Annals of Plant and Soil Research 25 (2): 230-234 (2023)
https://doi.org/10.47815/apsr.2023.10261

Effect of different nitrogen levels on the productivity of perennial grasses under hilly terrace conditions of Nagaland

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Received, February, 2023; Revised accepted, April, 2023

ABSTRACT

A field study was carried out to evaluate the yield potential of different nitrogen levels on the productivity of perennial grasses under the hilly terrace condition of Nagaland at SASRD, Medziphema, Nagaland University, during the rabi season of 2018-2019. The perennial grasses under study were Congo signal, Setaria, and hybrid Napier with five different levels of nitrogen i.e., 0 kg N/ha, 60 kg N/ha, 80 kg N/ha, 100 kg N/ha, and 120 kg N/ha, which were laid out in Randomized Block Design (RBD) with three replications. Among the perennial grasses hybrid Napier recorded the highest plant height (183 .11 cm) and the lowest in Congo signal (121.82 cm). However, Seteria recorded the highest tillers/tussock (24.33) and leaf: stem ratio (1.33). The application of nitrogen a had significant effect on the performance of all grasses. The highest plant height was observed under the r application of 100 kg N/ha. The green forage yield and dry matter yield were higher in all the grasses which received 100 kg N/ha. However, a further increase in the application of 120 kg N/ha tends to decrease the yield of all grasses. Under the interaction of grasses and nitrogen Setaria with the application of 100 kg N/ha recorded the highest green forage yield (881.83 q/ha) and dry matter yield (110.23 q/ha). The crude protein (%) and N-content (%) increased with increasing N levels and significantly highest values were recorded at the application of 120 kg N/ha respectively.

Keywords: Perennial grass, growth, yield, and quality parameters

INTRODUCTION

The nutritious green forage stands not only at the forefront of the economical production of animal products but also for the availability of drought power in the era of the energy crisis. The ruminant sector provides a significant proportion of self-employment opportunities and supplements the income of most the sector of the Indians Agrarian society. Agriculture is the prime source of livelihood for the majority (85%) of the rural population in the Northeast region. It is characterized by subsistence, low input-low output, a technologically lagged mixed farming system, and is dominated by smallholders. Although cereals dominate the cropping pattern in this region, livestock is an important component of a mixed farming system and dependence on livestock as an alternative source of income is significant. Further, because of social and religious acceptance, the consumption of meat is relatively higher in this region, and that of milk and milk products is lower (Kumer *et al.,* 2007). Nagaland has a cattle population of 45107, buffaloes 33757 and Mithun 404652. The low productivity and poor efficiency of livestock in Nagaland is due to the feeding of natural grasses, rice straw which are not only less nutritious but also becoming scare with increases in livestock population year after year. Growing of perennial fodder crops is a of greater importance as they provide good quality forage with high production potentiality for assured supply of year-round green and nutritious forage contribution of high yielding perennial forage crops are significant. Fertilizer management is an integral part of any agricultural production system and it pay back more profit per unit investment. Judicious use of fertilizer is an important management practices to increase single cut sorghum forage production (Nirma *et al.,* 2016). Nitrogen plays a significant role in crop production (Bélanger and Gastal, 2000) and it is the most important plant nutrient required for forage crop production and is required in large quantities (Balasubramanian *et al.,* 2010). Nitrogen is significant for plant life processes, it is one of the main nutrients for grasses, it is important for yield and yield quality (Adamovics, 2015). Nitrogen management practices may therefore influence the growth and forage qualities of the grasses. Keeping in view of these facts the experiment was conducted with to assess the growth and yield of different perennial grasses for use as fodder in the hilly terraces of Nagaland.

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MATERIALS AND METHODS

A field experiment was carried out during the *rabi* season of 2018 and 2019 in the experimental farm of the School of Agricultural Sciences and Rural Development (SASRD) Nagaland University, Medziphema. The farm is situated at the foothill of Nagaland at an altitude of 310 meters above the mean sea level with a geographical location of 25° 45' 43" North latitude and 95° 53' 04" East longitude. The climate of Medziphema is a sub-humid tropical climate with high relative humidity and moderate temperature with medium to high rainfall. The average mean temperature during summer varies from 21 °C to 32 °C while during winter, it varies from 8 °C to 20 °C. The average rainfall varies from 1800-2500 mm, starting from April and ending with the month of November, while the period from December to March remains comparatively dry. The experimental plot's soil was acidic, well-drained, and sandy loam in texture. The treatments consisted of 15 combinations of three different perennial grasses i.e., Congo signal (*Brachiaria ruzizienis*), Setaria (*Setaria* sp) and hybrid Napier (*Pennisetum purpureum* X *Pennisitum typhoides*) with five nitrogen levels. These were tested in randomized block design and replicated thrice. The net plot size of 5 m x 4 m and spacing of 50 cm x 50 cm were adopted for all the crops. A commonly recommended dose of phosphorus and potassium was applied to the crops at the time of sowing. The remaining agronomic practices were followed as per the recommendation for the region. Observation recorded for all the perennial grasses is growth parameters (plant height, numbers of tillers, and leaf: stem ratio), green fodder yield (q/ha), and dry matter yield (q/ha) parameters. The experimental data recorded during the investigation were tabulated and analyzed using appropriate standard statistical methods.

RESULTS AND DISCUSSION

Hybrid Napier recorded the highest plant height (183.11 cm), and the lowest was observed in Congo signal (121.82 cm), while Setaria recorded the highest tillers/tussock (24.33) and leaf: stem ratio (1.33). The plant height under different doses of nitrogen was found to be increased with increased doses from 0 kg N/ha to 120 kg N/ha, but a decrease in tillers/tussock with increased nitrogen doses was observed, while the leaf: stem ratio was found to be non-significant. The stimulating effects of N fertilizer on vegetative growth may be attributed to the increased availability of soil N which might have beneficial effects on cell division, cell elongation, and meristematic activity. The effect of N doses in plant height in the present study agreed with the previous finding (Hamada *et al.,* 2008). These results are in conformance with those of Zhao *et al.* (2005); Almodrates *et al.* (2008); Olanite *et al.* (2010); Verma *et al.* (2012); Raki *et al.* (2013).

The fodder yield and crude protein yield increased with increasing levels of nitrogen. The highest green forage yield (GFY) and dry matter yield (DMY) were recorded in the Setaria with 699.37 q/ha and 87.42 q/ha while the lowest yield was recorded in the hybrid Napier (265.51 q/ha and 33.82 q/ha). The higher yield in green forage may be due to higher production of tillers/tussock with a higher leaf: stem ratio.

Significant differences in green forage yield were recorded due to different doses of nitrogen on different perennial grasses. During the first and second cuts, a significant increase in yield was observed with an increase in levels of 100 kg N/ha and then it tend to decrease in yield with a further increase in nitrogen level. Application of nitrogen @ 100 kg/ha recorded the highest green forage yield (612.03 q/ha) and dry matter yield (76.42 q/ha) while the treatment control (0 kg N/ha) recorded the lowest yield. The effect of nitrogen doses on different grasses was found to be significant. However, during the first cut, no significant differences in yield were served due to the interaction of grasses and nitrogen doses. The low yield in the first cut was due to the initial establishment of the crops and low tillers per tussock, which tends to increase with due course of growth. The highest green forage yield (881.83 q/ha) and dry matter yield (110.23 q/ha) were recorded from Setaria, which received 100 kg N/ha while hybrid Napier, which received 0 kg N/ha recorded the lowest yield (140.23 q/ha) among all the treatments. The improvement in the fodder yield could be attributed to improved growth parameters, *viz*., plant height and tillers. Similarly, Zhao *et al.* (2005) reported that applying N fertilizer significantly increased the yield of forage sorghum. These results closely conformed with the findings of Hugar, (2010); Saini, 2012. The increase in DM% due to N application may be due to the fact that N increases leaf area development, maintenance, and photosynthates efficiency (Zahiud *et al.,* 2002).

Table 1: Effect of different nitrogen doses on the growth of perennial grasses

Treatments	Plant height (cm)	Tillers	Leaf : Stem Ratio
Grasses (G)			
G1-Congosignal	121.82	20.40	1.44
G2-Setaria	128.55	24.33	1.33
G3-Hybrid Napier	183.11	11.26	0.75
SEm±	3.331	1.490	0.432
C.D (P=0.05)	11.156	4.992	0.443
Nitrogen (N)			
N0-Control	128.03	21.22	0.90
N1-60kg N/ha	131.96	24.33	1.03
N2-80kg N/ha	146.77	16.55	1.15
N3-100kg N/ha	167.70	15.66	0.97
N4-120kg N/ha	148.00	15.55	1.31
SEm±	4.300	1.924	0.171
C.D (P=0.05)	14.403	6.445	NS
	GXN		
G1N0	114.89	25.67	0.88
G1N1	112.22	21.67	0.93
G1N2	118.45	21.67	1.16
G1N3	125.45	15.00	1.12
G1N4	138.11	`18.00	1.61
G2N0	115.44	27.00	1.08
G2N1	117.56	38.00	1.21
G2N2	138.33	19.67	1.56
G2N3	137.00	19.67	1.23
G2N4	134.44	17.33	1.58
G3N0	153.78	11.00	0.75
G3N1	166.11	13.33	0.97
G3N2	183.56	8.33	0.73
G3N3	240.67	12.33	0.57
G3N4	171.44	11.33	0.75
SEm±	7.448	3.332	0.295
C.D (P=0.05)	24.947	NS	NS

Significant differences in crude protein (%) and nitrogen content (%) were observed. Among the grasses, the highest crude protein (9.70 %) and nitrogen content (1.55%) were recorded in Congo signal, while the lowest content was obtained from hybrid Napier (7.43% and 1.18%). The quality content was significant with an increase in nitrogen doses. The highest crude protein (9.40%) and nitrogen content (1.50%) were recorded with application applications of 120 kg/ha, while the 0 kg/ha application recorded the lowest content of crude protein (7.86%) and nitrogen content (1.25%). Similarly, the interaction of grasses with nitrogen doses was found to be significant. The quality content increased with increased nitrogen doses. The highest crude protein (10.83%) and nitrogen content (1.73%) were recorded with the application of 120 kg N/ha in the Congo signal. These results are in close conformity with the finding of Chonamki *et al.* (2003); Ayub *et al.* (2007); Verma *et al.* (2012) Raki *et al.* (2013).

Table 2: Effect of different nitrogen doses on yield and quality of perennial grasses

Treatments	GFY (q/ha) I-cut	GFY (q/ha) II-cut	GFY (Total)	DMY (q/ha) I-cut	DMY (q/ha) II-cut	DMY (q/ha)	% N Content	Crude protein (%)
Grasses (G)								
G1-Congosignal	132.88	252.08	384.96	16.61	31.54	48.15	1.55	9.70
G2-Setaria	219.73	479.64	699.47	27.47	60.01	87.42	1.38	8.66
G3-Hybrid Napier	84.16	178.26	265.51	11.58	22.24	33.82	1.18	7.43
SEm±	12..555	6.483	19.552	1.675	0.835	2.232	0.013	0.081
C.D (P=0.05)	42.052	21.715	65.491	5.612	2.798	7.477	0.043	0.273
Nitrogen (N)								
N0-Control	97.25	192.54	289.79	12.15	24.06	36.21	1.25	7.86
N1-60kg N/ha	126.67	241.63	368.30	17.61	30.33	47.94	11.31	8.18
N2-80kg N/ha	154.87	309.66	469.67	19.35	38.81	589.06	1.36	8.52
N3-100kg N/ha	193.32	418.71	612.03	24.16	52.26	76.42	1.44	9.03
N4-120kg N/ha	155.85	354.08	509.94	19.48	44.19	63.67	1.50	9.41
SEm±	16.208	8.369	25.242	2.163	1.078	2.882	0.016	0.105
C.D (P=0.05)	54.289	28.034	84.549	7.245	3.613	9.653	0.056	0.352
GXN								
G1N0	94.77	179.77	274.54	11.85	22.47	34.32	1.41	8.83
G1N1	118.10	212.10	330.20	14.76	26.90	41.67	1.46	9.11
G1N2	109.77	201.93	311.70	13.72	25.24	38.96	1.53	9.56
G1N3	178.50	356.33	534.83	22.31	44.30	66.61	1.63	10.19
G1N4	163.30	310.30	473.60	20.41	38.79	59.20	1.73	10.83
G2N0	151.07	303.57	454.63	18.89	37.95	56.84	1.28	8.00
G2N1	207.93	407.30	615.23	25.99	50.91	76.90	1.35	8.44
G2N2	251.10	502.77	735.87	31.39	63.15	94.24	1.40	8.73
G2N3	268.13	613.70	881.83	33.52	76.71	110.23	1.43	8.96
G2N4	220.43	570.87	791.30	27.56	71.36	98.92	1.47	9.21
G3N0	45.93	94.30	140.23	5.74	11.79	17.53	1.08	6.75
G3N1	53.97	105.50	159.47	12.07	13.19	25.26	1.12	7.00
G3N2	103.73	224.30	343.47	12.97	28.04	41.00	1.16	7.27
G3N3	133.33	286.10	419.43	16.67	35.76	52.43	1.27	7.96
G3N4	83.33	181.10	264.93	10.48	22.43	32.91	1.31	8.19
SEm±	28.073	14.497	43.721	3.746	1.868	4.992	0.029	0.182
C.D (P=0.05)	NS	48.557	146.443	NS	6.258	16.721	0.097	0.611

CONCLUSION

Grasses are heavy feeders of nutrients; among the three perennial types of grass, Setaria recorded the highest green forage and dry matter yield, while hybrid Napier recorded the lowest green forage yield (265.51 q/ha) and dry matter yield (33.82 q/ha). Significant differences in green forage yield were recorded with different nitrogen levels; however, further increases in nitrogen levels tend to decrease the yield. Interaction of grasses with nitrogen levels, application of 120 kg N/ha in both Setaria and Congo signal recorded the highest green forage yield (881.83 q/ha), dry matter yield (110.23 q/ha) as well as crude protein (10.83%) and nitrogen content (1.73%), respectively.

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