Virginia Tech
VIRGINIA POLYTEHNIC INSTITUTE AND STATE UNIVERSITY

THE EFFECT OF BOLSTER® TREATMENT ON THE GROWTH OF BENTGRASS SUBJECT TO WILTING AND INFECTED WITH NEMATODES

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INTRODUCTION

In turfgrass management's, nematode 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 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 BOLSTER® application on bentgrass under nematode free, lance or root-knot (RKN) nematode infestations.

MATERIALS AND MEHTODS

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

Plant Materials: A 2.5 cm thick 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 very another day. The height of the turf was maintained at 0.6 cm, with a mower adapted for micro plots.

Inoculum: Two nematode genera, Root-knot (*Meloidogyne hapla*) and lance (*Hoploiaimus*) nematodes were involved in this study. Root-knot nematodes (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 southeastern Pennsylvania. Pure inoculums 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) (N1), and 10 ml RKN inoculum solution (7800 eggs) (N2). The inoculum were introduced by injecting the solution 2.5 cm deep uniformly before placing the expanded metal pieces on the soil surfaces.

Biostimulant Treatment: One week after transplanting, the sod started to receive biostimulant treatments every two weeks at 0 and 1.6 ml of Bolster diluted to one liter with 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.

BOLSTER® Plant Biostimulant is a registered trademark of Sustane Natural Fertilizer

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Stress Treatment: Plants were all well watered with tap water uniformly to maintain maximum vigor from 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 each 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 severe 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; and 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 Barker (1985). Nematode concentration was expressed as te 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 (figs. 1 and 7). When Bolster was applied to the non-infected nematode bentgrass (NO) a significant enhancement of shoot density was obtained. Enhancement of shoot density associated with Bolster treatment of nematode infested bentgrass (N-1 or N-1) was not significant from the non-treated Bolster nematode infested bentgrass. However, the shoot enhancement of the Bolster +N1 or Bolster +N2 was sufficient so that no significant difference was obtained when compared to the control (N0). This data shows that the Bolster treatment lessened the effects of nematode infestation of bentgrass.

WILTING

Wilting symptoms significantly increased when the bentgrass was infested with lance nematodes (N1) (Figs. 2 and 8). Although wilting was severe when the turf was infected with root-knot nematodes (N2), the differences were not significant when compared with the control (NO) (Fig.2). Bentgrass treated with Bolster caused the turf infested with either nematode to exhibit less wilting than the corresponding turf not treated with Bolster.

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TURF QUALITY

Bentgrass infested with either lance or root-knot nematodes caused a reduction in turf quality (Figs. 3 and 9), which was negated with treatment of Bolster. Turf quality was enhanced with Bolster treatments on non-infested bentgrass, but statistical significance was not obtained.

DRY CLIPPING YIELDS

Nematode infestation did not affect clipping yields (Figs. 4 and 10). In all cases clipping yields were increased with treatment of Bolster; however, the increases, though substantial (up to 70%), were not statistically significant.

ROOT DEVELOPMENT

Root mass of non-nematode infected bentgrass was enhanced with Bolster treatment (Fig. 5 and 11). Lance nematodes caused a significant reduction of root development (Fig. 5), which was offset with Bolster treatment. Root-knot nematode infection did not cause a significant root mass reduction; however, the Bolster treatment did cause some increase in root mass (Fig. 11). Measurements of root length (Figs. 6 and 12) substantiated 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, Bolster treatments had more impact on offsetting stress associated with the lance nematode than with the root-knot nematode.

NEMATODE COUNTS

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

Since root-knot nematodes are strictly endoparasictic, counts were made per unit mass of roots. Root-knot nematodes observed in the infected non-Bolster treated bentgrass averaged 1653 per gram of roots; while the infected Bolster treated bentgrass averaged only 955 per gram of root. Bolster produced a significant (42%) decrease in RKN infections.

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

In this study root mass was only reduced 8% when the bentgrass was infected with root-knot nematodes. Only a 6% increase was obtained with Bolster treatment of root-knot nematode infected bentgrass. In other words no significant difference in root mass was obtained between non-Bolster treated and Bolster treated bentgrass that was infected with root-knot nematodes, or with either of these treatments and the control. Evidently, in this study, the root-knot nematodes did not influence bentgrass root development. In spite of the fact that Bolster treatment caused a reduction in the number of root-knot nematodes, the presence of these nematodes was sufficient to prevent the Bolster treatment from enhancing root growth. However, it appears that Bolster treatment did enhance root metabolic activity of the root-knot infected grass in the foliar growth and conditioning was enhanced.

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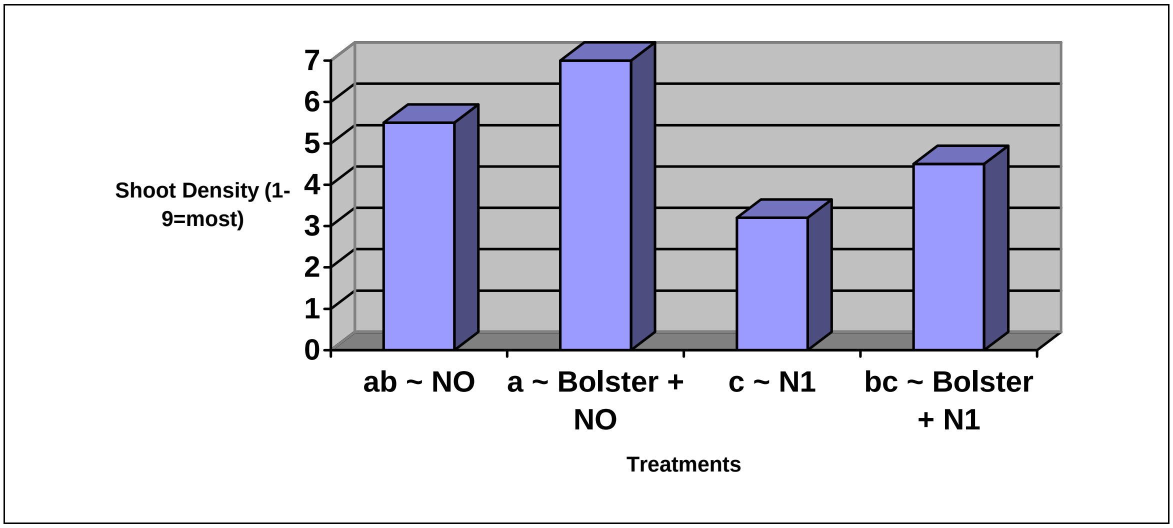

Fig 1. Turf density, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_1 = lance nematode infection and Bolster = biostimulant treated.

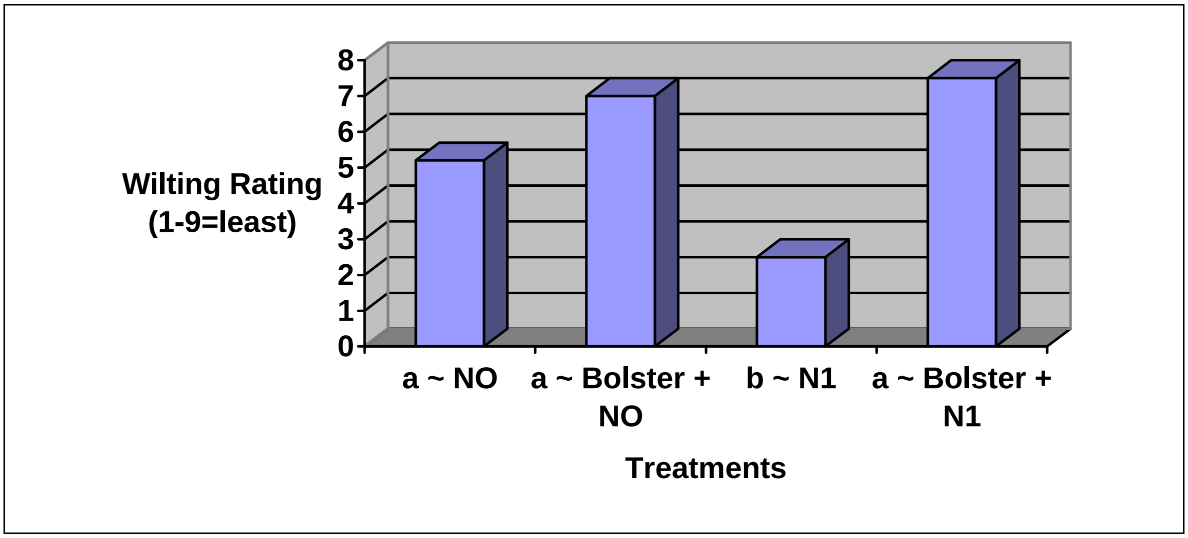

Fig.2. Wilting, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_1 = lance nematode infection and Bolster = biostimulant treated.

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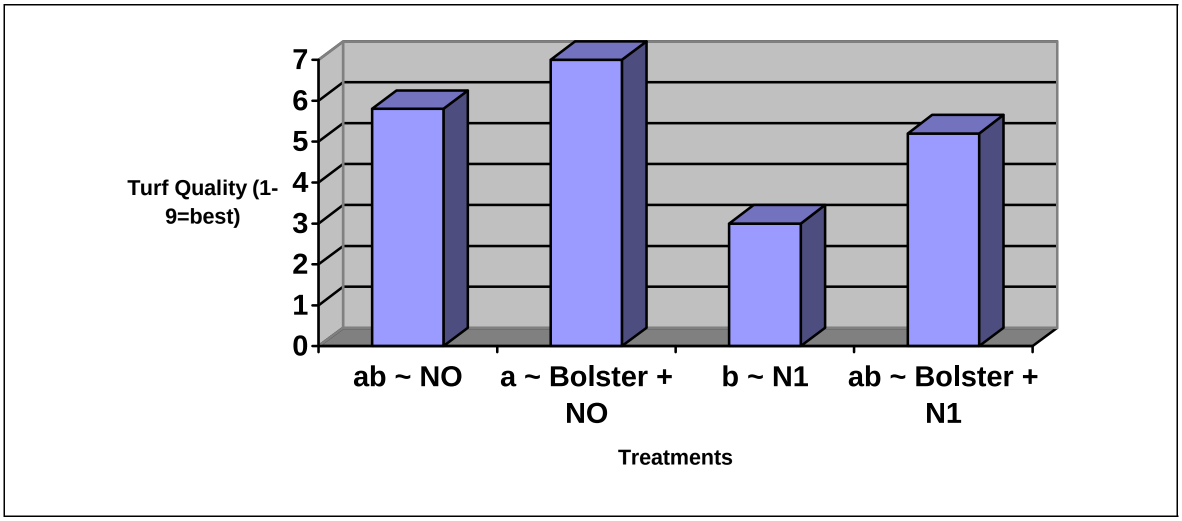

Fig.3. Turf quality, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_1 = lance nematode infection and Bolster = biostimulant treated.

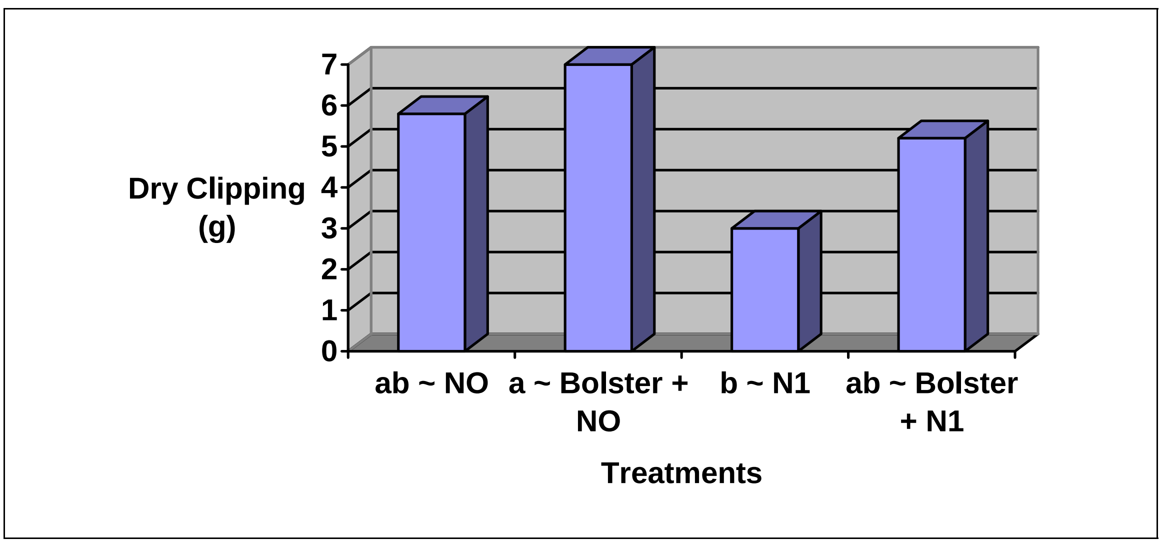

Fig.4. Dry clipping yield, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_1 = lance nematode infection and Bolster = biostimulant treated.

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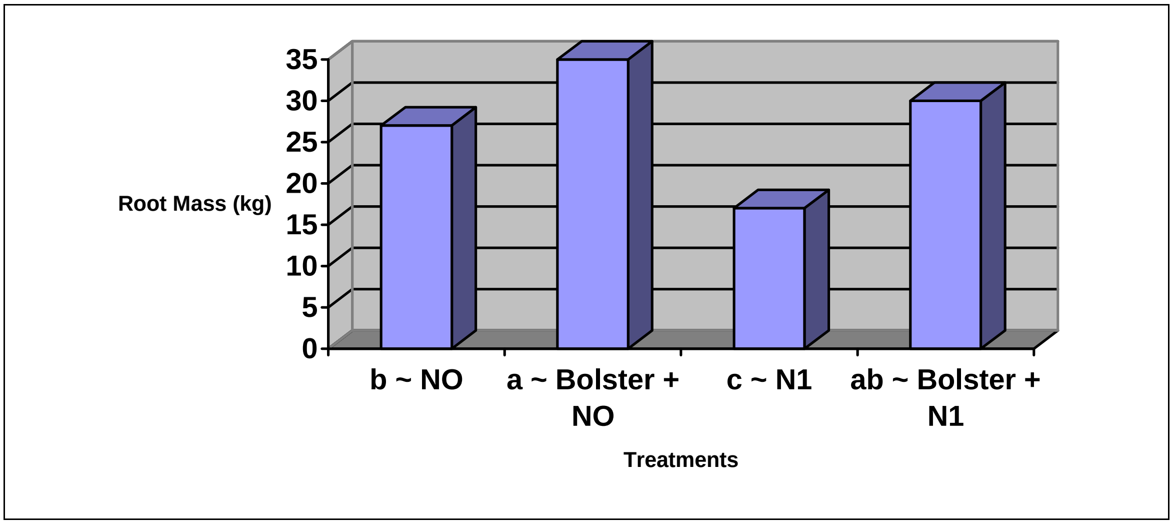

Fig. 5. Root mass, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_1 = lance nematode infection and Bolster = biostimulant treated.

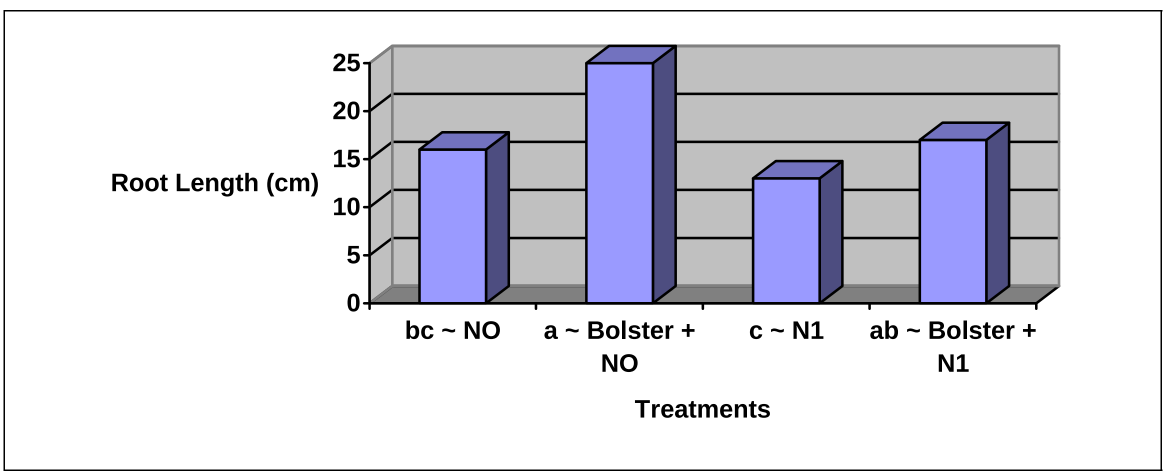

Fig.6. Root length, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_1 = lance nematode infection and Bolster = biostimulant treated.

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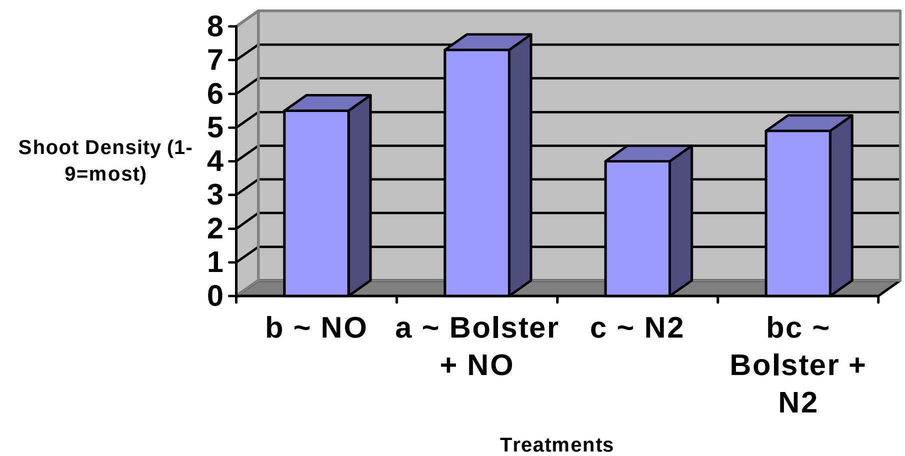

Fig.7. Turf density, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_2 = lance nematode infection and Bolster = biostimulant treated.

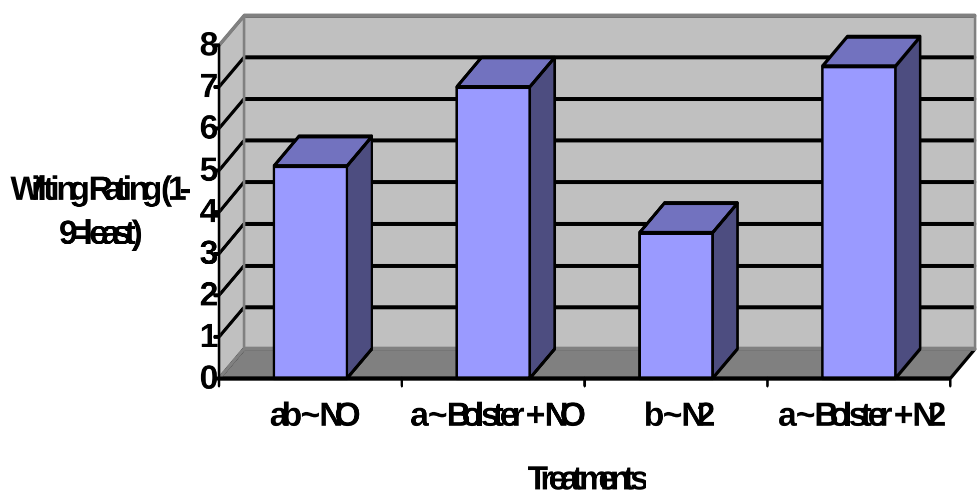

Fig. 8. Wilting, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_2 = lance nematode infection and Bolster = biostimulant treated.

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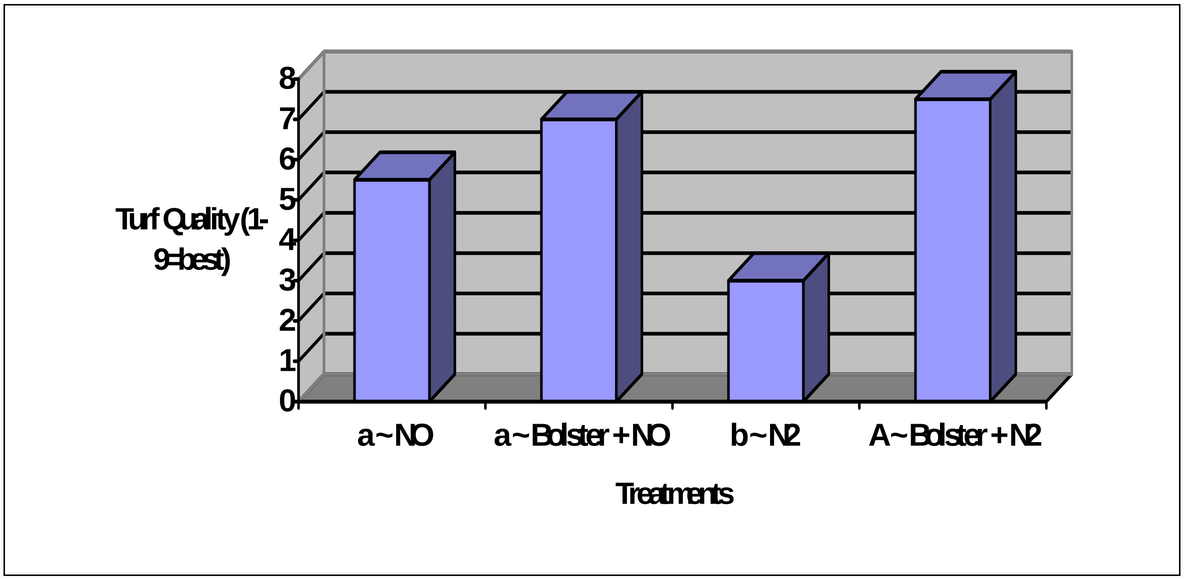

Fig.9. Turf quality, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_2 = lance nematode infection and Bolster = biostimulant treated.

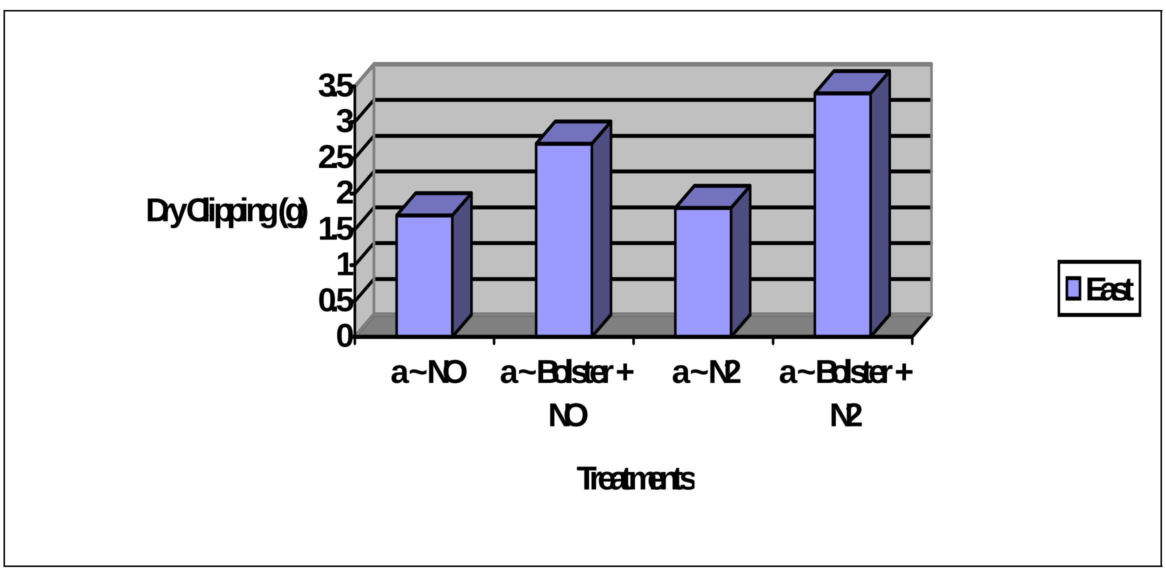

Fig.10. Dry clipping yield, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_2 = lance nematode infection and Bolster = biostimulant treated.

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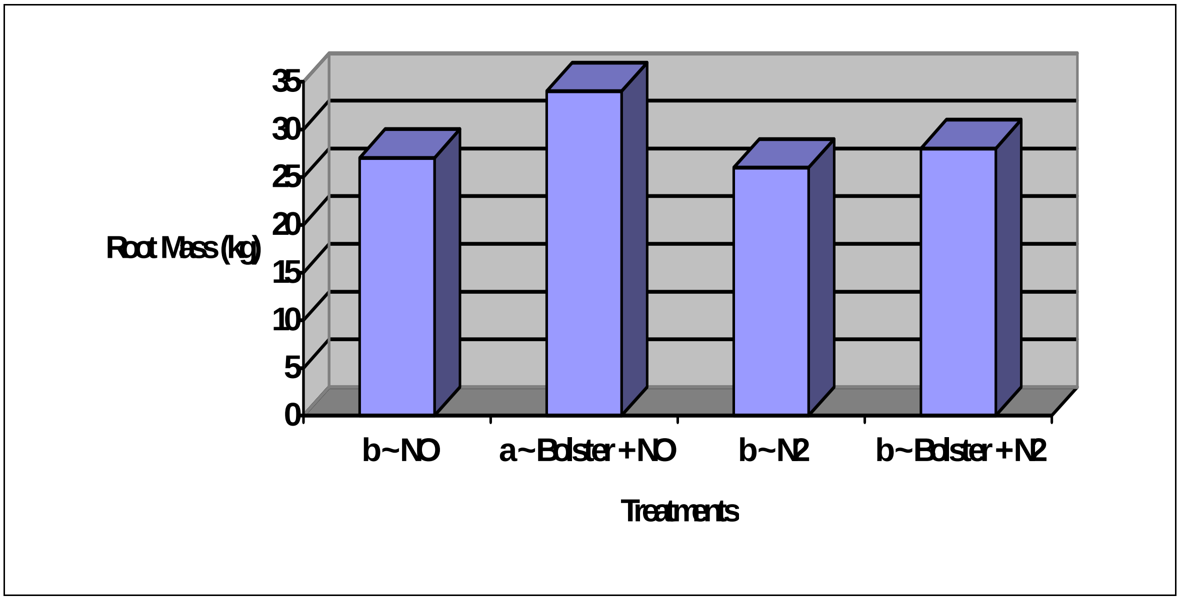

Fig.11. Root mass, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_2 = lance nematode infection and Bolster = biostimulant treated.

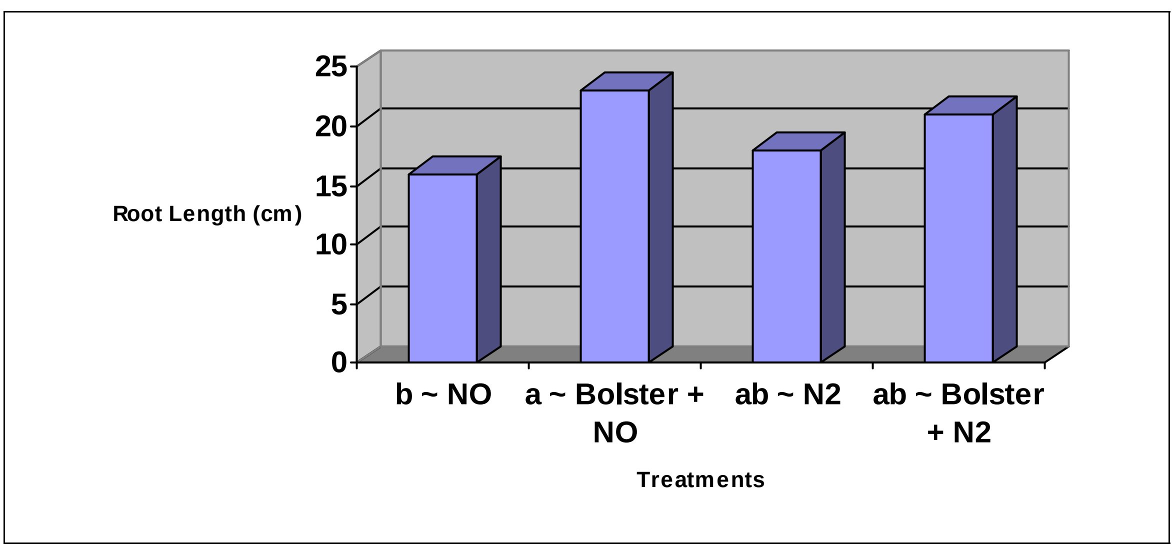

Fig.12. Root length, sixteen weeks after transplanting, as influenced by Bolster application and Lance nematode inoculation on bentgrass. The means followed by a same letter are not significantly different at 0.05 probability. N_0 = nematode free, N_2 = lance nematode infection and Bolster = biostimulant treated.