Sod Production as influenced by 3D Plant Biostimulant on Tall Fescue

METHODS AND MATERIALS:

Rebel II tall fescue was seeded on a silt soil in September 1992 at the Virginia Tech Turfgrass Research Center in Blacksburg, Virginia. This soil had a pH of 6.0 and 500 lb. of 10-10-10 fertilizer was applied in September and again in May. The turf was mowed at 2-inches weekly during the growing season and irrigated to insure adequate turf growth.

The plant biostimulant, 3D, was applied at two rates to separate plots. The 3 oz. per 1000 sq. ft treatment was applied in April 1993 and again in July 1993. The 3/4 oz. per 1000 sq. ft treatment was applied every two weeks from April to September 1993. Each treatment received a total of 6 oz of 3D. These treated plants were compared to a non-biostimulant-treated sod.

On August 18, 1993, sod 1 ft. x 3 ft. x 3/4-in. thick was clamped in an apparatus that was especially designed to measure the energy required to sever the turf into two pieces. This data was used to measure the change in sod strength. One square foot pieces of sod obtained from these plots were also placed on 1-sq. ft pieces of expanded metal and transplanted to another field. The sod was irrigated to prevent desiccation and permitted to grow for five weeks. At this time, the expanded metal pieces were vertically lifted with an apparatus that was designed to measure the energy required to dislodge the sod from the soil. This data indicated the root mass that developed since transplanting the sod.

RESULTS:

The fescue treated with 3 oz. of 3-D per 1000 sq. ft. in April and again in July developed **an enchanted sod strength of 340% of the control turf,** while the tall fescue treated with 3/4 oz. 3-D every two weeks caused the turf to **develop sod strength 380%** of the control turf.

The fescue treated with 3 oz. of 3-D per 1000 sq. ft. in April and again in July developed an enhanced **root mass of 57% *greater* when compared** to the control, while the tall fescue treated with 3/4 oz. 3-D every two weeks caused the turf to develop **root mass 39% greater than the control.**

RESEARCHER: R. E. Schmidt, Virginia Tech

Sod Production as influenced by 3D Plant Biostimulant on Tall Fescue

Drought Tolerance of Tall Fescue as Influenced by 3D Incorporated with Cellulose Paper Mulch At time of Seeding

METHODS AND MATERIALS:

Rebel tall fescue was hydroseeded in the field with cellulose paper mulch (1500 lbs./A) blended with various dosages of 3D during September 1993. Plugs were sampled from the plots on March 2, 1994. The soil was washed from the roots and transplanted to Terraria, each of which contained 15 kg of soil adjusted to 7% moisture. The grass was permitted to grow under this water stress condition for six weeks. At the time, leaf moisture status, root mass, and Foliar yields were determined.

RESULTS:

Leaf moisture content was enhanced with 3D treatment. Leaf moisture ranged from 16% increase for the 0.5 gallon treatment to 25% for the 1 or 2 gallon treatments.

Root mass increased by 134% when the hydroseeding included 0.5 gal./A to 319% with the 2 gal./A treatment.

Foliar yield increases ranged from 37 to 82 from the lowest to highest 3D dosage.

TITLE: Primo and Banner alone and in combination with a commercial biostimulant on photosynthesis capacity, antioxidant activity, and tolerance to environmental stress of creeping bentgrass.

EXPERIMENTAL PROCEDURE:

Material: A mature Penncross bentgrass (*Agrostis Palustris*).

Mowing height: 0.625 cm. (1/4")

Experimental design: Split-plot design with four replications.

Location: Va. Tech Turfgrass Research Center, Blacksburg, VA 1996

Main plot:

Fertility: 200 g N (444.4 g Urea)/100m^2 **[0.41 lb N/1000 ft^2]** on May 26, June 26, July 17, Aug. 15, Sept. 15, Oct. 15 and Nov. 25.

65 g P_2O_5/100 m^2 **[0.13 lb /1000 ft^2]** on May 20, July 17, and October 15.

130 g K_2O/100 m^2 **[0.27 lb /1000 ft^2]** on May 20, July 17, and October 15.

Application dates of growth control materials:

May 14, June 11, July 7, Aug. 6, Sept. 9, Oct. 7, Oct. 31, and Dec. 31.

Measurements:

1. Leaves sampled and SOD analyzed on May 30, July 30, Sept. 30 and Dec. 3.

2. Chlorophyll fluorescence measured before sampling on May 30, July 30, Sept. 30 and Dec. 3.

3. Dollarspot disease ratings were taken on July 1, July 11 and Oct 7.

Table 1. Growth control materials and rates (sub-plot) applied at each application.

Treatment	Rate (amount/1000 sq. ft.)	Rate (amount/1000 sq. ft.)
1. Control	-	-
2. 3-D	53.1 cc	1.8 oz
3. Primo SB	3.69 cc	0.125 oz
4. Banner	23.6 cc	0.8 oz
5. Banner + 3-D	12 cc + 26.6 cc	0.4 oz + 0.9 oz
6. Primo + 3-D	3.69 cc + 26.6 cc	0.125 oz + 0.9 oz

NOTICE THE LOWER RATES OF THE COMBINATION TREATMENTS

Data were subjected to ANOVA analysis and mean separations were ascertained by degree comparisons (treatments with control).

Leaves sampled from each plot in May, July, September, and December were frozen with liquid nitrogen and stored at -20C for superoxide dismutase (SOD) determinations. The assay as described by Giannopolitis and Ries (1977) were employed to ascertain the concentration of the SOD enzyme.

Immediately prior to obtaining the samples for SOD analysis, the photosynthetic function of the various treated grasses was obtained by measuring chlorophyll fluorescence. During photosynthesis, a small portion of the light re-emitted from the chlorophyll molecules is referred to as chlorophyll fluorescence (Papageorgiou, 1975). Bjorkman and Demming (1987) have shown that the decrease in quantum yield for photosynthesis is correlated with chlorophyll fluorescence. Thus, fluorescence may be used as a diagnostic probe for measuring photoinjury due to environmental stress (Wilson and Greaves, 1990). The ratio of variable fluorescence to maximum fluorescence was used to ascertain the photosynthetic capacity in this study.

In this study, ten centimeters plastic rings filled with dark colored Styrofoam were placed randomly on the surface of a plot to insure the turf did not receive light for a minimum of 15 minutes. Chlorophyll fluorescence and content of the dark-adapted turf were measured with a OS-50 chlorophyll fluorometer (OPTI-SCIENCES, Tyngsboro, MA 01879).

RESULTS:

REMEMBER THE LOWER RATES OF THE COMBINATION TREATMENTS

Photosynthetic capacity:

Photosynthetic capacity (PC) of the field-grown bentgrass generally increased from May until late September and then decreased in early December. **When grass was measured in July, all treated grass had significantly higher PC values than the control.**

In late September, the least stressful period of the study, Primo and Primo + 3D treated grasses had enhanced PC when compared to the non-treated grass. By early December, PC was lower than when measured in September. All treated grass had higher PC than the non-treated control.

Antioxidant content:

As with they photosynthetic capacity, the antioxidant, superoxide dismutase (SOD), increased from May through September and then decreased by early December. In subsequent months, all treated grass had higher SOD content than the non-treated grass.

The 3-D-treated grass from July to December had significantly more SOD than the control.

On July 30, only grass treated with Primo and Banner had significant SOD enhancement.

Chlorophyll concentration:

As with photosynthetic capacity and antioxidant content, chlorophyll concentrations increased from May to late September, followed by a decrease in early December. **In late July, all treatments, except the Banner + 3-D, applied to grass grown under low nitrogen**

produced significantly more chlorophyll concentration than the control. In early December, all treatments to the turf grown under low nitrogen had significantly more chlorophyll content than the control.

Grass treated with Primo or Primo + 3-D produced grass with the most chlorophyll content.

Disease:

As would be expected, the triazole fungicide, Banner, was effective in reducing dollarspot disease incidence**. However, lower dosages of Banner (12 cc/1000 sq. ft.) plus a low rate of 3-D may be effective in dollarspot control than the higher rate of Banner (23.6 cc).**

Banner and Primo are registered trademarks of Novartis Crop Protection Inc.

THE EFFECT OF 3D TREATMENT ON THE GROWTH OF BENTGRASS SUBJECT TO WILTING AND INFECTED WITH NEMATODES

INTRODUCTION:

In turfgrass management's, nematodes damage is often a problem, resulting in poor turfgrass quality and poorly developed root systems. Turfgrass managers have a special interest in biological products that improve the quality and the growth of turfgrass, and fertility of soil, and that enhance the resistance to pests and diseases, since the use of chemical fertilizers and pesticides is often environmentally undesirable. Therefore, if the enhancements to root growth, nutrient uptake and disease resistance by the application of a fortified seaweed concentrate could improve turfgrass, the chemicals used in turfgrass management to control pests could be greatly reduced. This study was designed to ascertain the effects of 3D application on bentgrass under nematode free, lance or root-knot (RKN) nematode infestations.

METHODS AND MATERIALS:

This experiment was carried out under greenhouse conditions with a temperature range from 22 Deg. C to 40 Deg. C, at Virginia Tech, Blacksburg, Virginia from January 29 to July 12, 1993.

PLANT MATERIALS: A 2.5 cm tick mature sod of bentgrass (Agrostis Palustris Huds) was placed on each of nineteen liter plastic containers, which had been filled with fumigated sandy loam soil (pH=6.8) and topped with an expanded metal screen. Nutrient levels and soil moisture were maintained for maximum plant vigor by fertilizing 2 grams of 20-20-20 each month per 600 cm^2 (290 kg ha^{-1}) and watering one liter of tap water every other day. The height of the turf was maintained at 0.6 cm, with a mower adapted for microplots.

INOCULUM: Two nematode genera, Root-knot (Meioidogyne, hapla) and lance (Hoplolaimus) nematodes were involved in this study. Root-knot nematode (RKN) were obtained from Dr. John Eisenback (Nematode Specialist, Virginia Tech). Lance nematodes were originally extracted from a bentgrass sample collected from a golf course in south eastern Pennsylvania. Pure inoculum from the two nematode genera, RKN and Lance, were increased on barley and bentgrass plant respectively. Soils in the containers used in this study were inoculated as follows: 10 ml tap water, 10 ml lance solution (7800 juveniles), and 10 ml RKN inoculum solution (7080 eggs) (N2). The inoculum were introduced by injecting the solutions 2.5 cm deep uniformly before placing the expanded metal pieces on the soil surface.

THE EFFECT OF 3-D TREATMENT ON THE GROWTH OF BENTGRASS SUBJECT TO WILTING AND INFECTED WITH NEMATODES - CONTINUED

BIOSTIMULANT TREATMENTS: One week after transplanting, the sods started to receive biostimulant treatments every two weeks at 0 and 1.6 ml of 3D diluted to one liter water for soil drench treatments. In each application, the same amount of water was used as a soil drench for the untreated containers. Biostimulant application was terminated by May 15, 1993.

STRESS TREATMENTS: Plants were all well watered with tap water uniformly to maintain maximum vigor form transplanting to April 15. On April 15 sufficient water was added to each container gravimetrically to bring the soil to field capacity (13%). Thereafter, no water was added to the containers until more than 80% of the plants showed wilting symptoms: then water was added to field capacity again. This cycle was repeated at approximately every two weeks intervals until the end of the experiment. Water content in container was balanced by weight with tap water at the 14-day intervals.

DATA COLLECTION: At the end of the last two water-wilting cycles, the following parameters were measured:

1) shoot density, rating 1-9, with 9 having the most shoots.

2) visualized wilting rating (9 = no wilting and 1 = most sever wilting).

3) visual quality: 9 = best and 1 = worst.

4) clipping yield (dry weight)

5) root mass: wires were attached at three equally spaced points to the screen in each bucket and the energy necessary to vertically lift the turf from the soil was measured to evaluate the root mass (Schmidt et al., 1986)

6) root length: expressed by measuring the longest root.

7) nematode concentration: equal amount of soil sample (Lance) or root sample (RKN) was taken from each container. Nematode extraction was conducted with the centrifugal flotation procedure described by Baker (1985). Nematode concentration was expressed as the number of adult nematodes in 10 grams of soil (for the Lance) or the eggs in one gram of fresh roots for the RKN.

EXPERIMENTAL DESIGN:

Treatments were arranged in a completely randomized block design and replicated three times.

RESULTS AND DISCUSSIONS

SHOOT DENSITY

Both lance and root-knot nematode infection caused a reduction in shoot density. When 3D was applied to the non-infected nematode bentgrass a significant enhancement of shoot density was obtained. Enhancement of shoot density associated with 3D treatment of nematode infested bentgrass, was increased, but was not significant from the non-treated 3D nematode infested bentgrass. **However, the shoot enhancement of the 3D treated nematode infested bentgrass was sufficient so that no significant difference was obtained when compared to the control (no nematode, no 3D).**

This data shows that 3D treatment lessened the effects of nematode infestation of bentgrass.

WILTING

Wilting symptoms significantly increased when the bentgrass was infested with lance nematodes. Bentgrass treated with 3D caused the turf infested with either nematode to exhibit less wilting than the corresponding turf not treated with 3D.

TURF QUALITY

Bentgrass infested with either lance or root-knot nematodes caused a reduction in turf quality which was negated with treatment of 3D.

DRY CLIPPING YIELDS

Nematode infestation did not affect clipping yields. In all cases clipping yields were increased with treatment of 3D: however, the increases, though substantial (up-to 70%), were not statistically significant.

ROOT DEVELOPMENT

Root mass of non-nematode infected bentgrass was enhanced with 3D. **Lance nematodes caused a significant reduction of root development, which was off-set with 3D treatment.** Root-knot nematode infection did not cause a significant root mass reduction; however, the 3D treatment did cause some increase in root mass. Measurements of root length substantiated the root the root mass data.

Results from this study indicate that Lance nematode infestation caused more stress to the bentgrass than the root-knot infestation. Therefore, 3D treatments had more impact on off-setting stress associated with the lance nematode than the root-knot nematode.

NEMATODE COUNTS

Sixteen weeks after the experiment was initiated soil was sampled from the container after the bentgrass was removed. Lance nematode counts showed that the infected non-3D-treated bentgrass had 3217 nematodes per 10 grams of soil compared to 2683 nematodes from the infected 3D treated bentgrass. *This was a statistically significant 17% decrease of lance nematodes associated with 3D treatments*

Since root-knot nematodes are strictly endoparasitic, counts were made per unit mass of roots. Root-knot nematodes observed in the infected non-3D treated bentgrass averaged 1653 per gram of roots, while the infected 3D treated bentgrass averaged only 955 per gram of root. *This was a significant 42% decrease.*

Please note that 3D is not a pesticide and the reduction of nematodes is probably do to a stronger healthier root system and possibly because of cellular or metabolic changes in the plants.

Clipping yields, wilting resistance, and turf quality were inversely proportional to nematode numbers. Root mass was only inversely proportional to the lance nematode numbers.

Evidently, in this study, the **root-knot** nematodes (not Lance Nematodes) did not influence bentgrass root development. In spite of the fact that 3D treatment caused a reduction in the number of root-knot nematodes, the presence of these nematodes was sufficient to prevent the 3D treatment from enhancing root growth. *However, it appears that 3D treatment did enhance root metabolic activity of the root-knot infected grass in that foliar growth and conditioning was enhanced.*

RESEARCHER: R.E. Schmidt, Virginia Polytechnic Institute and State University

THE EFFECT OF 3-D TREATMENT ON THE GROWTH OF BENTGRASS SUBJECT TO WILTING AND INFECTED WITH NEMATODES

DROUGHT TOLERANCE OF KENTUCKY BLUEGRASS AS INFLUENCED BY 3D INCORPORATED WITH CELLULOSE PAPER MULCH AT TIME OF SEEDING

METHODS AND MATERIALS:

Ram 1 Kentucky bluegrass was hydroseeded in the field at 100 lbs. per acre with cellulose paper mulch (1500 lbs./A) blended with various dosages of 3D during September 1993. Plugs were sampled from the plots on March 2, 1994. The soil was washed from the roots and transplanted to Terraria, each of which contained 15 kg of soil adjusted to 7% moisture. The grass was permitted to grow under this water stress condition for six weeks. At the time, leaf moisture status, root mass, and foliar yields were determined.

RESULTS:

Kentucky bluegrass leaf moisture content was enhanced from 23 to 27% above the control turf with 3D treatments of 0.5 to 2 gallons per acre. Root mass increased from 33 to 128% % above the control turf when 3D was applied with the hydroseeding mulch.

The application of 3D to the hydroseeding slurry subsequently enhanced foliar development by 20 to 95%. The most foliage was obtained with the Kentucky bluegrass that was treated with 1 gallon of 3D per acre in the hydroslurry.

INFLUENCES OF PLANT GROWTH REGULATORS ON DROUGHT STRESS TOLERANCE IN KENTUCKY BLUEGRASS

(Experiment 1 - field) (Experiment 2 - greenhouse)

INTRODUCTION

The growth and development of turfgrass can be suppressed by various environmental stresses, such as drought stress, saline stress, etc. Drought stress can impair physiological and morphological determinants, photosynthesis, protein biosynthesis, hormonal function, and balance. As a result, the turfgrasses grown under drought stress have poor quality, high disease incidence, and low survival.

Research has indicated that biostimulants, when applied to plants, can stimulate growth and metabolism, improve plant resistance to stress environments. These biostimulants include hormones (auxin, cytokinins, etc.) vitamins, organic acids, chelating agents, enzymes, coenzymes and triazole compounds. Recent studies have showed that foliar applications of cytokinin- like growth regulators can enhance root growth, increase plant resistance to environmental stress, such as drought stress. The objectives of this research were to examine the influence of selective plant growth regulators on drought stress tolerance of Kentucky bluegrass under drought stress conditions.

METHODS AND MATERIALS:

'Plush' Kentucky bluegrass (*Poa pratensis L.*) was established at the Turfgrass Research Center at Virginia Tech, Blacksburg, Virginia in September 1992 on a Groseclose silt loam (clayey, kaolintic, mesic Type Hapludult) with a pH of 6.2. Soil P and K content at the time of this experiment was 21 and 34 micro-gram, respectively. In addition, urea was applied at 50 kg n/ha in May 1993. At 10-10-10 fertilizer to supply 50 kg n/ha was applied at time of seeding.

Plots, 1.5m *x* 1.8m 1/4, 1/2, and 1 gallon per acre were treated on April 19 and July 13, 1993. A compressed air boom sprayer that delivered 123 liter/ha of solution at a pressure of 276 KPa was used for foliar application of 3D biostimulant to the plots. All treatments were arranged in a randomized complete block design with replications.

Four weeks (Experiment 1) and 14 weeks (Experiment 2) after the July application, a 15-cm diam *x* 5-cm deep plug was taken from each of the treated plots and transplanted into a root ring. Root rings were made from plastic 15-cm diam PVC pipe and cut to provide 5 cm-inch depth. Two steel wires with 3 mm-inch diameter were inserted at right angles through holes drilled 6 mm from the bottom edge of ring (Schmidt et al., 1986). The transplanted plugs were saturated under a mist system and placed under a rain shelter preventing the plugs from getting water.

Five days after transplanting, wilting resistance for each plug was rated based on a visual scale of 1-9 with 9 indicating the best (no wilting). Eleven days after transplanting, the plugs, which were completely wilted, were saturated again. Drought recovery for each plug was rated based on a visual scale of 1-9 with 9 indicating complete recovery.

Single degree of freedom contrasts for treatment comparisons with a control was used as statistical analyses for each date of evaluation for the wilting and recovery data.

The experiment was repeated in the greenhouse at Virginia Tech during October and November, 1993 (Experiment 2).

RESULTS AND DISCUSSION:

Experiment 1   Effects of PGRs on drought stress tolerance of Kentucky Bluegrass (field).

Application of 3D improved the drought stress resistance of Kentucky bluegrass. The average wilt resistance of turf increased 24.8% with 3D when compared to the control at 5 days after transplanting (DAT). Turf receiving 3D at the rate of 1/2 gallon per acre had a significant increase in wilt resistance when compared to the control.

The turf recovery from wilting was improved 100.9% with the application of 3D at 1 gallon per acre for each date when compared to the control at 10 days after saturated (DAT) with 3D.

The result indicated that foliar application of 3D can alleviate wilting and accelerate recovery of Kentucky bluegrass under serious drought conditions.

In the effect of drought and subsequent recovery of Kentucky bluegrass treated with 1 gallon of 3D in April and July as compared to non-treated Kentucky bluegrass are shown.

Experiment 2   Effects of PGRs on drought stress tolerance of Kentucky bluegrass (greenhouse).

Wilting resistance of Kentucky bluegrass doubled with applications of 3D

when compared to the control at 5 DAT (Table 2). Drought recovery was improved four fold with treatments of 3D, regardless of dosage.

The results of the experiments in the water shelter at the Turfgrass Research Center (Experiment 1) and the Greenhouse at Virginia Tech (Experiment 2) consistently indicated that proper foliar application of 3D can alleviate plant wilting, accelerate recovery, and improve drought stress tolerance of Kentucky bluegrass significantly. ***Application of 3D mix at a rate of 1 gallon per acre per treatment had the influence on drought tolerance.***

Influences Of Plant Growth Regulators On Drought Stress Tolerance In Kentucky Bluegrass

INFLUENCE OF 3-D ON BERMUDAGRASS UNDER SALINE STRESS

OBJECTIVE:

This experiment was conducted to examine the influence of 3D on saline stress tolerance in Bermudagrass.

METHODS AND MATERIALS:

The mature bermudagrass was treated with 3D at a level of 0, 1, and 2 gallon/acre on June 2, 1995. Two weeks after treatment, the plugs (4”) were taken from the treated plots in the field and transferred to the 1 L metal cans which contained 10 lbs. soil plus 0, 13.6, or 26.2 g of salt/can, respectively.

The bermudagrass plugs were put in the greenhouse and irrigated with salt water (1721.4 g salt to 6968 cc water) twice a week or when needed. The grass was permitted to grow for 5 weeks before being examined. Water stress level (WSL), plant height, clippings, and root development via the root vertical lift technique were measured. The fresh clippings were dried for 24 hrs. at 60 C to obtain dry weights.

RESULTS:

1. Water relation

The leaf water content decreased significantly in terms of WSL, as salt level increased. **Application of 3D improved water status of leaves significantly under both high and low salt levels, when compared to the control.**

2. Shoot growth

Saline stress reduced plant height and clipping weight significantly. However, fresh **clipping weight of bermudagrass with application of 3D** at a rate of 1 or 2 gallon/acre subjected to the highest salinity **increased 45.0% and 84.3%,** respectably, when compared to the control. Similarly, dry clipping weight of bermudagrass treated with 3D at 1 or 2 gallon/acre increased 54.6% and 86.1%, respectively, when compared to the control.

3. Root development

Root growth was also suppressed under saline stress. However, 3D treated turf exhibited better root growth under high level of saline stress. Root development was measured with the vertical lift technique, showed that **bermudagrass grown under high salinity and treated with 3D at 1 or 2 gallon/acre increased root mass 49.6% and 63.9%, respectively, over the control.**

Influence Of 3-D On Bermudagrass Under Saline Stress - continued

In summary, saline stress at both 3800 and 7600 ppm levels suppressed shoot and root growth of bermudagrass obviously. However, foliar application of 3D enhanced the plant growth and improved water statue of bermudagrass under the higher level of saline stress in this study, although not significant difference was observed under 0 and 3800 ppm salt levels. ***This result suggested that an application of 3D was most beneficial to enhance growth of this moderately salt-tolerant grass under a high salt level.*** Further study is needed to examine growth response of bermudagrass under higher level of saline stress and adjusted 3D rates.

RESEARCHERS: Xunzhong Zhang and R. E. Schmidt, Virginia Tech.

MATERIAL SAFETY DATA SHEET

SECTION I. CHEMICAL IDENTIFICATION

Product Name: Plant Growth Supplement

Common Name: 3D (liquid)

SECTION II. INGREDIENTS AND COMPOSITION INFORMATION

	CAS #	OSHA-PEL	ACGIH-TLV
Seaweed	NE	NE	NE
Humic Acid	NE	NE	NE
Iron Sulfate	7720-78-7	N/A	1480 mg/m^3

SECTION III. PHYSICAL DATA

Density	75.55 lb. /ft^3
Boiling Point	250^o F
Melting Point	N/A
Vapor Pressure	<17 mm hg @ 25^o C
PH	4-6
Solubility in Water	water soluble
Appearance & Odor	black (liquid)

SECTION IV. FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method)....N/A

NFPA Rating ....Health 1 - Fire O - Reactivity O - Special Hazard O

Flammable Limits (Lel)..N/A (Uel) ....N/A

Extinguishing Media......Water, foam, carbon dioxide or dry chemicals

SPECIAL FIRE FIGHTING PROCEDURES: Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full protective clothing.

*This information is taken from sources or based upon data believed to be reliable; however, Plant-Wise Biostimulant Co. makes no warranty as to the absolute correctness or sufficiency of any of the foregoing or that additional or other measures may not be required under particular conditions.

SECTION V. REACTIVITY DATA

Stability: This is a stable material.

Conditions to avoid: Do not store in direct sunlight or at temperatures above 120°F.

Incompatibility: Contact with strong base may ruin this product

Hazardous Decompositions Products: Thermal decomposition products may include toxic sulfur oxides.

Hazardous Polymerization: Will not occur.

SECTION VI. SPILL OR LEAK PROCEDURES

Wear protective clothing, gloves, goggles, and (if exposure may exceed recommended levels) self-contained breathing apparatus. Contain spill with absorbent; collect into drums for proper disposal. Cover and label drums. Flush area with water if possible.

SECTION VII. HEALTH HAZARD DATA

INHALATION: May irritate respiratory tract.

SKIN CONTACT: May cause irritation, particularly on damp skin. Repeated or prolonged contact could lead to dermatitis.

EYE CONTACT: May cause irritation and conjunctivitis.

INGESTION: May cause heartburn, nausea, vomiting, gastric discomfort constipation or diarrhea. Symptoms of severe poisoning may occur within 30 minutes or may be delayed for several hours. Severe hemorrhagic gastritis with abdominal pain, retching, violent diarrhea and vomiting may occur. Circulatory system may be affected with symptoms of shock, rapid, weak or no pulse, severe hypotension and pulmonary emphysema may occur.

EMERGENCY AND FIRST AID PROCEDURE:

INHALATION: Remove from exposure. If breathing is difficult or has stopped, administer artificial respiration or oxygen as indicated. Immediately seek medical aid.

SKIN CONTACT: Wash skin thoroughly with soap and water. Seek medical aid.

EYE CONTACT: Flush immediately with large amounts of water, lifting the lower and upper lids occasionally. Seek medical aid.

INGESTION: Give 1-2 large glasses of water or milk. Induce vomiting. Immediately seek medical aid. Never give liquids to an unconscious person.

SECTION VIII. SPECIAL PROTECTION INFORMATION

RESPIRATORY: Respiratory protection approved by NIOSH/MSHA for protection against pesticides should be used to avoid inhalation. Appropriate respiration selection depends on the type and magnitude of exposure.

SKIN: Clean gloves and body-covering clothing should be worn to prevent irritation in situations where direct contact with product may occur.

EYES: Employees should be required to wear chemical safety splash goggles in situations where direct contact with the product may result in eye injury.

VENTILATION: Local exhaust ventilation should be used to control worker exposure to below recommended Permissible Exposure Levels (PEL).

OTHER PROTECTIVE EQUIPMENT: Emergency eye wash stations and deluge safety showers should be available in the work area.

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SECTION IX. SPECIAL PRECAUTIONS

PRECAUTION TO BE TAKEN IN HANDLING AND STORAGE: Store in a cool, dry location. DO NOT store near food or feed. Keep out of reach of children and pets.