Influence of nitrogen and phosphorus levels on growth and quality of Bermuda lawn grass (*Cynodon dactylon*) cv. Selection-1

Kanda Jena And C. R. Mohanty

[*] Department of Floriculture and Landscaping, College of Agriculture, Odisha
[**] University of Agriculture and Technology, Bhubaneswar-751003, Odisha

DOI: 10.29322/IJSRP.9.12.2019.p9651
http://dx.doi.org/10.29322/IJSRP.9.12.2019.p9651

Abstract- A field trial was conducted during the period from October, 2013 to January, 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_0P_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 %) 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 20 g/m^2 vermicompost. Phosphorus was applied in a single dose along with 25 % each of N and K after 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 fresh weight of clipping, number of leaves per clipped shoot, verdure fresh weight and growth rate of shoots showed significant improvement under the highest dose of fertilizer viz., 30-15-5 g NPK/m^2 as compared to control viz., $N_0P_0K_0$ during all the observations and other lower dose of fertilizers during most of the observations recorded at different times. Although uniformity of lawn showed marginal improvement due to application of fertilizer over control as assessed by visual scoring, no significant difference was noticed among various treatments during any of the observations. So far as turf colour was concerned the best colour with maximum visual rating was noticed under the highest levels of N and P, yet it was at par with lower doses like 30-10-5, 30-5-5, 20-15-5 and 20-10-5 g NPK/m^2. Based on the result, it was concluded that a dose of 30-15-5 g 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.

Index Terms- Bermuda lawn grass, clipping, verdure, growth rate, uniformity, colour.

I. INTRODUCTION

Turfs provide beauty and attractiveness to the environment and are important in human activities from the functional, recreational and ornamental stand point (Beard, 1973). Ornamental turfs (lawn) serve a decorative function. Their uniform green appearance enhance the beauty of a landscape. To the landscape designers the lawn is considered as the green canvas on which the entire garden picture is built. Although lawn is vital part of a modern landscape garden, information available on various aspects of its management is very meagre under Indian condition and as such very little information is available on its nutritional management for development and maintenance of a quality lawn. *Cynodan dactylon* popularly known as Bermuda grass is one of the most widely used warm season turn grasses all over the world in lawns, parks, playground, aesthetic fields and golf courses, where dense turf is desired (Leto *et al*., 2008). Hence, it was considered worth while to conduct a study on nutritional management of Bermuda turf grass cv. Selection 1 which is an important variety used in private and public gardens as well as in various landscape projects for making lawns under Indian condition.

II. 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 indicated 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 treatments 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 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 groves 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 fresh weight of clipping, number of leaves per clipped shoot, fresh weight of verdure, uniformity and colour were recorded four times during the experimental period at trimonthly interval the first one commencing from January, 2014. Growth rate of shoot was estimated thrice i.e., between April - July, July - October, 2014 and October 2014-January, 2015.

For determination of fresh weight of clipping per unit area, 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 sub sample 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 and expressed in grams. For determination of number of leaves per clipped shoot, 20 shoots were randomly selected from fresh clipping and the total leaf number presented in individual shoot was counted and the mean of 20 readings was calculated and used for analysis. For estimation of fresh weight of verdure the entire quantity of plant materials from 0.1 m^2 subsample area in each plot were clipped close to the ground surface (mass of grass remaining below the clipping height) immediately after mowing the turf. The verdure was calculated from the same subsample area used for collection and determination of clipping fresh weight and its weight was recorded immediately after collection and expressed in grams. Growth rate of shoot was estimated by measuring the shoot length increment between the two consecutive cuts and was expressed in percentage. Uniformity, an estimate of even appearance of turf (an area free from patches, blemishes and irregular growth habit) and turf colour were evaluated each time after 24 hours of mowing visually by five persons based on 1 to 5 scale (poorest to best). The value of assessment was presented by the mean value of five observations.

III. RESULTS AND DISCUSSION

Fresh weight of clipping

Fresh weight of clipping is one of the important parameters related to better growth of turf. Significant difference was noticed in fresh weight of clipping due to application of various levels of nitrogen and phosphorus with a fixed dose of potassium (Table 1). It was significantly lower under untreated control ($N_0P_0K_0$) which increased with increasing dose of fertilizers and the maximum weight was observed with application of highest dose of fertilizers viz., 30-15-5 g NPK/m^2 (T_{10}) which differed significantly from control as well as other doses of fertilizer. During April and October the minimum clipping fresh weight of 8.96g and 11.93 g per 0.1 m^2 area were recorded under control respectively while the maximum fresh weight of 20.34 g and 24.50 g per 0.1 m^2 were recorded under T_{10} i.e., 30-15-5 g NPK/m^2 during the corresponding observation period. Higher fertilizer rates ensured ample supply of nutrients which encouraged vigorous growth resulting in higher fresh weight of clipping. The result of the present study is in conformity with earlier workers like Soldat *et al*. (2008), Pease et al. (2011) and Mc Mahon and Hunter (2012) who also recorded higher clipping yield in different turf grasses with higher nitrogen rates. On the other hand phosphorus is a constituent of many energy rich compounds in plants and also involved in active root growth and helps in uptake of other nutrients (Marshner, 1986).

IV. NUMBER OF LEAVES PER CLIPPED SHOOT

Various levels of nitrogen and phosphorus had significant influence on number of leaves per clipped shoot of Bermuda grass during different times (Table 1). The leaf number was minimum under control which showed an increasing trend with increase in N and P rates and maximum number was recorded under T_{10} receiving the highest dose (30-15-5 g NPK/m^2) of fertilizer. However, during April average leaf number under T_{10} and T_9 (30-15-5 g NPK/m^2) were statistically comparable with each other which recorded 9.96 and 9.83 leaves per clipped shoot respectively. Similarly during October T_{10}, T_9 and T_8 (30-5-5 g NPK/m^2) did not show any significant variation in leaf number which had 14.54, 13.81 and 13.61 leaves per clipped shoot respectively. On the other hand the untreated control ($N_0P_0K_0$/m^2) recorded 8.04 and 11.59 leaves per clipped shoot during April and October respectively. It was observed that nitrogen at its highest rate i.e., 30 g/m^2 was the most effective dose along with 15, 10 or 5 g phosphorus which could improve the leaf number.

It has been reported that higher doses of nitrogen increased shoot growth (Trenholm *et al*., 2001, Beard,1973). Further Prine and Burton(1956) reported that increasing N fertilization increased stem length and internode number. These may be the contributing factors for increasing leaf number per clipped shoot as observed in the present investigation.

V. Fresh weight of verdure

Fresh weight of verdure was also significantly influenced by various levels of N and P along with fixed dose of K.(Table 2) 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 fresh weight of verdure was significantly lower under control which increased with increasing rates of N and P fertilization and maximum fresh weight was recorded under T_{10} (30-15-5 g NPK/m^2). However, during April and October it was closely followed by and at par with T_9 (30-10-5 g NPK/m^2). During April a verdure fresh weight of 6.42 g per 0.1 m^2 was recorded under control while it was 8.42 g and 8.37 g per 0.1 m^2 under T_{10} and T_9 respectively. During October the verdure fresh weight under control was 7.06 g per 0.1 m^2 whereas the same under T_{10} and T_9 were 10.25 g and 10.19 g per 0.1 m^2 respectively.

The finding of the present study with respect to nitrogen is in accordance with observations of Trenholm *et al*. (2001) who also reported higher weight of verdure in two ecotypes of Seashore Paspalam with increased rate of N from 192 kg to 392 kg/ha. Alderman et al. (2011) also reported that N fertilization increased stem mass in Tifton 85 Bermuda grass as compared to control and lower rates. Increase in fresh weight of verdure due to application of higher doses of N and P may be attributed to the fact that adequate nitrogen is necessary to maintain high shoot density which contributes towards verdure while phosphorus is extremely important for rooting, cell division and synthesis of compounds used by plants for better growth (Beard, 1973).

VI. Growth rate of shoots

Growth rate of shoots which was calculated on the basis of percentage increase in shoot length between two consecutive cuts was significantly influenced by various levels of N and P fertilization(Table 2). It was significantly lower under control (i.e., $N_0P_0K_0$) which increased with increasing dose of fertilizer and the maximum growth rate was observed under T_{10} receiving the highest dose of fertilizer treatment (30-15-5 g NPK/m^2). Growth rate of shoots between April and July under control was 94.00 per cent while it was 201 per cent under T_{10} during the same observation period. During the period between October and January the growth rate under control was 219.00 per cent. On the other hand it was 289.00 per cent under T_{10} closely followed by and at par with T_9 (30-5-5 g NPK/m^2) which recorded growth rate of 288.00 and 286.00 per cent respectively. It was observed that T_{10}, T_9 and T_8 which received highest dose of nitrogen i.e., 30 g/m^2 exhibited better performance as compared to lower nitrogen rates. Similar findings have also been reported by Alderman et al. (2011) who concluded that increasing N fertilization increased growth rate of Tifton 85 Bermuda grass. Positive influence of nitrogen on growth rate of Bermuda grass shoot may be attributed to the fact that nitrogen is a component of nucleic acid, amino acid, protein, chlorophyll and coenzymes affecting rate of shoot development while phosphorus improved root growth ultimately affecting the shoot growth since shoot growth is dependent on root growth (Beard, 1973).

VII. Uniformity

Uniformity of turf indicated by free from uneven growth, blemishes and maintenance of dense uniform grass was usually assessed by scoring technique in 1 (poorest) to 5 (best) point scale as influenced by various levels of fertilizer treatments.

As indicated in Table 3 uniformity with lowest scoring was produced under control which showed a marginal improvement with increasing dose of fertilizer treatment and the most uniform turf was produced under T_{10} which received the highest dose of fertilizer i.e. 30-15-5 g NPK/m^2. The uniformity in control plots had least visual scoring of 3.81 and 4.13 during April and October respectively while the uniformity under T_{10} which was observed to be most satisfactory had visual scoring of 4.50 and 4.81 respectively during the same observation period. However, application of fertilizer could not bring any significant improvement in uniformity as evident from the result of the present investigation.

It appeared that uniformity of the turf is mostly influenced by the growth pattern of specific grass species/variety which is an inherent character of that particular grass species/variety and is less affected by fertilizer application as observed in the present study on Bermuda grass cv. Selection-1. However, higher uniformity with increased visual quality of Seashore Paspalum turf grass was observed by Treholm *et al*. (2001) due to application of higher nitrogen rates.

VIII. Colour

Lawn/turf with attractive green colour is always preferred in any garden, park or play ground which counts much towards its aesthetic value. The data in Table 3 revealed that significant difference existed among various levels of fertilizer treatment with respect to assessment of colour of Bermuda lawn grass. It was observed that minimum scoring for colour was obtained by the turf under control and the rating was increased with increasing rates of fertilizer application. During April most inferior colour was noticed under control with a scoring of 4.14 and it was at par with T_2 (10-5-5 g NPK/m^2) and T_3 (10-10-5 g NPK/m^2) with visual scoring of 4.33 and 4.45 respectively. On the other hand the best colour was noticed under T_{10} (30-15-5 g NPK/m^2) which had a visual scoring of 4.95. Besides other treatments like T_9 (30-10-5 g NPK/m^2), T_8 (30-5-5 g NPK/m^2) and T_7 (20-15-5 g NPK/m^2) also had better performance with respect to colour with similar scoring of 4.95. Further turf colour under T_6 (20-10-5 g NPK/m^2) was also statistically comparable with these treatments which had a visual scoring of 4.83.

During October, turf with most inferior colour was also noticed under control with a scoring of 3.63. However, it was at par with T_2, T_3 and T_4 which had visual scoring of 4.00, 4.00 and 4.06 respectively. On the other hand best colour with a visual scoring of 4.63 was noticed under T_{10}. However, it was followed by and at par with T_9, T_8, T_7, T_6 and T_5 which had visual scoring of 4.38, 4.38, 4.19, 4.19 and 4.13, respectively.

It is a well known fact that nitrogen is a component of chlorophyll. It promotes rapid growth, encourages a dense lawn and produces a dark green turf (Beard, 1973). In the present study

only higher rates of nitrogen i.e., 30 or 20 g/m^2 irrespective of phosphorus doses could improve the colour of Bermuda turf. The visual scoring for colour under untreated control and treatments receiving lower nitrogen rate i.e., 10 g/m^2 were more or less similar and less attractive without showing significant variation. The result of the present study is in conformity with the findings of Trenholm *et al.* (2001) who also observed that higher nitrogen rate (392 kg/ha) increased the visual quality and colour of Seashore Paspalam turf grass as compared to lower nitrogen rate of 196 kg per hectare.

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 a dose of 5 g potassium per sq. metre which exhibited better performance in terms of growth and quality parameters. Various parameters were appreciably improved with increased dose of nitrogen and phosphorus and the best performance was observed with the highest dose of nitrogen and phosphorus i.e., 30 g N and 15 g P with 5.0 g K per sq. metre.

REFERENCES

[1] 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.

[2] Beard JB. 1973. Turf grass science and culture. Prentice Hall, Inc.

[3] Leto C, Sarno M, Tuttolomondo T, Bella SI and Licata M. 2008. Two year studies into native Bermuda grass (Cynodon spp.) germplasm from Sicily (Italy) for the constitution of turf cultivars. Acta Horticulturae, 7100: 39-48.

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

[5] McMahon G and Hunter A. 2012. Turf quality and growth suppression of Agrostis stolonifera 'Penn A4' with plant growth regulators and various fertilizer rates. Acta Hortculturae, 938: 129-136.

[6] Pease BW, Koeritz EJ, Soldat DJ and Stier JC. 2011. Nitrogen source and rate effects on velvet bent grass putting green turf. Crop Science. 51:342-352.

[7] 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.

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

[9] Trenholm LE, Carrow RN and Duncan RR. 2001.Wear tolerance, growth and quality of Seashore Paspalum in response to nitrogen and potassium. Hort. Science, 36(4):780-783.

AUTHORS

First Author – Kanda Jena, Department of Floriculture and Landscaping, College of Agriculture, Odisha
Second Author – C. R. Mohanty, University of Agriculture and Technology, Bhubaneswar-751003, Odisha,
e-mail: chitta.mohanty55@gmail.com

Table 1 Interaction effect of nitrogen and phosphorus on fresh weight of clipping and number of leaves per clipped shoot of Bermuda lawn grass cv. Selection-I during April and October, 2014

Treatment (NPK g/m^2)	Fresh weight of clipping (g/0.1 m^2)		Number of leaves per clipped shoot	
	April	October	April	October
T_1 ($N_0P_0K_0$) (Control)	8.96	11.93	8.04	11.59
T_2 ($N_{10}P_5K_5$)	11.02	15.60	8.30	11.88
T_3 ($N_{10}P_{10}K_5$)	13.64	16.38	8.61	12.13
T_4 ($N_{10}P_{15}K_5$)	14.40	20.33	8.65	12.79
T_5 ($N_{20}P_5K_5$)	15.49	20.40	9.20	12.89
T_6 ($N_{20}P_{10}K_5$)	16.96	20.73	9.30	13.09
T_7 ($N_{20}P_{15}K_5$)	17.23	23.69	9.35	13.21
T_8 ($N_{30}P_5K_5$)	17.80	23.93	9.49	13.61
T_9 ($N_{30}P_{10}K_5$)	17.85	24.20	9.83	13.81
T_{10} ($N_{30}P_{15}K_5$)	20.34	24.50	9.96	14.54
SEm (±)	0.03	0.06	0.08	0.40
CD at 5%	0.07	0.17	0.23	1.16

Table 2 Interaction effect of nitrogen and phosphorus on fresh weight of verdure and growth rate of shoots of Bermuda lawn grass cv. Selection-I

Treatment (NPK g/m^2)	Fresh weight of verdure (g/0.1 m^2)		Growth rate of shoots (%)	
	April 2014	October 2014	April-July, 2014	October 2014 - January, 2015
T_1 ($N_0P_0K_0$) (Control)	6.42	7.06	94.00	219.00
T_2 ($N_{10}P_5K_5$)	7.10	7.34	105.00	228.00
T_3 ($N_{10}P_{10}K_5$)	7.10	7.86	114.00	228.00
T_4 ($N_{10}P_{15}K_5$)	7.64	8.71	118.00	260.00
T_5 ($N_{20}P_5K_5$)	7.69	8.74	122.00	267.00
T_6 ($N_{20}P_{10}K_5$)	7.90	8.85	130.50	277.00
T_7 ($N_{20}P_{15}K_5$)	7.95	9.06	133.00	285.00
T_8 ($N_{30}P_5K_5$)	7.99	9.47	142.00	286.00
T_9 ($N_{30}P_{10}K_5$)	8.37	10.19	151.00	288.00
T_{10} ($N_{30}P_{15}K_5$)	8.42	10.25	201.00	289.00
SEm (±)	0.03	0.02	1.27	1.19
CD at 5%	0.08	0.07	3.71	3.44

Table 3 Interaction effect of nitrogen and phosphorus on visual scoring in 1(poorest) -5(best) point scale for uniformity and colour of Bermuda lawn grass cv. Selection-I during April and October, 2014

Treatment (NPK g/m^2)	Uniformity		Colour	
	April	October	April	October
T_1 ($N_0P_0K_0$) (Control)	3.81	4.13	4.14	3.63
T_2 ($N_{10}P_5K_5$)	4.00	4.19	4.33	4.00
T_3 ($N_{10}P_{10}K_5$)	4.06	4.25	4.45	4.00
T_4 ($N_{10}P_{15}K_5$)	4.13	4.25	4.51	4.06
T_5 ($N_{20}P_5K_5$)	4.13	4.31	4.60	4.13
T_6 ($N_{20}P_{10}K_5$)	4.19	4.31	4.83	4.19
T_7 ($N_{20}P_{15}K_5$)	4.25	4.38	4.95	4.19
T_8 ($N_{30}P_5K_5$)	4.38	4.38	4.95	4.38
T_9 ($N_{30}P_{10}K_5$)	4.50	4.44	4.95	4.38
T_{10} ($N_{30}P_{15}K_5$)	4.50	4.81	4.95	4.63
SEm (±)	0.197	0.192	0.106	0.179
CD at 5%	NS	NS	0.31	0.52