 1,000 square feet / 45 - 60 grams per 92 sq meters of bed space.
* Thoroughly mix the required dosage in sufficient volume of water (5 – 50 gallons per 1,000 sq ft of bed space) and apply product mixture as a soil drench or sprench to landscape plantings.
* Use higher water volume for sprench applications. Water volume should be adjusted based on canopy when applying as sprench.
* Product mixture should be applied in such a manner as to wet top 1/4 - 1/2 inch of soil in order to facilitate root colonization.
* Apply product mixture every 4 - 6 weeks throughout the growing season
* Apply as soil drench or sprench through low pressure watering nozzles such as fan nozzles, drench watering systems, hydraulic sprayers, handheld or backpack sprayers.

DEEP ROOT FEED

* Apply as required throughout the growing season to maintain plants and enhance root architecture
* Thoroughly dissolve product at the rate of 1 lb per 100 gal / 0.45 kg in 378 liters of potable water
* Mix required volume and inject using a grid system by spacing holes on 2.0 to 3.0 foot centers, in a grid pattern, extending at least to the drip line of the plant. Inject prepared solution into the soil to a depth of at least 3" for shrubs and 6" for trees. Utilize a total volume 1 gal of finished solution per 5 feet of plant height injecting equal amounts of product mixture into each hole.

GREENHOUSE MAINTENANCE RATES

* Prepare a stock solution by dissolving 1 - 1.5 lbs in 8 gallons / 0.45 - 0.68 kg in 30 liters of clean potable water
* Use higher rate on plants exposed to abiotic stress (heat, cold, drought, humidity)
* Run stock solution through injector system @ 1 : 100 dilution & apply at the rate of 10 – 30 gal per 1000 sq ft of table space
* Rate may be adjusted based on plant type and growing media
* 1st application: drench plug tray just prior to transplanting.
* 2nd application: drench 2 weeks after transplanting.
* 3rd application: drench 3-4 weeks after second application.
* If the growth cycle extends beyond 8 weeks, continue drench every 2-4 weeks throughout balance of crop cycle

HYDROPONIC RATES

* Add product directly to reservoir at each nutrient change
* Change nutrient reservoir on a weekly basis * Aerate for optimum results

PHASE	U.S.	METRIC
Cuttings & Transplants	1 teaspoon per 5 gal water	5 grams per 20 liters water
Maintenance Phase	1 1/2 teaspoon per 5 gal water	7.55 grams per 20 liters water
Vegetative Growth Phase	2 teaspoon per 5 gal water	10 grams per 20 liters water
Transition To Bloom Phase	1 teaspoon per 5 gal water	5 grams per 20 liters water
Bloom / Ripening Phase	1 teaspoon per 5 gal water	5 grams per 20 liters water

CONTAINER RATES

* Thoroughly dilute in a sufficient volume of water and apply to soil & apply every 2 - 4 weeks or as required

PLANT HEIGHT	CUTTINGS & TRANSPLANTS	MAINTENANCE PHASE	VEG GROWTH PHASE	TRANSTION TO BLOOM PHASE	BLOOM PHASE
6 - 24 inches	0.5 - 1 tsp	1 - 2 tsp	1 - 2 tsp	1 - 2 tsp	1 - 2 tsp
25 - 36 inches	0.75 - 1.25 tsp	1.5 - 2.5 tsp	1.5 - 2.5 tsp	1.5 - 2.5 tsp	1.5 - 2.5 tsp
37 - 52 inches	1 - 1.5 tsp	2 - 3 tsp	2 - 3 tsp	2 - 3 tsp	2 - 3 tsp
53 - 72 inches	1.5 - 2 tsp	2.5 - 3.5 tsp	2.5 - 3.5 tsp	2.5 - 3.5 tsp	2.5 - 3.5 tsp
72 + inches	2 - 3 tsp	4 - 5 tsp	4 - 5 tsp	4 - 5 tsp	4 - 5 tsp

Ornamental Trees, Shrubs, Herbaceous Perennials, Annuals, Roses - Watering Can Method

* Thoroughly dilute 2 tablespoons / 1 ounce / 30 grams of concentrate in 2 gallons / 7.5 liters of potable water.
* Apply around base of plants using 2 gallon per 1000 square feet

Ornamental Trees, Shrubs, Herbaceous Perennials, Annuals, Roses - Hose End Sprayer Method

* Thoroughly dilute 8 tablespoons / 4 oz / 120 grams of concentrate in 1 gal / 3.8 liters of potable water making sure you create homogeneous mixture. Place 32 oz of product mixture in Ortho Dial N Sprayer. Set spray dial on 1 oz and apply the 32 oz mixture to 1000 square feet of bed space. Apply to both soil & foliage.

ROW CROPS - IN FURROW

* Dilute 2 lbs per acre / 2.24 kg per hectare in a sufficient volume of water to achieve desired and uniform coverage
* Apply in furrow to increase biological activity in rhizosphere

ROW CROPS - POST PLANT

* Begin applications once soil temperatures reach 50° F / 10° C
* Apply as soil drench or sprench (soil & foliar) via pressurized drench - flood or drip - trickle system, boom sprayer, hand-held calibrated irrigation equipment or ebb and flow systems. * Do not apply this product through irrigation system
* For soil drench irrigate immediately after application with a minimum of 1/4 - 1/2 inch of water in order to bring product mixture into root zone (rhizosphere)
* When applying as sprench (soil & foliage) irrigate 24 hours after application
* Apply at the rate of 2.75 lb – 5.5 lbs per acre / 3 - 6 kg per hectare at 2 - 4 week intervals throughout crop cycle
* Use higher rate and frequency on crops exposed to or species susceptible to abiotic stress (heat, cold, drought, humidity)
* Lack of effectiveness can result from non-uniform distribution of product mixture

PLANT SAFETY

* Product has been tested on numerous plant species with no apparent phytotoxic response
* However the product has not been tested on every plant variety in combination with all possible tank mixes, under every conceivable environmental condition. We always recommend testing product on a small number of plants to check for adverse plant response PRIOR to full scale field application

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