

Effect of introduction of Kazungula grass (*Setaria sphacelata*), spacing and nitrogen on the productivity of a natural grassland

N.T. RAFIQUE AND K. THAKURIA

Department of Agronomy, Assam Agricultural University, Jorhat 785 013

Received : September 2000

ABSTRACT

An experiment was conducted during 1995 and 1996 under rainfed condition, to study the effect methods of introduction of Kazungula grass [*Setaria sphacelata* Schum (L.) Stapf & Hubbard ex Moss], spacing and N levels productivity of natural grasslands of Assam Agricultural University, Jorhat. Introduction of *Setaria* either by killing or without killing the existing vegetation at different spacings could not influence the production of herbage and crude protein during both the years. However, no killed plots produced higher dry matter and crude proteins than killed plots. Closer spacings of 30 cm x 30 cm and 40 cm x 40 cm recorded 5.18 and 4.79% higher green forage and 20.75 and 14.23% dry matter yield, respectively, over the wider spacing of 50 cm x 50 cm. On an average, increasing the N levels up to 120 kg/ha increased the green forage, dry-matter and crude protein yields as well as enriched the soil with organic carbon, available N, P and K. The optimum economic dose of N was 145.66 kg N/ha in respect of green forage production.

Key words : Planting methods, Spacing, Nitrogen, Natural grassland, *Setaria sphacelata*

In Assam, natural grasslands occupy an area of 0.187 million ha which are deteriorating due to over-grazing, predominance of unproductive grass species, lack of fertilization and poor management practices. The grasslands are in active growth only for 4–5 months during the rainy season in a year. Introduction of ecologically suitable grass species like Kazungula grass following proper planting method and spacing would be helpful in promoting the production and quality of forage from a

grassland. Practically none of the grasslands of the state is fertilized in any form except that animals add some dung and urine while grazing. Nitrogen plays a key role in improving the production and quality of herbage in natural grassland. Keeping in view the aforesaid facts, the present investigation was initiated.

MATERIALS AND METHODS

An experiment was laid out in a natural grassland of the University at Jorhat during

1995 and 1996 under rainfed condition. The soil was sandy loam in texture with pH 5.2, medium in organic carbon (0.51%) but low in available N (173.46 kg/ha), available P (6.72 kg/ha) and available K (54.80 kg/ha). The experiment comprising 2 methods of introduction (killing vegetation and no killing) and 3 spacings (30 × cm 30 cm, 40 × 40 cm, 50 cm × 50 cm) were assigned to main plots and 4 levels of N (0, 40, 80 and 120 kg N/ha) were kept in subplots of split-plot design with 3 replications. Among the various grass species, *Imperata cylindrica* L. Raeusch. and *Saccharum spontaneum* L. were the dominant grass species in the experimental site and the legume component was practically absent. Killing of the existing vegetation was done as per treatment by spraying paraquat (Gramoxone) @ 17.5 kg/ha and K @ 16.6 kg/ha was applied at the time of planting in 1995 only. Nitrogen was applied in the form of urea as per treatment in 2 equal halves, at planting or first rain and after the first cut. Three rooted slips of *Setaria* were planted per hill on 25 April 1995 in 7–8 cm wide and 8–10 cm deep holes as per spacing treatments and retained up to 8 October 1996. The total rainfall received during the period of experimentation in 1995 and 1996 was 1,342.9 and 1,529.1 mm respectively. Mean maximum temperature during 1995 and 1996 ranged from 26.8 to 34.2°C and 25.3 to 35.3°C, respectively, whereas the mean minimum temperature in the corresponding years ranged from 16.7 to 26.4°C and 17.0 to 26.9°C.

The herbage was harvested twice in each year. The yield data of both the years are reported here as total of all the cuts. All the

growth parameters were recorded at second cut in each year.

RESULTS AND DISCUSSION

The average green forage yield in 1995 was 13.76 tonnes/ha compared with 23.75 tonnes/ha in 1996. The corresponding dry-matter yield was 7.49 and 11.03 tonnes/ha. The yield levels were lower in the first year than in the second year, irrespective of the treatments. The lower green forage and dry-matter yields during the year of establishment (1995) may be attributed to the fact that the introduction of *Setaria* was done at the end of April which took sometime for establishment and in the meantime some part of favourable weather for the growth of introduced *Setaria* grass passed away, and as a result it could not contribute as effectively as it did during the second year. Besides, the variation in total amount and distribution of rainfall in both the years greatly affected the performance of grasses. The difference in the amount of rainfall received during both years of crop period was 186.2 mm.

Effect of introduction (killing vs no killing)

The effect of introduction methods of the *Setaria* either by killing or without killing of existing vegetation on green forage, dry matter and crude protein yields was non-significant (Table 1). However, green forage yield in the second year and dry-matter yield during both years were higher in the plots where the existing vegetation was not killed. This trend was expected, as the introduced grass might not be expected to contribute significantly towards produc-

tion until and unless established properly to exhibit its full potential. Prasad and Mukherjee (1980), Sood (1981) and Shah and Singh (1986) also reported that the contribution of introduced species was not up to significant level in the first year. The growth parameters of *Setaria*, viz. plant height, shoots/tussock, survival% and per cent proportion as well as available nutrient contents in soil were also not affected significantly due to killing or no-killing treatments except the per cent proportion in 1996 when the killed plots showed higher proportion than no killed plots (Tables 2, 3). The higher proportion of *Setaria* in killed plots may be due to reduction in competition from native vegetation. Sood and Kumar (1995) also reported similar results.

Effect of spacing

Different spacings had no significant

influence on herbage production except the dry-matter yield in 1996 when introduction of *Setaria* at 30 cm × 30 cm spacing resulted significantly higher yield over 50 cm × 50 cm spacing but was at par with 40 cm × 40 cm spacing. On an average, 30 cm × 30 cm and 40 cm × 40 cm spacings resulted in increase to the tune of 5.18 and 4.79% green forage over 50 cm × 50 cm spacing respectively. The corresponding increase in dry-matter yield was 20.75 and 14.23%. The crude protein yield also recorded significantly higher at 30 cm × 30 cm spacing over the other 2 spacings during 1996 and of average over 2 years. The higher yields at 30 cm × 30 cm and 40 cm × 40 cm over 50 cm × 50 cm spacings may be attributed to higher biomass production of *Setaria* per unit area in these treatments (Table 2). The organic carbon and available N, P and K contents in soil were also not affected significantly by different spacings.

Table 1. Green forage, dry-matter and crude protein yields as influenced by method of Kazungula grass introduction, spacing and nitrogen level

Treatment	Green forage yield (tonnes/ha)			Dry-matter yield (tonnes/ha)			Crude protein yield (kg/ha)			Average net return (Rs/ha)
	1995	1996	Average	1995	1996	Average	1995	1996	Average	
<i>Methods of introduction</i>										
Killing vegetation	13.88	23.67	18.78	7.48	10.84	9.16	368.5	552.4	460.4	3,385.2
No killing	13.63	23.82	18.72	7.50	11.21	9.35	402.7	550.0	476.4	3,588.1
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
<i>Spacing (cm × cm)</i>										
30 × 30	12.88	25.29	19.09	7.32	12.69	10.01	402.1	646.3	524.2	3,522.0
40 × 40	13.79	24.24	19.02	7.80	11.14	9.47	384.0	549.9	467.0	3,576.0
50 × 50	14.59	21.71	18.15	7.35	9.24	8.29	370.6	457.3	414.0	3,362.1
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	134.0	69.88	
<i>N (kg/ha)</i>										
0	11.49	17.62	14.56	6.94	9.28	8.11	313.9	400.9	357.4	2,686.8
40	13.93	22.49	18.21	7.55	10.85	9.20	388.0	516.4	452.2	1,432.5
80	14.40	25.69	20.05	7.69	11.33	9.51	403.9	587.54	495.7	3,722.4
120	15.20	29.18	22.19	7.77	12.64	10.21	436.4	700.0	568.2	4,105.3
CD (P=0.05)	1.36	2.57	1.57	NS	1.03	0.65	46.8	47.9	36.99	

Effect of nitrogen

The green forage and dry-matter yields increased significantly with increasing levels of N up to 120 kg N/ha during both the years and average of 2 years except the dry-matter yield in 1995 when the effect of N was non-significant (Table 1). On an average, the per cent increase in green forage yield due to 40, 80 and 120 kg N/ha over the control was 25.1, 27.4 and 52.2% respectively. The corresponding increase in dry-matter yield was 13.4, 17.3 and 25.9%. Further, the increase in average green forage yield due to 40 kg N/ha over the control, 80 over 40 and 120 over 80 kg N/ha was 25.1, 10.1 and 10.7% respectively. The corresponding increase in dry-matter yield was 13.4, 3.4 and 7.4%. Thus, it shows that first increment of N resulted in higher green as well as dry matter yields

than that of subsequent increments. Significantly taller plants and higher number of shoots/tussock and survival percentage of introduced *Setaria* might have resulted in significant increase in forage yield. The crude protein yield also increased significantly with up to 120 kg N/ha when the 2 years data were averaged. This might be owing to increase in crude protein content and dry-matter production up to this level of N. Dwivedi *et al.* (1991) and Sood and Bhandari (1992). The net returns were also recorded highest with 120 kg N/ha.

Available N, P and K contents in soil also increased with increasing levels of N, but the increase was significant only up to 80 kg N/ha in both the years under study (Table 3). Similar increase in residual available N, P and K in soil was also

Table 2. Growth attributes of *Setaria sphacelata* as influenced by method of Kazungula grass introduction, spacing and level of N

Treatment	Plant height (cm)		Shoots/tussock		Survival (%)		Proportion of <i>Setaria</i> (%)	
	1995	1996	1995	1996	1995	1996	1995	1996
<i>Methods of introduction</i>								
Killing vegetation	64.6	59.9	4.4	7.9	83.6	68.4	29.3	36.6
No killing	64.2	58.0	3.7	7.1	78.4	59.9	29.1	30.8
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	5.5
<i>Spacing (cm × cm)</i>								
30 × 30	64.4	57.9	4.1	6.9	79.9	53.9	31.7	40.4
40 × 40	63.8	61.9	3.8	7.5	79.9	63.9	29.1	34.5
50 × 50	65.1	56.9	4.3	8.2	83.9	74.7	26.9	26.2
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	6.7
<i>Level of N (kg/ha)</i>								
0	54.1	50.4	3.0	4.1	78.4	49.4	28.3	33.6
40	64.3	57.3	3.6	6.6	79.9	59.6	27.6	32.4
80	63.1	61.2	4.8	9.1	80.5	68.0	29.4	34.7
120	76.2	66.9	4.9	10.4	85.5	79.5	31.7	34.0
CD (P=0.05)	7.9	5.2	0.9	1.5	6.3	7.5	NS	NS

Table 3. Organic carbon and available N, P and K in soil as influenced by method of Kazungula grass introduction, spacing and level of N

Treatment	Organic carbon (%)		Available nutrients (kg/ha)					
			N		P		K	
	1995	1996	1995	1996	1995	1996	1995	1996
<i>Methods of introduction</i>								
Killing vegetation	0.532	0.702	177.9	218.4	8.22	10.02	56.96	63.47
No killing	0.654	0.619	175.7	210.2	8.89	11.85	59.81	67.80
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	5.50
<i>Spacing (cm × cm)</i>								
30 × 30	0.642	0.653	184.0	220.9	8.70	11.36	56.67	63.63
40 × 40	0.560	0.751	177.6	224.8	7.56	11.08	60.13	66.53
50 × 50	0.577	0.686	168.7	196.9	9.41	10.36	58.36	66.75
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	6.7
<i>Levels of N (kg/ha)</i>								
0	0.532	0.595	128.9	153.8	7.40	6.67	54.95	60.84
40	0.576	0.668	176.6	200.6	8.13	9.58	58.45	65.32
80	0.572	0.752	193.7	243.7	8.93	12.69	60.32	65.96
120	0.691	0.770	207.9	258.9	9.77	14.99	59.82	70.43
CD (P=0.05)	NS	0.128	36.5	37.1	0.79	2.79	2.39	6.33

reported by Hazra and Singh (1994).

The optimum level of N worked out to be 145.66 and 110.83 kg N/ha for green forage and dry-matter yield respectively.

Overall, it can be concluded that introduction of *Setaria* can be done at a spacing of 40 cm × 40 cm in natural grassland without killing the existing vegetation and with the application of 120 kg N/ha or even more for higher production of quality herbage.

REFERENCES

- Dwivedi, G.K., Kanodia, K.C. and Rai, P. 1991. Response of *Setaria* varieties to fertilizer nitrogen for seed yield and its attributes. *Indian Journal of Agricultural Research* 25 (2) : 95-101.
- Hazra, C.R. and Singh, D.P. 1994. Soil and water conservation and silvipasture for wasteland improvement at Garahwal watershed. *Range Management and Agroforestry* 15 (1) : 35-42.
- Prasad, L.K. and Mukherjee, S.K. 1980. Pasture improvement by grass and legume introduction. *Forage Research* 6 (2) : 225-226.
- Shah, M.H. and Singh, C.M. 1986. Improvement of natural grassland by grass legume introduction and nitrogen management in North Western Himalaya. *Himachal Journal of Agricultural Research* 12 (2) : 82-91.
- Sood, B.R. 1981. 'Effect of methods of introduction and fertilizer management on the production potential and quality of natural grasslands of Kangra Valley.' Ph.D. Thesis, Himachal Pradesh Vishwavidyalaya, Palampur.
- Sood, B.R. and Bhandari, J.C. 1992. Response of *Setaria anceps* cv Narok to nitrogen and phosphorus in natural grassland of Kangra Valley. *Range Management and Agroforestry* 3 (2) : 139-141.
- Sood, B.R. and Kumar, P. 1995. Production and economics of natural grassland improvement. *Range Management and Agroforestry* 16(2) : 17-22.