

Interactive Effects of Salinity and Primo on the Growth of Kentucky Bluegrass

M. Pessarakli¹, K.B. Marcum², D.M. Kopec¹, and Y.L. Qian³

¹University of Arizona, ²Texas A&M University, ³Colorado State University

Abstract

Kentucky bluegrass (Poa pratensis L.), cv. Nu Star was studied in a greenhouse to evaluate its growth responses in terms of shoot length and dry weight under NaCl (sodium chloride) salinity and different levels of Trinexapac-ethyl(primo Max). Plants were grown hydroponically under control and one level of salinity [EC (electrical conductivity) of 5 dS/m] and three levels of primo Max (0.3, 0.6, and 0.9 oz/1000 ft²), using Hoagland solution No. 1. Plant shoots (clippings) were harvested weekly, oven dried at 60 °C, and dry weights recorded. At each harvest, shoot length was measured and recorded, percent visual canopy green cover was also estimated. The results show that shoot length and shoot dry weight (DW) of Kentucky bluegrass significantly decreased with both salinity and primo treatments, although the differences in shoot length and shoot DW were not significant between primo treatments at 0.6 and 0.9 oz/1000 ft² application rates. The green coverage of the turf canopy decreased under salinity stress, and the reduction of green canopy coverage by salinity was more pronounced when turf was treated by primo, suggesting that primo significantly reduced the salt tolerance of Kentucky bluegrass. The above results were observed for both cumulative as well as the weekly growth responses.

Introduction

Kentucky bluegrass (*Poa pratensis* L.) a common cool season turf species, grows worldwide as a turfgrass species in cool regions. It is also commonly used for overseeding on the warm-season grasses in warm climates. Its growth can be manipulated and controlled by using various growth regulators. Among the commonly used compounds is primo. The compound is used to produce plants which require less mowing, but more stress (i.e., salinity and drought) tolerant, consequently require low maintenance and grow in poor soil conditions. Studying the compound in combination with salinity stress would probably produce more desired grasses.

Objectives

The objectives of this study were to compare growth responses of Kentucky bluegrass in terms of shoot length and dry weight (shoot clippings weight) grown under NaCl salinity and different levels of primo, and to find the optimum level of primo for this interaction effect on this turf species.

Materials and Methods

Kentucky bluegrass (*Poa pratensis* L.), cv. Nu Star, was used in a greenhouse experiment to evaluate its growth in terms of shoot length and dry weight (shoot clippings weight) grown under 5 dS/m NaCl salinity and three levels of primo Max (0.3, 0.6, and 0.9 oz/1000 ft²), using Hoagland solution No. 1. (Hoagland and Arnon, 1950), using hydroponics technique.

The plants were grown from seeds in cups, 9 cm diameter and 7 cm height. Silica sand was used as the plant anchor medium. Each cup was fitted into one of the 9 cm diameter holes cut in a rectangular plywood sheet 46 cm X 37 cm X 2 cm. The plywood sheets served as lids for the hydroponics tubs and supported the cups above the solution to allow for root growth, and were placed on 42 cm X 34 cm X 12 cm Carb-X polyethelene tubs containing half strength Hoagland solution No. 1 (Hoagland and Arnon, 1950, Pessaraki and Tucker, 1988, Pessaraki et al., 2001). Eight replications of each treatment were used in a Randomized Complete Block design (RCB) in this investigation.

Plants were allowed to grow in this nutrient solution for 90 days. During this period, the plant shoots (clippings) were harvested weekly in order to allow the grass to reach full maturity and develop uniform and equal size plants. The harvested plant materials (clippings) were discarded. The culture solutions were changed biweekly to ensure adequate amount of plant essential nutrient elements for normal growth and development.

After 90 days growing in this nutrient solution, the salinity treatment was started by adding NaCl to the nutrient solution (1 dS/m every day) to reach the 5 dS/m targeted salinity level. Seven days after the completion of the salt treatment, shoots and roots were cut to have plants with uniform roots and shoots prior to the initiation of the primo treatment. Three levels of primo Max (0.3, 0.6, and 0.9 oz/1000 ft²), were used. The combination of control, salinity, and the primo resulted in eight treatments [C (control), CP1 (control-primo level 1), CP2 (control-primo level 2), CP3 (control-primo level 3), S (salinity), SP1 (salinity-primo level 1), SP2 (salinity-primo level 2), and SP3 (salinity-primo level 3)]. These symbols are defined in detailed in Table 1. The culture solution levels in the tubs were marked at the 10 liter volume level and maintained at this level by adding distilled water as needed. Culture solutions were changed bi-weekly to maintain the desired plant nutrient levels. The plant shoots (clippings) were harvested weekly for the evaluation of the dry matter production. At each weekly harvest, shoot length was measured and recorded. The percent of the visual green cover was also estimated and recorded.

The harvested plant materials were oven dried at 60° C and dry weights were measured and recorded. The recorded data were considered the weekly plant dry-matter production.

Statistical Analysis

The data were subjected to Analysis of Variance, using SAS statistical package (SAS Institute, 1991). The means were separated, using Duncan Multiple Range test.

Results and Discussion

The results for both cumulative as well as the average weekly growth responses were essentially the same and are presented in Tables 2-5.

Shoot Length

Shoot length significantly decreased at any rates of primo application (Tables 2-5). This reduction was more pronounced under salinity stress. The effect of primo showed immediately after its application (Table 2). At the first harvest (one week after salt treatment), there was no difference between the control and the NaCl treated plants (but, not treated with primo). However, the differences among these factors were significant as time progressed (Tables 3- 5). The values for the shoot lengths were statistically the same for any rates of primo application alone or combined with NaCl treatments (Table 2). However, later in the growth period, a significant difference between the low level of primo (0.3 oz/1000 ft²)

was detected compared with the other rates of application, 0.6 and 0.9 oz/1000 ft² (Tables 3-5). The results presented in these Tables (Tables 3-5) also indicate that there was no difference among the medium (0.6 oz/1000 ft²) and the high (0.9 oz/1000 ft²) rates of primo application, either primo alone or combined with NaCl.

Shoot Dry Weight

Shoot dry weights responses followed exactly the same pattern as shoot lengths for the first harvest (Table 2). As the shoot lengths, the shoot dry weights significantly decreased under primo alone or combined with NaCl as the growth period progressed (Tables 3-5). As indicates in this Tables (Tables 3-5), this significant difference was clearly shown between the low (0.3 oz/1000 ft²) level of primo application rate compared with the medium (0.6 oz/1000 ft²) and the high (0.9 oz/1000 ft²) levels whether plants were treated with only primo or with primo combined with NaCl. The differences in shoot dry weights were not significant between the medium (0.6 oz/1000 ft²) and the high (0.9 oz/1000 ft²) rates of primo applications for the plants treated either with primo alone or with primo combined with NaCl. However, reduction in shoot dry weights was more pronounced at the highest (0.9 oz/1000 ft²) primo application rate combined with NaCl compared with any other treatments.

Percent Canopy Green Cover

There was no difference in the percent canopy green cover among the treatments at the first harvest (Table 2). However, as the growth period progressed, the differences among the different treatments were clearly shown (Tables 3-5). The values for the control plants were always significantly higher than those for any other treatments. The gap between the values was wider as growth period progressed.

Conclusions

Both shoot lengths and shoot dry weights (DW) significantly decreased at any level of Trinexapac-ethyl (primo) or salinity/primo levels. Reduction in the above parameters was more pronounced under salinity stress. This is a clear indication of the interaction effects of primo and salinity, suggesting that primo significantly reduced the salt tolerance of Kentucky bluegrass. The differences in shoot lengths and shoot DW were not significant between the medium (0.6 oz/1000 ft²) and the high (0.9 oz/1000 ft²) levels of primo for either control or salinity/primo treatments. The percent canopy visual green cover decreased linearly for primo or salinity/primo treated plants compared with the control. This reduction was more pronounced under salinity stress and as growth period progressed. Shoot length and shoot dry weight (DW) of Kentucky bluegrass significantly decreased with either salinity or primo treatments, although the differences in shoot length and shoot DW were not significant between primo treatments at 0.6 and 0.9 oz/1000 ft² application rates.

References

- Hoagland, D.R., and D.I. Arnon. 1950. The water-culture for growing plants without soil. Calif. Agric. Exp. Stn. Circ. 347 (Rev.).
- Pessaraki, M. and T.C. Tucker. 1988. Dry matter yield and nitrogen-15 uptake by tomatoes under sodium chloride stress. Soil Sci. Soc. Am. J. 52:698-700.
- Pessaraki, M., K.B. Marcum, and D.M. Kopec. 2001. Growth Responses of Desert Saltgrass under Salt Stress. Turfgrass Landscape and Urban IPM Research Summary 2001, Cooperative Extension, Agricultural Experiment Station, The University of Arizona, Tucson, U.S. Department of Agriculture, AZ1246 Series P-126, pp. 70-73.
- SAS Institute, Inc. 1991. SAS/STAT User's guide. SAS Inst., Inc., Cary, NC.

Table 1. Definitions of the symbols (abbreviations) for the treatments.

Symbols	Definitions
C	control (no salt, no primo)
CP1	control & primo (0.3 oz/1000 ft ²)
CP2	control & primo (0.6 oz/1000 ft ²)
CP3	control & primo (0.9 oz/1000 ft ²)
S	salt (no primo)
SP1	salt & primo (0.3 oz/1000 ft ²)
SP2	salt & primo (0.6 oz/1000 ft ²)
SP3	salt & primo (0.9 oz/1000 ft ²)

Table 2. Bluegrass growth responses (week 1 harvest) to salinity and primo interactions.

Tmnt	Sht lng (cm)	Sht DW(g)	CGC (%)
C	4.3a	0.24a	100
CP1	3.4b	0.19ab	100
CP2	3.3b	0.16b	100
CP3	3.2b	0.15b	100
S	4.1a	0.22a	100
SP1	3.0b	0.14b	100
SP2	2.9b	0.10b	95
SP3	2.8b	0.10b	95

The values are means of eight replications.
All the values followed by the same letter in each column are not statistically different at the 0.05 probability level.

Table 3. Bluegrass growth responses (cum.) to salinity and primo interactions.

Tmnt	Sht lng (cm)	Sht DW(g)	CGC (%)
C	33.6a	2.66a	100
CP1	25.2b	1.54b	90
CP2	14.7c	0.84c	80
CP3	11.9c	0.63c	60
S	23.8b	1.33b	75
SP1	9.1cd	0.77c	50
SP2	4.9de	0.56cd	35
SP3	2.8e	0.21d	20

The values are means of eight replications.
All the values followed by the same letter in each column are not statistically different at the 0.05 probability level.

Table 4. Bluegrass growth responses (weekly average) to salinity and primo interactions.

Tmnt.	Sht lng (cm)	Sht DW(g)	CGC (%)
C	4.8a	0.38a	100
CP1	3.6b	0.22b	95
CP2	2.1c	0.12c	85
CP3	1.7c	0.09c	65
S	3.4b	0.19b	80
SP1	1.3c	0.11c	60
SP2	0.7cd	0.08cd	45
SP3	0.4de	0.03d	30

The values are means of eight replications.
 All the values followed by the same letter in each column are not statistically different at the 0.05 probability level.

Table 5. Bluegrass growth responses (% of the control) to salinity and primo interactions.

Tmnt.	Sht lng (cm)	Sht DW(g)	SP1,2,3/S	
C	100	100	<u>Shoot</u>	
CP1	75	58	<u>length DW</u>	
CP2	44	32		
CP3	35	24		
S	71	50	100	100
SP1	27	29	38	58
SP2	15	21	21	42
SP3	8	12	16	16

The values are means of eight replications.
 All the values followed by the same letter in each column are not statistically different at the 0.05 probability level.