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Original Research Paper

Effect of sprigging density and foliar nitrogen on the growth of Bermuda grass (*Cynodon dactylon* L. Pers. x *Cynodon transvaalensis*)

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ABSTRACT

Turf grasses have been utilized by humans to enhance their environment for more than 10 centuries. Aesthetically, lawns enhance the quality of life, contribute to social harmony and community pride, increase property values and compliment other landscape plants. The beauty of any garden largely depends on the greenness of the lawn. The first and foremost criteria for a well establishment and a satisfactory lawn are selection of suitable grass species and methods of its establishment. Hence, an experiment was laid out to study the effect of different sprigging density and foliar nitrogen on the growth and establishment of bermuda grass (*Cynodon dactylon* L. Pers. x *Cynodon transvaalensis*) in floriculture unit of the Department of Horticulture, Faculty of Agriculture, Annamalai University, Tamil Nadu during the year 2013-2015. Bermuda grass sprigs were planted in different spacing levels and foliar spray of urea with twelve treatment combinations comprising of different levels *viz.*, 10 x 10 cm with 1%, 1.5% and 2%; 15 x 15 cm with 1%, 1.5% and 2%; 20 x 20 cm with 1%, 1.5% and 2%; 25 x 25 cm with 1%, 1.5% and 2%, in factorial randomized block design with three replications. From the results, it was found that the earliest spread and ground cover were observed in planting sprigs at closer spacing of 10 x 10 cm in combination with foliar application of nitrogen in the form of urea as 2 % for two times at seven and fifteen days after planting.

Keywords : Bermuda grass, spacing, foliar nutrition

INTRODUCTION

A lawn is more than just a patch of grasses which under proper planting and aftercare can be proved as a beauty spot. It is one of the important features of landscape garden. Lawn is an inevitable component in gardens as because it serves as an important aid to beauty for the landscapes. The beauty of any garden largely depends on the greenness of the lawn. The success of a lawn largely depends on the selection of right type of grasses suitable to the climatic and soil conditions, besides appropriate cultural practices and management skills. The first and foremost criteria for a well establishment and a satisfactory lawn are selection of suitable grass species and methods of its establishment. A proper planting method ensures good ground cover in a short span of time. Hence, selection of appropriate method suitable for selected grass species is of greater importance in establishment of lawn. However, establishment is made based on the growth pattern of grass species. Since, Bermuda grass is a stoloniferous type of grass, the spread and ground cover is more rapid. The faster spread is largely depends on the distance between sprigs planted. On the other hand, nutrition played a major role in establishment and greenness of lawn. Nitrogen is an essential element for all living things and the mineral element needed in larger quantities for lawn grasses. Although nitrogen fertilization is essential for healthy lawn, the quantity and method of application determines the growth rate of lawn grasses. It is evident that foliar spray of nitrogen showed better results (Baldwin *et al.*, 2009). Foliar spray of urea is not so easier due to the scorching effect of leaf lamina of lawn if the dosage is increased even to micro level. Hence standardizing the dosage of application of urea as foliar spray to Bermuda grass is a timely need for many landscapers. Hence, an experiment was formulated to study the effect of different spacing levels and foliar nitrogen on the growth and establishment of bermuda grass.

MATERIAL AND METHODS

Bermuda grass springs were planted at four different spacing levels *viz.*, 10 x 10 cm, 15 x 15 cm, 20 x 20 cm and 25 x 25 cm and foliar spray of urea (7 and 15 days after planting) with urea as nitrogen sources @ 1%, 1.5% and 2% in the floriculture unit of the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil nadu during 2015. The experiment was conducted with 12 treatment combinations in factorial randomized block design (FRBD) and three replication. Observations were recorded during 15, 30, 45 and 60 days after planting for percent ground cover, number of runner, length of runner and shoot density, root length, shoot length, root / shoot ratio, leaf area and number of leaves per clipped shoot at 60 days after planting. The data were statistically analyzed by using Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Significant differences were noticed among the treatments (**Table 1**). Among the spacing levels, maximum ground cover percentage was observed in closest spacing S_4 (8.68 %, 84.23%, 96.75 % and 98.61 % at 15, 30, 45 and 60 days after planting respectively. The least ground cover percentage was recorded in wider spacing S_1 (51.56 %, 74.46 %, 85.16 % and 86.12 % at 15, 30, 45 and 60 days after planting respectively. Among the various Nitrogen levels, maximum ground cover percentage was recorded in the N_3 (55.36 %, 79.59 %, 91.52 %, and 92.67 % in 15, 30, 45 and 60 DAP respectively. The least values was recorded in N_1 (52.82 %, 76.03 %, 87.05 % and 88.12 % in 15, 30, 45 and 60 DAP respectively. The data on interaction of spacing x nitrogen showed that maximum ground cover per cent was recorded in S_4N_2 (60.07 %, 86,26 %, 99.15 % and 101.21 %) and the least ground cover per cent was recorded in S_1N_1 (49.94 %, 72.05 %, 82.35 % and 83.01 % in 15, 30,45 and 60 DAP respectively. This might be due to the fact that the formation of stolon above the soil is quite rapid in closer spacing (10 x 10 cm) which expands and spreads the empty spaces with more number of runner and increased density of the shoot leading to quick coverage of areas in this treatment which ensured the highest ground cover per cent in addition to the impact of foliar nitrogen. This might be due to the absorption of nitrogen through leaves in ionic form and translocation in plants without any loss and significant increase in the above characters. This is in accordance with the findings of Deleuran *et al* (2009) in perennial rye grass; Stiglbauer *et al*. (2009) in Zoysia grass, Han *et al*. (2013) in brome grass, David *et al*. (2003) Guertal and Evans (2006) in Bermuda grass.

Maximum number of runners was observed in medium spacing S_4 (10.08, 14.13, 19.25 and 26.88 in 15, 30, 45 and 60 DAP respectively. However, lowest number of runners was recorded in wider spacing S_1 (5.35, 9.58, 15.26 and 21.07 in 15, 30, 45 and 60 DAP respectively among the spacing levels. Among the various Nitrogen levels, maximum number of runners was recorded in N_3 (8.37, 12.46, 17.7 and 24.7 in 15, 30, 45 and 60 DAP respectively). The least values was recorded in N_1(6.81,11.08,16.62 and 22.96 in 15, 30, 45 and 60 DAP respectively). The data on interaction of spacing x nitrogen showed that maximum number of runners was recorded in S_4N_3 (11.20, 15.31, 20.08 and 28.12 in 15, 30, 45 and 60 DAP respectively). However, least number of runners was recorded in S_1N_1 (4.56, 8.91, 14.75 and 20.16) at 15, 30, 45 and 60 DAP respectively. The data on length of runners showed significant variations among the treatments. Among the spacing levels, the longest runner was noticed under wider spacing S_1 (7.13 cm, 14.85 cm, 17.04 cm and 20.22 cm) at 15, 30, 45 and 60 DAP respectively. The least values were recorded in closest spacing S_4 (4.76 cm, 13.06 cm, 15.44 cm and 18.70 cm at 15, 30, 45 and 60 DAP respectively. Among the various nitrogen levels, lengthy runner was recorded under N_3 (7.96 cm, 16.20 cm, 18.30 cm and 21.02 cm) at 15, 30, 45 and 60 DAP respectively. However, the shortest runner was noticed under N_1 with 3.94 cm, 11.93 cm, 14.39 cm and 18.47 cm at 15, 30, 45 and 60 DAP respectively. The data on interaction of spacing x nitrogen showed that, maximum length of runner was recorded in S_1N_3 (9.20 cm, 17.50 cm, 19.50 cm and 21.80 cm at 15, 30, 45 and 60 DAP respectively). However, the shortest runner was recorded in S_4N_1 (2.55 cm, 10.85 cm, 13.41 cm and 17.81 cm in 15, 30, 45 and 60 DAP respectively). This might be due to the fact that enough space available for the runners to grow due to less competition of nutrients which in turn produced maximum length of runners. Further, each node produced a considerable amount of root which adhered to the soil and involved in the uptake of nutrients. This might be the reason for the enhancement in the length of runners in this treatment. Similar results were also observed by Wijitphan *et al.* (2009) in Napier grass and Deleuran *et al* (2010) in *Festuca* grass.

Various levels of spacing had significant differences in the shoot and root length (**Table.2**). Among them, medium spacing (S3) recorded highest shoot length of 11.19 cm and root length of 7.84 cm. The lowest shoot and root length was recorded in wider spacing S1(6.60 cm and 6.45 cm) respectively. Among the nitrogen levels, maximum shoot length (10.90 cm) was recorded in N_3. Similarly, the same treatment N_3 recorded for the maximum root length (7.87 cm). The lowest shoot length (6.46 cm) and root length (6.33 cm) was recorded in N_1. Interaction effect of spacing and nitrogen also had significant effect on shoot and root length. Maximum shoot length (13.76 cm) and root length (8.70 cm) was recorded in S_3N_3. However, lowest length of shoot and root was recorded under S_1N_1 with 4.80 cm and 5.69 cm respectively. Maximum values in the medium spaced treatment and optimum dosage of nitrogen showed positive influence due to the role in cell division as well as protein synthesis. Bowmann *et al.*(2002) and Boyer *et al.*(2014) reported favourable effects on length of runners in Bermuda grass; Bilgilli and Acikgoz (2005) for shoot length in Kentenky blue grass and Totten *et al.*(2007) for root length in creeping bent grass with the increased dose of nitrogen.

The data pertaining to root/shoot ratio showed that, S_2 and S_3 recorded the highest value (0.26) and both was on par with each other. The lowest value was recorded in S_1 and S_4 with 0.24. However, under various nitrogen levels, the highest root shoot ratio was recorded in N_3 (0.27). The lowest value was noticed in N_1(0.23). Maximum root/shoot ratio (0.29) was observed in S_3N_3 and the lowest root/shoot ratio (0.22) was recorded in S_1N_1 in the interaction effect of spacing and nitrogen. Maximum shoot density was noticed in closest spacing S_4 (1244.63 m2) and the lowest density was recorded in S_1 (828.38 m2) observed under spacing levels. Similarly, the treatment N_3 recorded the maximum shoot density (1140.55 m2) and the lowest value was noticed in N_1 (901.52 m2). However, in the interaction effect, maximum values was obtained in S_4N_3 (1404.00 m2) and minimum density was noticed in S_1N_1 (732.76 m2). The shoot density progressively increased with the increment in N levels and recorded maximum in 2% urea spray. This might be due to the absorption of nitrogen through leaves in ionic form and translocation in plants without any loss. This might have induced higher metabolic activity and significant increase in the shoot density. The results of Johnson *et al.*(1987); White (1987); Rodriguez *et al.*(2001);Kopp *et al.*(2002); David *et al.*(2003); Guertal and Evans (2006) in Bermuda grass and Ledeboer and Skogley (1973) in *Lolium perenne*; Fry and Dernoedon (1987); Carroll *et al* (1996) in *Zoysia japonica* are in consonance with the results of this experiment.

Maximum leaf area of 0.59 cm^2 and 0.53 cm^2 was noticed in S_4 and N_3 among the spacing levels and nitrogen levels respectively. However, minimum values of 0.39 cm^2 and 0.41 cm^2 was observed under S_2 and N_1 at spacing and nitrogen levels respectively. In the interaction of spacing x nitrogen, maximum leaf area was recorded in S_4N_3 with 0.67 cm^2 and minimum value was noticed in S_2N_1 with 0.28 cm^2. Application of various levels of spacing on number of clipped shoot recorded maximum values in S_4 (12.34) and minimum value was recorded under S_1 with 8.24.Among the nitrogen levels, maximum number of leaves per clipped shoot is observed in N_3 (12.13) and minimum value was recorded in N1 (8.18). The data on interaction of spacing x nitrogen showed maximum values in the treatment S_4N_3 with 14.50 and minimum values in S_2N_1 with 6.53. The increased leaf area and number of clipped shoot in closest spacing treatment might be because of the rapid growth and production of more number of leaves and the sprigs produced lengthy stolen in the treatment.

Interestingly, the data on maximum leaf area (0.67 cm2) and more number of leaves (14.50) was recorded in the treatment S_4N_3 (10 x 10 cm and 2 % Urea). This may be due to the fact that the closely planted sprigs attributed for maximum shoot density which ensured the highest ground cover per cent in addition to the impact of foliar nitrogen. The application of foliar nitrogen rapidly increased the absorption mechanism and might have enhanced the photosynthetic rate. These results corroborate the findings of Guertal and Evans (2006) in Bermuda grass and Razmjoo and Kaneko (1993) in perennial rye grass; Razmjoo *et al.*(1996) in creeping bent grass and Zhao *et al.*(2008) in tall fescue grass.

From the above results, it was clearly evident that early ground cover, number if runners, leaf area, number of leaves are the positive characters of a good quality lawn which is exhibited by the treatment S_4N_3 (10 X 10 cm spacing and 2% foliar spray of Urea) established through sprigging method. Even though the treatment S_3N_3 exhibited maximum values for shoot length, root length and root shoot ratio, more considerations were given for the visual quality which attributed through per cent ground cover, shoot density, number of runners, leaf area and number of leaves per clipped shoot. Hence, it could be concluded that the best quality of Bermuda grass turf can be established at the earliest duration by planting sprigs at closer spacing of 10 x 10 cm in combination with foliar application of nitrogen in the form of urea as 2 % spray for two times at seven and fifteen days after planting.

Table 1. Effect of spacing and foliar nitrogen of Bermuda grass (*Cynodon dactylon* L. Pers. x *Cynodon transvaalensis*)

Treatment	Per cent ground cover (%)				Number of runners				Length of runners (cm)			
	15 DAP	30 DAP	45 DAP	60 DAP	15 DAP	30 DAP	45 DAP	60 DAP	15 DAP	30 DAP	45 DAP	60 DAP
S_1N_1	49.94	72.05	82.35	83.01	4.56	8.91	14.75	20.16	5.28	12.32	14.72	18.70
S_1N_2	50.04	73.50	83.97	84.91	5.29	9.49	15.23	20.97	6.92	14.74	16.90	20.16
S_1N_3	54.06	77.85	89.16	90.46	6.21	10.36	15.82	22.09	9.20	17.50	19.50	21.80
S_2N_1	51.04	73.79	84.36	85.26	5.48	9.78	15.50	21.28	4.45	12.75	15.15	18.95
S_2N_2	52.53	75.82	86.76	87.86	6.40	10.65	16.25	22.40	7.11	15.35	17.33	20.41
S_2N_3	51.43	74.08	84.75	85.61	7.32	11.52	17.00	23.52	8.06	16.55	18.63	21.23
S_3N_1	52.92	76.11	87.15	88.26	9.16	13.26	18.50	25.76	3.50	11.08	14.28	18.44
S_3N_2	58.58	84.28	96.75	98.61	10.08	14.13	19.25	26.88	7.30	15.60	17.76	20.66
S_3N_3	55.90	80.17	91.95	93.41	8.97	12.97	18.23	25.45	8.25	16.12	18.20	20.98
S_4N_1	57.39	82.20	94.35	96.01	8.05	12.39	17.75	24.64	2.55	10.85	13.41	17.81
S_4N_2	54.41	78.14	89.55	90.81	8.24	12.10	17.48	24.33	5.40	13.70	16.02	18.20
S_4N_3	60.07	86.26	99.15	101.21	11.20	15.31	20.08	28.12	6.35	14.65	16.89	20.09
Sed	1.10	0.99	1.05	1.09	0.60	0.56	O.60	0.26	0.49	0.43	0.31	0.44
Cd (P=0.05)	2.28	2.05	2.18	2.26	1.26	1.18	1.25	0.55	1.02	0.89	0.65	0.93
S mean												
S_1	51.56	74.46	85.16	86.12	5.35	9.58	15.26	21.07	7.13	14.85	17.04	20.22
S_2	51.66	74.56	85.29	86.24	6.40	10.65	16.25	22.40	6.54	14.88	17.03	20.19
S_3	54.41	78.14	89.55	90.81	8.42	12.48	17.82	24.80	6.35	14.50	16.74	20.02
S_4	58.68	84.23	96.75	98.61	10.08	14.13	19.25	26.88	4.76	13.06	15.44	18.70
Sed	0.63	0.57	0.61	0.63	0.34	0.32	0.34	0.15	0.28	0.24	0.18	0.26
Cd (P=0.05)	1.32	1.18	1.26	1.30	0.72	0.68	0.72	0.31	0.59	0.51	0.37	0.53
N mean												
N_1	52.82	76.03	87.05	88.12	6.81	11.08	16.62	22.96	3.94	11.93	14.39	18.47
N_2	54.41	77.92	89.25	90.54	7.50	11.59	17.05	23.64	6.68	14.84	17.00	19.85
N_3	55.36	79.59	91.52	92.67	8.37	12.46	17.70	24.7	7.96	16.20	18.30	21.02
Sed	0.55	0.49	0.52	0.54	0.30	0.28	0.30	0.13	0.24	0.21	0.15	0.22
Cd (P=0.05)	1.14	1.02	1.09	1.13	0.62	0.58	0.62	0.27	0.51	0.44	0.32	0.46

Table 2. Effect of spacing and foliar nitrogen of Bermuda grass (*Cynodon dactylon* L. Pers. x *Cynodon transvaalensis*)

Treatment	Shoot length (cm)	Root length (cm)	Root/shoot ratio	Shoot density (m^2)	Leaf area (cm^2)	Number of leaves per clipped shoot
S_1N_1	4.80	5.69	0.22	732.76	0.39	6.94
S_1N_2	6.26	6.62	0.25	828.38	0.43	8.02
S_1N_3	8.55	7.05	0.26	924.00	0.40	9.77
S_2N_1	5.01	6.12	0.23	734.66	0.28	6.53
S_2N_2	7.51	7.12	0.27	830.28	0.36	8.69
S_2N_3	9.01	8.27	0.28	925.90	0.55	11.26
S_3N_1	7.30	6.98	0.24	1021.52	0.47	9.10
S_3N_2	12.51	7.84	0.26	1308.30	0.63	13.42
S_3N_3	13.76	8.70	0.29	1115.24	0.52	13.01
S_4N_1	8.76	6.55	0.24	1117.14	0.51	10.18
S_4N_2	11.26	7.41	0.25	1212.76	0.59	12.34
S_4N_3	12.30	7.48	0.25	1404.00	0.67	14.50
Sed	0.47	0.43	0.16	1.51	0.10	0.78
Cd	0.98	0.89	0.03	3.14	0.21	1.61
(*P*=0.05)						
S mean						
S_1	6.60	6.45	0.24	828.38	0.40	8.24
S_2	7.10	7.17	0.26	830.28	0.39	8.82
S_3	11.19	7.84	0.26	1148.35	0.54	11.84
S_4	10.77	7.48	0.24	1244.63	0.59	12.34
Sed	0.27	0.24	0.009	0.87	0.59	0.45
Cd	0.56	0.51	0.019	1.81	0.12	0.93
(*P=0.05*)						
N mean						
N_1	6.46	6.33	0.23	901.52	0.41	8.18
N_2	9.38	7.24	0.25	996.66	0.50	10.61
N_3	10.90	7.87	0.27	1140.55	0.53	12.13
Sed	0.23	0.21	0.008	0.75	0.05	0.39
Cd	0.49	0.44	0.017	1.57	0.10	0.80
(*P=0.05*)						

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