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Response of Bermuda Lawn Grass (*Cynodon dactylon*) cv. Selection-1 to Various Doses of Nitrogen and Phosphorus Fertilization

Kanda Jena and C. R. Mohanty*

Department of Floriculture and Landscaping, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar-751003, Odisha, India

**Corresponding author*

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A B S T R A C T

A field trial was conducted during the period 2013 - 2015 to study the effect of nitrogen and phosphorus on growth and quality of Bermuda lawn grass (*Cynodon dactylon*) cv. Selection-1 and to determine the most suitable dose for establishment and maintenance of a quality lawn. In the present investigation three levels of nitrogen viz., 10, 20 and 30 g/m^2, three levels of phosphorus *viz*., 5, 10 and 15 g/m^2 and a fixed dose of potassium viz., 5 g/m^2 were tried along with untreated control (viz., N_0, P_0 and K_0) comprising of 10 different combinations. Nitrogen, phosphorus and potassium were applied as urea (46.0 % N), single super phosphate (16.0 % P_2O_5), and muriate of potash (60.0 % K_2O) respectively. The textural class of the soil of the experimental site was sandy loam with a pH of 5.82. The chemical analysis of the soil indicated that it contained 80 kg/ha available nitrogen 51 kg/ha available phosphorus, 517 kg/ha, exchangeable potassium and 1.34 % organic carbon. Stem cuttings of Bermuda turf were planted in the experimental plots with basal application of 200 g/m^{2}vermicompost. Phosphorus was applied in a single dose along with 25 % each of N and Kafter three months of planting. Rest N and K were applied in three equal splits @ 25 % at three months interval. Observations were recorded on various growth and quality parameters. The result of the study revealed that significant differences existed among various treatments with respect to most of the parameters which recorded lowest values under untreated control *viz.*, N_0, P_0 and K_0 and increased with increasing doses of fertilizer and the maximum values were recorded with the highest dose of fertilizer treatment viz., 30-15-5 g of NPK/m^2. Parameters like dry weight of clipping, number of leaves per clipping lot, leaf area of individual leaf blade, total leaf area per clipping lot and verdure dry weight showed significant improvement under the highest dose of fertilizer viz., 30-15-5 g NPK/m^2 over control *viz.*, N_0, P_0 and K_0 during all the observations and other lower doses of fertilizer during most of the observations recorded at different times. Although leaf nitrogen content of verdure was higher under fertilizer treatments over control, no significant variation was noticed among various treatments. Based on the result it was concluded that a dose of 30-15-5 of NPK/m^2 was the most suitable dose for establishment and maintenance of a quality lawn developed from Bermuda lawn grass, cv.Selection-1.

Introduction

Turf grasses are the low growing monocot plants that form a sort of contiguous ground cover maintained at a particular height by regular mowing. Many out door sports and recreational activities utilize turf including baseball, cricket, foot ball, golf, lawn tennis and polo. Turf provides a cushioning effect that reduces injury to the participants. A turf provides beauty and attractiveness of its own. The clean, cool, natural greenness of lawn turfs enhance the beauty of a landscape which provide a pleasant environment to live and work with. Management of turf grasses refers to a wide range of activities such as cultural practices for establishment and maintenance of turfat a desired level. However, information available on various management practices of lawn/turf in general and nutritional management in particular is meagre under Indian conditions. There are many arbitrary recommendation abut fertilizer application. It has been reported that application of 50-60 g/m^2 of fertilizer mixture consisting of two parts of calcium ammonium nitrate, one part of super phosphate and one part of potassium sulphate during rainy season and again in February –March maintained good growth of lawn grass(Arora,2013). Hence, it was felt necessary to conduct a study on nutritional management of Bermuda lawn grass cv. Selection-1 which is one of the popular warm season turf grasses widely used for establishing lawn in private and public gardens, parks and in various out door sports grounds under Indian condition.

Materials and Methods

The present investigation was undertaken in the form of a field experiment in the Ornamental garden of College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar during 2013-2015. Prior to conducting the experiment the soil of the experimental site was analyzed which was found to be sandy loam in texture with a pH of 5.82. Chemical analysis of the soil revealed that it contained 80 kg/ha available nitrogen, 51 kg/ha available phosphorus, 517 kg/ha exchangeable potassium and 1.34 % organic carbon. Bermuda grass (*Cynodon dactylon*), cv. Selection-1 was used in the present investigation. The experiment was conducted following Randomized Block Design with four replications. Nitrogen at 10, 20 and 30 g/m^2 and phosphorus at 5, 10 and 15 g/m^2 were applied as treatments with a fixed dose of potassium (*viz*., 5 g/m^2) which were compared with an untreated control. In total there were 10 treatment combinations which were T_1 - N_0 P_0 K_0 (control), T_2 - N_{10} P_5 K_5, T_3 – $N_{10}P_{10}K_5$, T_4- N_{10} P_{15} K_5, T_5 – N_{20} P_5 K_5, T_6-N_{20} P_{10} K_5, T_7-N_{20} P_{15} K_5, T_8 – N_{30} P_5 K_5, T_9- N_{30} P_{10} $K_5$and T_{10}- N_{30} P_{15} K_5.

During land preparation, after final ploughing and prior to levelling, vermicompost @ 200 g/m^2 was thoroughly incorporated into the soil. Stem cuttings of cv. Selection-1 of Barmuda lawn grass were planted continuously in shallow grooves drawn at a distance of 10 cm in the prepared plots on 30th October, 2013. Various doses of nitrogen and phosphorus along with fixed dose of potassium in different combinations as per the treatment schedule were applied in four splits. First application was done on 30th January, 2014 with full dose of phosphorus and 25 per cent each of nitrogen and potassium. The rest 75 per cent of nitrogen and potassium were applied in three equal splits @ 25 per cent each during 30th April, 30th July and 30th October, 2014. The fertilizers were applied each time after clipping of grasses in the experimental plots. The nutrients N, P and K were applied in the form of urea (46 % N), single super phosphate (16 % P_2O_5) and muriate of potash (60 % K_2O) respectively. On the other hand control plots *viz*., $N_0P_0K_0$

received only vermicompost without application of any chemical fertilizers. Usual management practices like irrigation, weeding and plant protection measures were taken up at regular intervals. Grasses were mowed at a height of 5.0 cm from the ground level by means of a Falcon rotary lawn mower. The first mowing was done during the last week of January, 2014 after all the plots attained full coverage. Subsequent mowing was done at an interval of three months.

Observations on various growth and quality parameters such as dry weight of clipping, number of leaves per clipping lot, area of individual leaf blade, total leaf area / clipping lot, verdure dry weight and leaf nitrogen content of verdure were recorded four times during the experimental period at trimonthly interval, the first one commencing from April, 2014. For determination of dry weight of clipping, the grasses which were not mowed during previous three months were clipped by means of a grass cutting shear at a height of approximately 5.0 cm above the ground level from a subsample area of 0.1 m^2 in each plot and collected in polythene bags and their weight was taken immediately to determine the fresh weight of clipping. After that the samples were transferred to paper bags and oven dried at 70^o c for a period of 48 hours to determine the dry weight of clipping and expressed in grams. Prior to keeping the fresh clipping in oven for drying, twenty shoots were randomly selected from the fresh clipping and the number of leaves per clipped shoot was determined by counting the total number of leaves present in individual shoot. The mean of twenty readings was calculated to find out the number of leaves per clipped shoot. The total number of shoots per unit area (0.1 m^2) was counted and the total number of leaves per clipping lot was determined by multiplying the total shoot number with average number of leaves per individual clipped shoot.

For determination of leafarea of individual leaf blade, a sub sample of twenty leaves was taken from fresh clipping. .The third leaf from the tip of twenty individual shoots was sampled for this purpose.Average leaf area of individual leaf was recorded by a portable leaf area meter model Systronics-211 and expressed in square centimeter. The data reported was the mean of twenty readings for this character. The total leaf area per clipping lot (ie from 0.1m^2 area)was calculated by multiplying the total number of leaves per clipping lot with individual leaf area.

For estimation of turf verdure weight, the entire quantity of plant materials from 0.1m^2 sub sample area in each plot which constituted the verdure were clipped close to ground surface(i.e plant materials below the clipping height) immediately after mowing the turf . The verdure was collected in polythene bags from the same sub sample area used for collection and determination of clipping fresh and dry weight. Fresh weight of verdure was recorded immediately after collection. Then the samples were transferred to paper bags and dried in oven at 70^0c for 48 hours for determining the dry weight which was expressed in grams. For determination of leaf nitrogen content of verdure, one gram of leaf sample after drying (at 60 ^{0}c) and grinding was taken for analysis as per the procedure suggested by Singh *et al.,* (2005) and expressed in percentage.

Results and Discussion

Dry weight of clipping

Clipping yield is an important parameter for evaluation of turf grass. High yield of clipping indicates higher growth rates of turf grasses. The data (Table-1) revealed that various fertilizer treatments significantly influenced the dry weight of clipping of Bermuda grass during each observation.

During April 2014 significantly lower dry weight of clipping(3.87 g/0.1 m^2) was recorded under control which did not receive any fertilizer treatment and it increased with increase in the dose of fertilizer. The highest dry weight of6.64 g was recorded under T_{10} which received 30-15-5 g NPK/ $m^{2.}$. However, it was atpar with T_9 (30-10-5 g NPK/ m^2) andT_8 (30-5-5 g NPK/m^2) which recorded 6.58 g dry weight of clipping in each case. During October 2014 the same trend was also observed. Significantly lower dry weight (5.40 g) was observed under control which increased with increasing levels of N and P and significantly higher dry weight (10.84 g) was recorded under T_{10}.

Higher fertilizer rates ensured ample supply of nutrients which encouraged vigorous growth resulting in higher dry weight of clipping. Rodriguez *et al*(2001) also observed similar increase in shoot dry weight with increasing fertilizer rates in *Cynodon dactylon*as observed in present investigation. Besides, Soldat*et al.,* (2008), Peas *et al.*, (2011) and Mc Mahon and Hunter(2012) also recorded higher clipping yield in different turf grasses with higher nitrogen rates. It was further observed that dry weight of clipping was higher during October as compared to April .It might be due to favorable environmental condition prevailing between July and October since the turf mowed in July was exposed to rainy season which favored vigorous growth.

Total number of leaves per clipping lot

Total number of leaves per clipping lot is another parameter which is also an important indicator of turf growth. In the present investigation total number of leaves per clipping lot from an unit area of 0.1 m^2 exhibited significant variation due to fertilizer application with various doses of N and P along with fixed dose of K (Table-1). During April 2014 least number of leaves(2506.00) per clipping lot were recorded under untreated control ($N_0P_0K_0$) which increased with increasing levels of fertilizer and the highest number of leaves (3918.03) was recorded under T_{10} receiving the highest dose of nitrogen and phosphorus. However, under T_{10} and T_9 (3718.90), the total leaf number was statistically comparable. During October 2014 significantly minimum number of leaves of 2875.96 was recorded under control. On the other hand maximum number of leaves per clipping lot (5129.74) was recorded under T_{10}. However, it was followed by and at par with T_9 and T_8 which recorded 5076.08 and4969.26 leaves respectively. It was noticed that treatments T_{10}, T_9 and T_8 which recorded higher number of leaves had highest dose of nitrogen i.e. 30 g/m^2. It may be mentioned that higher number of shoots per unit area,higher clipping shoot length with higher number of leaves per clipped shoot as observed under higher fertilizer application rate were the contributing factors for recording higher number of leaves per clipping lot.

Leaf area of individual leaf blade

Significant variation in leaf area was observed due to application of various levels of nitrogen and phosphorus with fixed dose of potassium(Table-2). It was significantly lower under untreated control which increased with increased level of fertilizer and maximum leaf area was recorded under T_{10} receiving the highest dose of fertilizer (30-15-5 g NPK/m^2). It differed significantly from control and other treatments during April 2014 while it was followed by and at par with T_9 receiving 30-10-5 g NPK/m^2 during October 2014. An average leaf area of 0.187 cm^2 and 0.247cm^2 was recorded under control and T_{10} respectively during April 2014. During October 2014 significantly lower leaf areaof 0.165 cm^2 was recorded under control while

average leaf area of0.422cm^2 and 0.414 cm^2 were recorded under T_{10} and T_9 respectively.

In case of bermuda grass the leaf width contributes very little to the individual leaf area. On the other hand leaf length has a significant contribution to the average area of leaf blade. Increased leaf length in bermuda grass due to increased fertilization with nitrogen has been reported by Prine and Burton (1956). Role of nitrogen in improving vegetative parameters has been reported by earlier workers. Nitrogen is used largely in synthesis of protein and is a part of chlorophyll molecule (Tisdale and Nelson, 1966) thus increasing vegetative parameters at higher concentration. Role of phosphorus may be attributed to the fact that it is involved in root growth thus helping in uptake of other nutrients(Marshner, 1986). Since higher doses of N and P improved the leaf length, obviously higher leaf area of individual leaf blade would be expected under higher fertilizer rates as observed in the present study.

Total leaf area per clipping lot

As observed in Table-2, total leaf area per clipping lot was minimum under control and showed an increasing trend with increase in fertilizer dose. The maximum was recorded under T_{10} receiving the highest dose of nitrogen and phosphorus with fixed dose of potassium (ie.30-15-5 g NPK/m^2). However, during April 2014 although the minimum leaf area of 468.26cm^2 was recorded under control($N_0P_0K_0$), it was at par with T_2 (501.20 cm^2) receiving 10-5-5 g NPK/m^2. On the other hand significantly higher leaf area of 940.33 cm^{2}was recorded under T_{10} which was closely followed by T_9 (8 18.17 cm^2)receiving 30-10-5 g NPK/ m^2. During October 2014 the lowest leaf area (632.95 cm^2) was also recorded under control while the highest area of 1806.95 cm^2 was recorded under T_{10}. However, all the treatments including control differed significantly from each other with respect to this parameter.

Higher number of leaves per clipping lot and longer leaves with greater leaf area of individual leaf blade recorded under higher application rate of fertilizer are two important factors contributing towards higher total leaf area per clipping lot due to which the highest total leaf area was recorded under T_{10} receiving the highest dose of N and P fertilizer.

It was also noted that total number of leaves and total leaf area per clipping lot were higher during October as compared to April. Favorable environmental condition prevailing after July mowing resulted in higher number of shoots per unit area, higher clipping length with higher leaf number as well as longer individual leaf blade with higher leaf area of individual leaf blade which might have contributed for the same as observed in the present investigation.

Verdure dry weight

Dry weight of verdure was significantly influenced by various levels of nitrogen and phosphorus fertilizers (Table-3) Verdure is an important parameter related to turf quality. Higher weight of verdure ensures a dense and compact turf which gives more comfort to the visitors. It was observed that dry weight of verdure increased with increased rate of N and P and the maximum was observed under T_{10}(3.71 g and 5.39 g/0.1m^2 during April and October respectively). On the other hand significantly lower dry weight was recorded under control (2.67 g and3.08 g/0.1m^2) during the same observation period.

Table.1 Combined effect of nitrogen and phosphorus on dry weight of clipping and number of leaves per clipping lot of Bermuda lawn grass cv. Selection-I during April and October, 2014

Treatment (NPK g/m^2)	Dry weight of clipping(g/0.1m^2)		Number of leaves/clipping lot (No/0.1m^2)	
	April	October	April	October
$T_1(N_0P_0K_0)$ (Control)	3.87	5.40	2506.00	2875.96
$T_2(N_{10}P_5K_5)$	4.86	6.90	2601.47	3828.48
$T_3(N_{10}P_{10}K_5)$	4.91	7.23	2737.50	3838.81
$T_4(N_{10}P_{15}K_5)$	5.25	8.70	2750.80	3951.42
$T_5(N_{20}P_5K_5)$	5.69	9.05	3148.63	4365.66
$T_6(N_{20}P_{10}K_5)$	5.80	9.17	3305.10	4414.90
$T_7(N_{20}P_{15}K_5)$	6.39	9.59	3413.35	4588.10
$T_8(N_{30}P_5K_5)$	6.58	9.67	3497.33	4969.26
$T_9(N_{30}P_{10}K_5)$	6.58	10.57	3718.90	5076.08
$T_{10}(N_{30}P_{15}K_5)$	6.64	10.84	3918.03	5129.74
SEm (±)	0.05	0.04	79.76	72.22
CD at 5%	0.15	0.10	231.40	209.53

Table.2 Combined effect of nitrogen and phosphorus on area of individual leaf blade and total leaf area per clipping lot of Bermuda lawn grass cv. Selection-I during April and October, 2014

Treatment (NPK g/m^2)	Area of individual leaf blade (cm^2)		Total leaf area per clipping lot (0.1m^2)	
	April	October	April	October
$T_1(N_0P_0K_0)$ (Control)	0.187	0.165	468.26	632.95
$T_2(N_{10}P_5K_5)$	0.207	0.191	501.20	974.65
$T_3(N_{10}P_{10}K_5)$	0.210	0.247	605.18	1148.55
$T_4(N_{10}P_{15}K_5)$	0.211	0.255	629.63	1169.91
$T_5(N_{20}P_5K_5)$	0.213	0.291	661.21	1192.63
$T_6(N_{20}P_{10}K_5)$	0.220	0.300	694.07	1244.49
$T_7(N_{20}P_{15}K_5)$	0.221	0.316	734.44	1252.90
$T_8(N_{30}P_5K_5)$	0.225	0.378	750.94	1472.06
$T_9(N_{30}P_{10}K_5)$	0.231	0.414	818.17	1655.57
$T_{10}(N_{30}P_{15}K_5)$	0.247	0.422	940.33	1806.23
SEm (±)	0.001	0.007	17.21	28.19
CD at 5%	0.003	0.019	49.93	81.80

Table.3 Combined effect of nitrogen and phosphorus on verdure dry weight and leaf nitrogen content of verdure of Bermuda lawn grass cv. Selection-I during April and October, 2014

Treatment (NPK g/m^2)	Verdure dry weight (g/0.1m^2)		Leaf nitrogen content of verdure (%)	
	April	October	April	October
$T_1(N_0P_0K_0)$ (Control)	2.67	3.08	0.27	0.28
$T_2(N_{10}P_5K_5)$	2.83	3.19	0.31	0.28
$T_3(N_{10}P_{10}K_5)$	2.99	3.46	0.37	0.29
$T_4(N_{10}P_{15}K_5)$	3.80	3.63	0.38	0.31
$T_5(N_{20}P_5K_5)$	3.07	3.95	0.38	0.31
$T_6(N_{20}P_{10}K_5)$	3.19	4.35	0.39	0.34
$T_7(N_{20}P_{15}K_5)$	3.26	4.40	0.41	0.40
$T_8(N_{30}P_5K_5)$	3.39	5.03	0.45	0.40
$T_9(N_{30}P_{10}K_5)$	3.54	5.18	0.48	0.44
$T_{10}(N_{30}P_{15}K_5)$	3.71	5.39	0.49	0.44
SEm (±)	0.03	0.02	0.14	0.10
CD at 5%	0.10	0.05	NS	NS

Similar findings have also been reported by Alderman *et al.,* (2011) who found that increased N fertilization increased stem mass(verdure) in 'Tifton 85' Bermuda grass as compared to control and lower rates. Increase in dry weight of verdure due to application of higher doses of N and P may be attributed to the fact that nitrogen is needed in the greatest amount which affects turf grass growth. Adequate nitrogen is necessary to maintain high shoot density which contributes towards the verdure which constitutes the verdure, while phosphorus is extremely important for rooting, cell division and synthesis of compounds used by plants for better growth(Beard, 1973). In the present study higher dry weight of verdure was recorded during October as compared to April, because the turf produced vigorous growth after mowing in July as it got the most favorable environment of rainy season ,between July and October which accelerated the growth and vigor of the turf.

Leaf nitrogen content of verdure

It was observed that leaf nitrogen content of verdure on percentage basis showed marginal increase due to application of various levels of fertilizer treatments (Table-3). It was the lowest under control ($N_0P_0K_0$) which increased with application rate of fertilizer and the highest nitrogen content was recorded under T_{10} receiving the highest dose of fertilizer ie, 30-15-5 g of NPK/m^2 during all the observations. Leaf nitrogen content of verdure under control was 0.27 and 0.28 per cent during April and October 2014 respectively where as it was 0.49 and 0.44 per cent under T_{10} respectively during the same observation period.

How ever, no significant increase in leaf nitrogen content of verdure was noticed due to various fertilizer treatments over control. On the contrary Machahary and Paswan (2003) observed increased in percentage nitrogen content of shoot tissue of doob and bahia grass due to increase in nitrogen application rate from zero to 40 g /m^2. In the present study the highest dose of nitrogen applied was 30 g/m^2 which might not be adequate for significant increase in nitrogen

level in verdure.

Based on the study it was concluded that Bermuda lawn grass cv. Selection-1 responded well to various doses of nitrogen and phosphorus along with 5 g potassium per square meter which exhibited better performance in terms of growth and quality parameters. Various parameters were appreciably improved with increased dose ofnitrogen and phosphorus and the most satisfactory performance was observed with the highest dose of nitrogen and phosphorus ie.30 g N and 15 g P with 5.0g K per square meter.

References

Alderman PD, Boote KJ and Sollenberger LE. 2011. Regrowth dynamics of 'Tifto 85' Bermuda grass as affected by nitrogen fertilization. *Crop Science.* 51: 1716-1726.

Arora JS.2013. IntroductoryOrnamental Horticulture. Kalyani Publisher, pp 236-239

Beard J B.1973. Turf grass science and culture. Prentice Hall,Inc

Machahary RK and Paswan L.2003.Effect of nitrogen on growth performance of two lawn grass species.Proceedings of theAbstract: *National Symposium on Recent Advances in Indian Floriculture.pp-15*

Marshner H. 1986. Mineral nutrition of higher plants. Academic Press Inc. London, U.K.

Mc Mahon G and Hunter A. 2012. Turf quality and growth suppression of Agrotis stolonifera 'Penn A4' with plant growth regulators and various fertilizer rates. *Acta Horticulturae*,938:129-136.

Peas BW, KoeritzEJ,Soldat DJ and Stier JC. 2011. Nitrogen source and rate effects on velvet bent grass putting green turf. *Crop Science*, 51:342-352

Premazzi LM, Monterio FA and Corrente JE. 2003. Tillering of 'Tifton 85' Bermuda grass in response to nitrogen rates and time of application after cutting. *Sci. Agric*.,60:565-571.

Prine GM and Burton GW. 1956. The effect of nitrogen rate and clipping frequency upon their yield, protein content and certain morphological characteristics of coastal Bermuda grass.*Agron. J*.,48:296-301.

Rodriguez-Fuentes H, Acuna-Askar K, Vidales-Contreras JA, Rodriguez-Absi J, Jimenez-Gracia G, Lopez-Jimenez MA and Rodriguez-Ortiz JC. 2009.Mineral nutrition requirements for Bermuda grass grown on a professional soccer field. *Acta Horticulturae*, 843:129-135.

Singh D, Chhonkar PK and Dwivedi BS. 2005. Manual on soil, plant and water analysis. New Delhi: Westville publishing house. pp-199.

Soldat DJ, Petrovic AM and Barlow J. 2008. Turf grass response to nitrogen sources with varying nitrogen release rate. *Acta Horticulturae*, 783: 453-462.

Tisdale S and NelsonW.1966.Soil fertility and fertilizers. Third edition, *Collier Mac Millan International Editions, Mac Millan Publishing Company Inc.* New York (USA)

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