Project Report

EFFECTS OF FOLIAR APPLICATION OF *NUTRISORB*™ ON SHOOT AND ROOT GROWTH DURING SOD TRANSPLANTING

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Creeping bentgrass is the most widely used cool-season grass on golf greens in the world. It produces superior quality turf with uniform density, beautiful green color, fine-textures leaves, and vigorous growth in spring and fall when temperature is between 15 and 24 ºC. However, severe decline in creeping bentgrass growth and turf quality occurs during summer months when temperature exceeds the optimum level and maximum plays occur on the golf courses. Leaf senescence and declines in tiller production and root growth are typical symptoms of heat injury in cool-season grasses during summer months. Our research has demonstrated that the declines in carbohydrate availability and nutrient uptake through roots under high temperatures are the major physiological causes of death of roots and leaf senescence for cool-season grasses, especially when grasses are mowed frequently at a height of 4 mm or lower.

At normal growing temperature, increases in fertilization promote turfgrass growth and increases turf quality. Foliar-N application can delay chlorophyll loss, increase plant height, leaf number, leaf area, and leaf dry weight. Root weight declines as N application increases. Research has shown that several mineral nutrients, especially N or P, reduce the loss of chlorophyll. Our research and other studies found that Ca^{2+} is involved in the regulation of plant responses to environmental stresses, including heat stress, low temperature, and drought. External treatment of Ca^{2+} can improve growth of plants under heat stress and alleviate high-temperature induced membrane leakage. Our research found that under heat stress, cool-season grasses treated with Ca^{2+} had relatively higher activities of antioxidant enzymes and lower levels of lipid peroxidation of cell membranes than untreated plants.

Carboxylic acid fertilizers (***Nutrisorb***™) are organic compounds of low molecular weight and the main ingredient is said to be a carboxylic acid derived from 5 monosaccharides. ***Nutrisorb***™ contains 25% polyhydroxycarboxylic acids (PHCA). It provides both inorganic nutrients in the form of N and organic compounds as PHCA. Previous research has demonstrated numerous beneficial effects of those compounds when applied to the foliar of agronomic crops, including increased shoot and root growth, nutrient uptake, and yield production. Earlier work also indicates that PHCA may alter carbohydrate and/or organic metabolism. As discussed earlier, the main physiological factor limiting root and turf growth in creeping bentgrass under high temperature conditions are carbohydrate and nutrient availability. ***Nutrisorb***™ can provide both to the plants. Therefore, we expect significant effects of those compounds in improving turf quality of cool-season grass.

While the beneficial effects of PHCA are widely recognized in agronomic crops, whether or not foliar application of those compounds could alleviate heat stress injury and promote healthy and vigorous turf for cool-season grasses deserves investigation. The objectives of this study are to investigate the effects of foliar application of ***Nutrisorb***™ on shoot and root growth of creeping bentgrass during sod establishment following transplanting under favorable temperature conditions and to examine whether heat tolerance of mature turfgrass could be improved by application of those compounds. This is to simulate the conditions during spring and fall (favorable temperature) when turfgrasses are newly planted and during summer when high temperature imposes high temperature stress to the plants. These objectives will be addressed by conducting two

experiments. If the compounds indeed can enhance heat tolerance and promote high quality turf, they could be widely used in the management of cool-season turfgrasses all year around. They could be applied not only in creeping bentgrass, but also other cool-season grasses such as Kentucky bluegrass, ryegrass, and tall fescue.

Turfgrass requires frequent application of fertilizers to maintain high quality turf surface. Golf greens typically are fertilized with N every two weeks. Most widely used N fertilizers in turfgrass management are inorganic compounds that can cause water pollution. ***Nutrisorb***™ are organic compounds and are more environmental friendly than typical, inorganic fertilizers used in turfgrass management. The compounds not only could be used on golf courses but also on home lawns and athletic fields to supplement a regular fertilizer program.

*Effects of **Nutrisorb***™ *on root and shoot growth during sod transplanting or establishment.*

For the effects during sod establishment, sod pieces of creeping bentgrass "Penncross" were collected from field plots and transplanted into clear plastic bags (5-cm diameter and 40 cm long) filled with fine sand. Plants were sprayed with ***Nutrisorb***™ in five rates immediately following transplanting and then weekly for four weeks:

a) 0 (water control)
b) 0.5 gallon per acre (low dose)
c) 1.0 gallon per acre (moderate dose)
d) 2 gallon per acre (high dose)
e) $Ca(NO_3)_2$ as a standard fertilizer (3 lbs per 1000 ft^2).

Those plants were grown at a daily maximum and minimum temperature of 20 and 15 ^{o}C. During the sod establishment period, plants were irrigated daily. Turf was mowed daily at 4 mm height with an electric clipper.

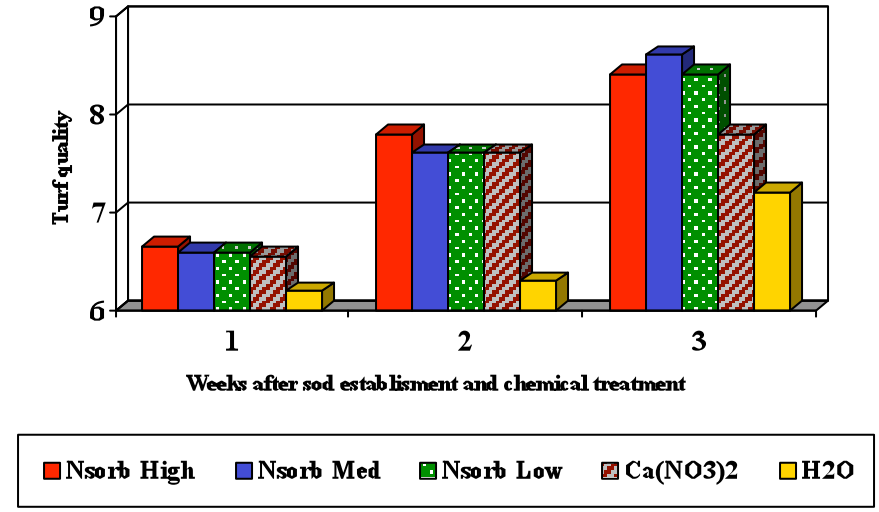
This experiment mainly examined whether the two compounds could promote sod establishment by stimulating root growth. Turf quality was rated based on color, density, and uniformity using a scale of 0 (brown, dry turf) to 9 (green, turgid turf), with a rating of 6.0 or higher indicating acceptable quality. Maximum rooting depth and root dry weight were measured at 1, 2, and 4 weeks of treatment. Shoots were analyzed for nitrogen content at 6 and 20 days after sod establishment.

Each treatment had four replicates. Therefore, a total of 120 tubes of plants were examined (2 compounds x 5 rates x 4 replicates x 3 samplings).

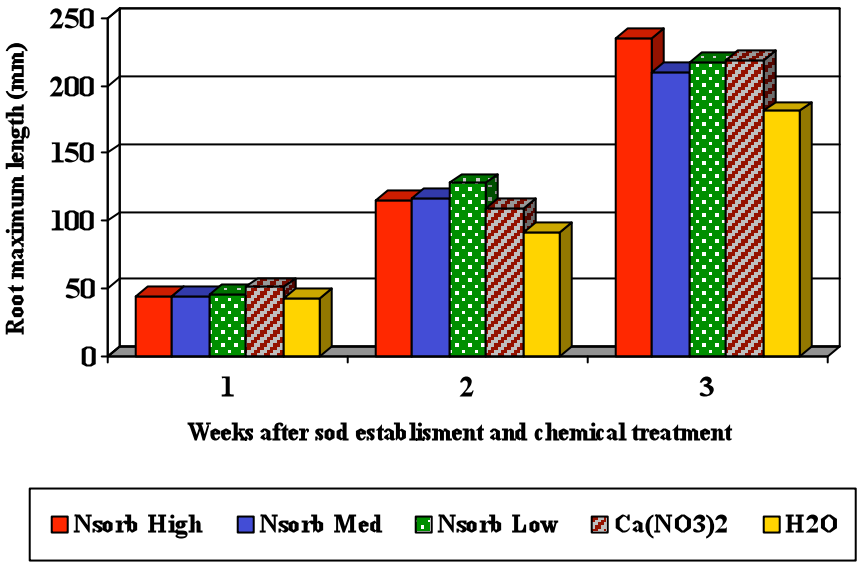
The application of ***Nutrisorb***™ at all doses and $Ca(NO_3)_2$ increased turf quality during the 4-week period of transplanting, except 4 week for the $Ca(NO_3)_2$ treated plants, compared to the control treated with water (Fig. 1). No effects for any of the treatments on maximum rooting depth at 1 week of application (Fig. 2). Low and medium doses of ***Nutrisorb***™ increased rooting depth at 2 week of treatment and the high dose of ***Nutrisorb***™ had positive effects at 4 week of treatment. Root dry weight was increased with the application of medium and high dose of ***Nutrisorb***™ at 2 and 4 weeks of application (Fig. 3). $Ca(NO_3)_2$ did not affect rooting depth (Fig. 2) or root dry weight (Fig. 3). Application of ***Nutrisorb***™ or Ca(NO3)2 increased N content in shoots 20 days after sod establishment (Fig. 4).

The ***Nutrisorb***™ treatment had the same effects as the $Ca(NO_3)_2$ treatment for turf quality, but ***Nutrisorb***™ treatment plants had higher root dry weight.

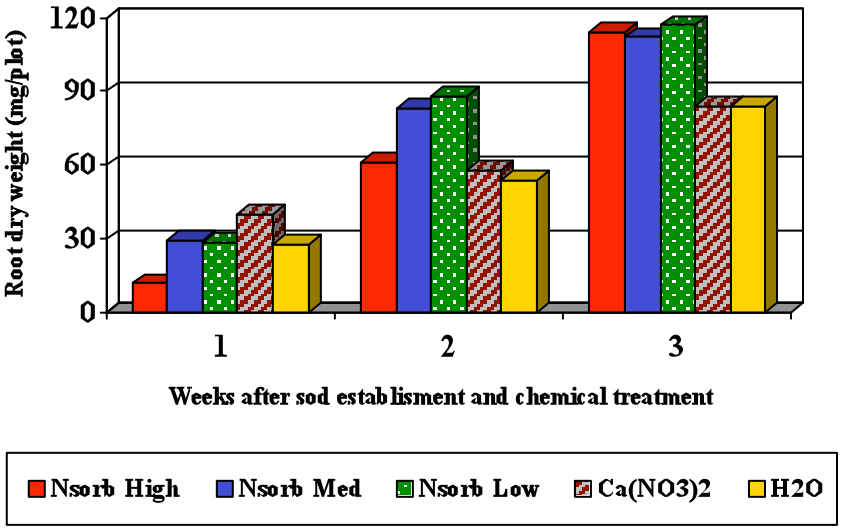
Turf quality during sod establishment (Fig. 1)



Rooting depth during sod establishment (Fig. 2



Root dry weight during sod establishment (Fig. 3)



Shoot nitrogen content at 6 and 20 days after soc establishment (Fig. 4)