Virginia Tech

Study of
Biofeed® Soil-Plus

Conducted by
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TITLE: **Manipulation of mineral nutrition with Soil-Plus on turfgrass chlorophyll activity, antioxidant activity, and tolerance to environmental stress.**

OBJECTIVES:

1. **To ascertain the influence of mineral fertilization and Soil-Plus treatments and their interactions on superoxide dismutase (SOD) concentration of turfgrass growing season and under soil moisture stress.**

2. **To ascertain the influence of plant SOD concentration on turfgrass photochemical and growth efficiency of turfgrass.**

PROCEDURE:

A mature Penncross creeping bentgrass (*Agrostis palustris*) area growing at the Virginia Tech Turfgrass Research Center was used for this study. The area was mowed at 0.625 cm three times weekly. Contact fungicides, such as chlorothalonis and mancozeb, as well as herbicides and insecticides were applied as needed to prevent the turf from becoming infected with pests. The turfgrass was irrigated to prevent drought injury.

An experimental split block design was utilized with the main block consisting of high and low fertility treatments as follows:

1. **Low fertility:**

   200 g N (from urea)/100m^2 on 10 July, 8 Aug., 23 Sept., and 14 Oct.

   65 g P_2O_5/100m^2 in July and October.

   130 g K_2O/100m^2 in July and October.

2. **High fertility:**

   500 g N (from urea)/100m on 10 July, 8 Aug., 23 Sept., and 14 Oct.

   163 g P_2O_5/100m^2 in July an October.

   260 g/100m^2 in July and October.

In separate sub-plots approximately 4 meters square were treated with Soil-Plus at 8 oz. per 1000 sq. ft. on 11 July, 21 August, and 15 October, or with Soil-Plus on 11 and 25 July, 8 and 21 August, 10 and 25 September, and 15 and 21 October and 1 November and compared to a non-treated control plot.

All treatments were replicated four times. Data were subjected to ANOV analysis and mean separation were ascertained by one degree contrast analysis (single treatment vs. control).

Leaves were sampled from each plot on 29 July and 2 October, two weeks following the biostimulant applications. These leaves were frozen with liquid nitrogen and stored at -20C for superoxide dismutase (SOD) determinations. The assay as described by Giannopolitis and Ries (1977) was 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 after 15 minutes in the dark. During photosynthesis, a small portion of the light is re-emitted from the chlorophyll molecules. This 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 phytoinjury due to environmental stress (Wilson and Greaves, 1990). Results obtained from dividing the variable fluorescence (FV) with the maximum fluorescence (FM) provides an estimation of the photosynthetic capacity.

Clipping yields were obtained in July, August, and October. Subsamples on 4 and 11 October were dried and stored for eventual mineral nutrient analysis to ascertain the influence of treatments on nutrient uptake.

Two 10cm diameter plugs were removed from each treated plot on 4 October. The soil was trimmed to 2cm depth and transplanted to 15cm diameter containers filled with a sandy soil medium and irrigated with a 2% saline solution three times per week for six weeks.

Photosynthetic capacity and clipping samples for SOD analysis were taken on 11 November. Root mass was ascertained by the vertical root lift technique (Schmidt et al., 1986_) on 14 November.

In addition, 10 cm plugs were removed from the treated plots on 8 October. The soil was trimmed from the plug to 2 cm and transplanted to a clear plastic container. Soil containing 7% moisture was placed into clear plastic containers to a depth of 10 cm. After transplanting, a 6 ml clear plastic cover was installed over the top of the container.

As previously described, leaf samples were taken on 11 November for superoxide dismutase concentration and chlorophyll fluorescence determinations for each treated plug. At the termination of the study, both foliage and root development were measured.

RESULTS:

Field study: Clipping yields.

Significant clipping yield increases occurred only twice. On 9 August the grass grown under the high fertility regime and treated frequently with Soil-Plus (Table 1) yielded 44% more than the control. On 11 October, the grass grown under low fertility and treated infrequently with Soil-Plus yielded 48% more than the non-treated control.

Color:

Color generally was improved with Soil-Plus applications (Table 2). However, under the high fertility regime the significant improvement occurred only on 1 August on turf treated frequently with Soil-Plus. Under low fertility, Soil-Plus treated turf improved color only in late August and September.

Photosynthetic capacity:

Conditions in October were such that the photosynthetic capacity of the bentgrass was near optimum regardless of treatments (Table 3). In late July, the environmental stress reduced the photosynthetic capacity; however, enhancement of photosynthetic capacity was realized when the turf was treated with Soil-Plus, especially on grass grown under the low fertility regime. These results were similar to chlorophyll capacity.

SOD antioxidant:

The antioxidant activity was generally improved with Soil-Plus treatments (Table 3). The increases were significant when the grass grown under high fertility was treated infrequently.

Sclerotinia dollarspot:

Soil-Plus did not statistically stimulate *Sclerotinia dollarspot* except on 6 August under low fertility and frequent Soil-Plus treatments (Table 4). Under high fertility, the grass that was treated with the high frequency of Soil-Plus caused dollarspot to be reduced.

Root development:

The bentgrass grown under the high fertility regime and irrigated with saline water did not statistically increase root mass when treated with Soil-Plus (Table 5). However, the grass treated frequently with Soil-Plus produced 15% more roots than the control.

Under the low fertility regime, the bentgrass irrigated with saline water significantly increased the root mass when treated with Soil-Plus regardless of frequency.

Nutrient analysis of the foliage:

Under high fertility, the grass treated with Soil-Plus did not significantly affect any nutrient concentration in the leaf tissue when sampled 4 August (Table 6). The exception was the grass frequently treated with Soil-Plus contained a significantly high amount of Mn when compared with the non-treated grass.

Under low fertility, the leaves of infrequently Soil-Plus treated grass was significantly lower in K, Ca, Mg, S, and Cu.

Under the high fertility regime, the grass treated infrequently with Soil-Plus was significantly lower in iron when sampled on 11 October (Table 7). No significant difference was obtained between any other treatment of the grass grown under high fertility.

Under low fertility, the frequent application of Soil-Plus significantly enhanced only the nitrogen content.

Development under low soil moisture:

Bentgrass grown under low soil moisture produced more leaf and root mass than when grown under the low than high fertility regime (Table 8). The effect of Soil-Plus did not significantly affect shoot or root mass. However, grass that was infrequently treated with Soil -Plus enhanced root mass by 27 and 42% under the high and low fertility regimes.

Photosynthetic capacity and chlorophyll content of the turf grown under low soil moisture tended to be enhanced when grown under the low rather than the high fertility regime (Table 9). Under the high fertility regime, the grass treated infrequently with Soil-Plus had significantly higher photosynthetic capacity and chlorophyll content than the non-treated grass.

Although the photosynthetic capacity and chlorophyll content of the grass treated with Soil-Plus regardless of frequency of treatment was higher than the non-treated control, only the grass frequently treated with Soil-Plus produced significantly more photosynthetic capacity and chlorophyll content.

The non Soil-Plus treated plants tended to have less antioxidant (SOD) under the high fertility regime than the low fertility regime (Table 10). Under the high fertility regime, the SOD content was enhanced with Soil-Plus treatments. Under the low fertility regime, the infrequent Soil-Plus treatment caused a 30% SOD increase.

LITERATURE CITED:

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