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EFFECT OF ROW SPACINGS AND NITROGEN LEVELS ON THE PRODUCTIVITY OF SEWAN (*LASIURUS SINDICUS*) GRASS IN HOT ARID REGION OF WESTERN RAJASTHAN

K. C. SHARMA*

Central Sheep and Wool Research Institute
Arid Region Campus,
Bikaner-334 006 (Rajasthan), India
**(e-mail : kc_64sharma@yahoo.com)*

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SUMMARY

The field experiment was conducted at Bikaner (Rajasthan) to find out the effect of different row spacings and nitrogen levels on the productivity and quality of sewan (*Lasiurus sindicus*) grass. Results indicated that closest row spacing viz., 25 cm recorded maximum fresh forage yield (153.7 q/ha), dry matter yield (51.3 q/ha), crude protein content (9.0%), CP yield (464.9 kg/ha), energy ratio (9.83) and energy productivity (544.4 g/MJ). These yields were at par with spacing 50 cm but significantly higher over 75 cm. Whereas highest values of net returns (Rs.10,558/ha) and B : C ratio (2.09) were recorded with 50 cm apart rows. In case of nitrogen, highest dose i. e. 60 kg N/ha recorded maximum fresh forage yield (177.5 q/ha), dry matter yield (59.2 q/ha), CP content (9.17%), CP yield (543.0 kg/ha) and net returns (Rs. 13,647/ha). These values were in statistical parity with N dose of 40 kg/ha but significantly higher over other lower levels. However, highest values of energy ratio (10.55), energy productivity (586.0 g/MJ) and B : C ratio (2.37) were recorded with 40 kg N/ha. Overall, it may be inferred that for getting higher energy efficient and economical forage yields, sewan grass should be sown at 50 cm apart rows and fertilized with 40 kg N/ha in hot arid region of Rajasthan.

Key words : Row spacing, nitrogen, forage productivity, protein, sewan grass

Due to frequent occurrences of famine in western Rajasthan, livestock production particularly small ruminants like sheep and goats is of paramount importance and most of time it is a life support of rural population. Small ruminant animals are mainly grazing based and productivity of these animals is directly correlated with the condition of native pastures. But the pastures of the region are not only over-exploited but also either completely destroyed or covered by inedible plant species like *Aerva pseudotomentosa*, *Leptadenia pyrotecnica* and *Crotolaria burhia*, etc. The pastures are not only down graded in productivity but quality especially protein content of these pastures is very low and not fit even for body maintenance. At present these pastures are not having potential to support large animal base of the region. In order that livestock industry can have a firm base, the carrying capacity of the native pastures is to be increased. Sewan (*Lasiurus sindicus*) grass is a most important and suitable perennial pasture grass of hot arid region of Rajasthan. The only solution of above problem is improvement of native pastures as well as use of cultivable wastelands for pasture development through reseeding or by applying other rejuvenation techniques. Major factors to be given attention for pasture improvement are the maintenance of proper plant population of appropriate grass species in field of sown or developed pastures along with proper nutrition to improve pasture quality. Because pasture quality is mainly assessed with its protein content, therefore, proper nitrogen nutrition can play an important role on pasture productivity of improved quality. The systematic work on proper row spacing and nitrogen optimization is meagre. Hence, present experiment was undertaken.

MATERIALS AND METHODS

The field experiment was conducted at Research

[1]Present Address : Indian Agricultural Research Institute, Regional Station, Old Sehore Road, Indore-452 001 (Madhya Pradesh), India.

Farm of CSWRI, Arid Region Campus, Bikaner during **kharif** season of 2010 to find out the proper row spacing and optimize the nitrogen requirement of sewan grass (*Lasiurus sindicus*) in hot arid region. The soil of experimental site was sandy having pH 8.35, EC 0.65 dS/m, low in organic carbon (0.23%), available N (112.4 kg/ha), P (7.80 kg/ha) and K (128.5 kg/ha). The treatments comprising combinations of three row spacings viz., 25, 50 and 75 cm and four nitrogen levels viz., 0, 20, 40 and 60 kg/ha were tested in randomized block design with three replications. The cultivar 'CAZRI-mutant-30-5' was sown in first week of July by using 10, 8 and 6 kg/ha seed under 25, 50 and 75 cm spacings, respectively. A basal dose of 20 kg each of P and K/ha through single super phosphate and muriate of potash, respectively, was applied to each plot at the time of sowing. While nitrogen was applied in two splits (half at sowing+remaining half at 4-week crop stage) as per treatment. Sewan seed was used after overnight soaking in fresh water. Irrigation was applied once just after sowing for assured germination. The crop of grass was sown on 4th of July and harvested once at maximum growth at flowering stage i. e. on 26.9.2013. Observations were taken on growth and forage yield at harvest. Plant samples were collected from each plot for dry matter yield and analysis of crude protein content. Energy attributes were worked as suggested by Panesar and Bhatnagar (1987) and Devasenapathy *et al.* (2009). Total rainfall received during crop growth period was 290.3 mm.

RESULTS AND DISCUSSION

Growth and Forage Yield

Results indicated that all the growth parameters viz., grass plant height, number of plants/m^2, number of tillers per tussock and tussock diameter were significantly influenced by the row spacing and nitrogen levels except the plant height by row spacing (Table 1), where differences were non-significant. Although, number of tillers per tussock and tussock diameter at canopy level were maximum at widest row spacing of 75 cm but maximum green fodder (153.7 q/ha) and dry matter (51.3 q/ha) yields were observed at closest spacing of 25 cm apart rows. The magnitude of increase in green fodder and dry matter yields was to the tune of 2.06 & 11.6 and 1.38 & 11.3 per cent over 50 and 75 cm row spacings, respectively. The yield increase at closer spacing was mainly attributed to higher plant population per unit area as compared to wider row spacing. Whereas more number of tillers per tussock and higher tussock diameter at wider row spacings compensated the productivity loss up to some extent at 50 cm apart rows, however, 75 cm row spacing failed in doing the same and resulted in poor fodder yield. Singh and Gupta (1995), Yadav and Rajora (1995), Rai (1995) and Sharma *et al.* (2006) recommended 50 cm row to row spacing of sewan grass.

All growth attributes were gradually improved with each successive increase of N levels from 0 to 60 kg N/ha. Increased growth attributes due to increasing N levels might be due to adequate availability of N to the crop, being a constituent of amino acid and chlorophyll enhanced the chlorophyll formation leading to increased photosynthetic activity with the eventual improvement in the growth attributes. Each increase in nitrogen level substantially increased the green fodder and dry matter yields of sewan grass up to the highest level viz., 60 kg N/ha but significant improvement was noticed only up to the level of 40 kg N/ha. The highest green fodder (177.5 q/ha) and dry matter (59.2 q/ha) yields recorded with 60 kg N/ha were higher by 1.95 & 2.0 per cent, 34.9 & 33.3 per cent and 67.1 & 66.3 per cent over 40, 20 and 0 kg N/ha, respectively. Increase in fodder yields was the function of increased values of growth parameters viz., tussock height, number of tussock/m^2, number of tillers per tussock and tussock canopy diameter. Increase in green forage and dry matter yields with increased levels of nitrogen was also reported by Yadav and Rajora (1995) and Sharma and Chander (2007).

Crude Protein Yield

Data on crude protein content (%) and CP yields indicated that both treatment variables significantly influenced the CP contents and CP yields of sewan grass forage. Maximum CP content (9.00%) was recorded at closest spacing of 25 cm and it significantly decreased with each increase in row spacings. While CP yields observed with 25 and 50 cm apart rows were at par but significantly higher over 75 cm spacing. Higher plant population and thinner plant type might be the reason of higher CP contents at closer spacing of sewan grass, whereas higher CP yield was because of increased CP content multiplied by higher dry matter yields. CP content (%) and CP yield were gradually increased with each

TABLE 1

Growth attributes, forage yields, protein content (%) and protein yield of sewan grass as influenced by treatment variables

Treatment	Tussock height (cm)	No. of tussocks (x 10^3/ha)	No. of tillers/ tussock	Tussock diameter	Green fodder yield (q/ha)	Dry matter yield (q/ha)	Protein content (%)	Protein yield (kg/ha)
A. Row spacing								
S_1	128.6	92.2	118.0	71.5	153.7	51.3	9.00	464.9
S_2	127.5	69.7	120.1	72.9	150.6	50.6	8.77	447.5
S_3	128.8	51.2	131.6	78.9	137.7	46.1	8.51	394.6
S. Em±	2.13	2.80	2.18	1.59	2.94	0.97	0.06	8.00
C. D. (P=0.05)	NS	8.30	6.39	4.66	8.61	2.84	0.18	23.48
B. Nitrogen levels (kg/ha)								
N_0	112.9	66.2	108.1	62.3	106.2	35.6	8.28	295.1
N_{20}	129.4	74.0	123.6	73.0	131.6	44.4	8.59	382.2
N_{40}	135.4	71.0	129.9	80.4	174.1	58.0	8.99	522.3
N_{60}	135.6	73.0	131.3	82.1	177.5	59.2	9.17	543.0
S. Em±	2.46	3.20	2.52	1.83	3.39	1.12	0.07	9.24
C. D. (P=0.05)	7.21	NS	7.39	5.37	9.94	3.28	0.20	27.11

S_1–25 cm, S_2–50 cm, S_3–75 cm, N_0–No nitrogen (control), N_{20}–20 kg N/ha, N_{40}–40 kg N/ha, N_{60}–60 kg N/ha.

TABLE 2

Energy relationships and economics of sewan grass cultivation as influenced by treatment variables

Treatment	Energy relationships				Economics			
	Energy input (x 10^3 MJ/ha)	Energy output (x 10^3 MJ/ha)	Energy ratio	Energy productivity (g/MJ)	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	Benefit : cost ratio
A. Row spacing								
S_1	9.35	92.0	9.83	544.4	9,998	20,520	10,522	2.05
S_2	9.30	91.1	9.79	539.2	9,682	20,240	10,558	2.09
S_3	9.25	82.8	8.95	492.3	9,362	18,440	9,078	1.97
B. Nitrogen levels (kg/ha)								
N_0	7.50	64.1	8.55	474.8	9,328	14,240	4,912	1.53
N_{20}	8.70	80.0	9.19	510.4	9,563	17,760	8,197	1.86
N_{40}	9.90	104.5	10.55	586.0	9,798	23,200	13,402	2.37
N_{60}	11.10	105.9	9.54	529.9	10,033	23,680	13,647	2.36

Labour wages Rs. 107/ manday and forage prices Rs. 400/q dry forage.

increase in N levels up to the highest dose of N viz., 60 kg/ha. Maximum CP content (9.17%) and CP yield (543.0 kg/ha) recorded with 60 kg N/ha were statistically at par with the values recorded with 40 kg N/ha but significantly higher over rest of the N levels. Increase in crude protein yield may be because of N sufficiency under increased rates of N, which proved instrumental in activating the growth and N uptake by the plants. Increase in crude protein content and yield with N application was also reported by Yadav and Rajora (1997).

Response Function

On the basis of mean values of dry matter yields of sewan grass recorded under different row spacings, response of nitrogen was quadratic and equation computed was :

$$Y = 34.74 + 0.707\ x - 0.00475\ x^2$$

Where, Y is the dry matter yield (q/ha) and x is the nitrogen dose (kg/ha).

On the basis of above equation, maximum yield dose of nitrogen and maximum expected dry matter yield were worked out to be 74.4 kg N/ha and 61.0 q/ha, respectively.

Energy Relationships

Various energy attributes viz., energy input, energy output, energy ratio and energy productivity showed that all attributes gradually decreased with each increase in row spacing with maximum values at closest row spacing of 25 cm. This was mainly because of more energy units used with increased seed rate in close row spacings resulted in high values of input energy, while output energy was the function of higher dry matter yields. Higher values of energy ratio and energy productivity at close row spacing were mainly because of proportionately greater improvement in output energy than input energy used. In case of nitrogen application, the values of energy inputs and energy outputs gradually increased with each increase in N levels from 0 to 60 kg/ha. But energy ratio and energy productivity values did not show similar trend and maximum values of above attributes (7.3 and 402.8 g/MJ) were obtained with 20 kg N/ha and thereafter improvements decreased with increase in N levels as compared to control (no nitrogen). It was because of proportionately lesser increase in output energy values than increased values of input energy used (Table 2).

Economics

Worked out economics showed that despite of maximum gross return (Rs. 20,520=00) under row spacing of 25 cm, 50 cm spacing recorded highest values of net returns (Rs. 10,558=00) and benefit : cost ratio (2.09). The reason for above was mainly higher cost of cultivation due to costly seed and proportionately lower increase in fodder yields. Widest row spacing of 75 cm recorded minimum values of all the economic attributes due to poor forage yields. In case of nitrogen application, although maximum values of net returns (13, 647/ha) were obtained with 60 kg N/ha but B : C ratio was the highest (2.37) under 40 kg N/ha followed by 60 kg N/ha (2.36) (Table 2). Control (no nitrogen) and 20 kg N/ha observed lower values of above all the attributes. Higher economic benefit under increased doses of N was because of greater increase in forage yields than cost involved on nitrogen application under cost of cultivation.

Therefore, it can be concluded that sowing of sewan grass can be done at 50 cm apart rows and crop can be fertilized with 40 kg N/ha in two splits (half at sowing+remaining 30 days after sowing) to provide higher energy efficient and economical fodder productivity in hot arid region of Rajasthan.

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