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Effect of nitrogen on productivity of grasses in sole and intercropping system in arid zone under rainfed condition

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ABSTRACT

An experiment conducted during 1995 and 1996 on sandy soils in rainfed condition revealed that *Cenchrus ciliaris* L. gave highest dry-matter yield (50.67 q/ha) at 40 kg N/ha with 50 cm x 50 cm spacing in sole cropping, which was at par with grass planted at 100 cm x 50 cm spacing at same level of N. The response of *Lasiurus sindicus* to different rates of N application was not significant (1995) due to low and ill-distribution of rainfall. The highest dry forage yield (32.30 q/ha) of *L. sindicus* was recorded at 50 cm x 50 cm with 40 kg N/ha in 1996. The intercropping of *L. sindicus* with *C. ciliaris* resulted in a highest yield of 45.33 and 47.00 q/ha at 40 kg N/ha with 50 cm x 50 cm spacing and was significantly higher over than that obtained at 100 cm x 50 cm spacing during 1995 and 1996 at same level of N. The lowest dry-forage yield was recorded where no nitrogen was applied at all the spacings.

***Key words*:** Arid zone, Rainfed, Grasses, Intercropping, N fertilization, Planting systems

In arid western Rajasthan, rainfed crop production is very risky and non-profitable due to low and erratic rainfall with onset of long dry spells during the cropping season. The failure of crops leads to poor surface vegetation, resulting in severe soil erosion problems and sometimes more fertile surface layer is washed away from the field through speedy winds. *Cenchrus ciliaris* and *Lasiurus sindicus* grasses are of perennial in nature, having different growth characteristics in relation to their rooting pattern as well as soil moisture and nutrient-use patterns. The uncertainty and poor rainfall in terms of quantity and time the pasture productivity is badly affected. Keeping above in view to increase the pasture productivity, the present investigation was started in 1993 with the objectives to study the dry-matter productivity per unit area, nitrogen response of these 2 grasses in sole and intercropping configurations under rainfed condition of arid region.

MATERIALS AND METHODS

In the present investigation grasses, i.e. *Cenchrus ciliaris* and *Lasiurus sindicus,*

were sown during rainy season of 1993 (the data are reported for 1995 and 1996). Both the grasses were sown at 2 planting systems, one as sole crop and another as an intercrop with 2 spacings, i.e. 50 cm × 50 cm and 100 cm × 50 cm. Four nitrogen doses (0, 10, 20, and 40 kg N/ha) were applied only once in a year during rainy season in furrows as a deep placement along with the rows. In another planting system the grass *Lasiurus sindicus* was intercropped as a alternate rows in 50 cm × 50 cm spacing and as a row intercropping between the rows in 100 cm × 50 cm spacing treatment.

Rainfall of 345.5 mm and 281.8 mm were recorded in 1995 and 1996 respectively. The highest rainfall of 172.5 mm was recorded in July and June during 1995 and 1996 respectively. In both years during rainy season there were 2 long dry spells which adversely affected the growth of both grasses. During winter (January to April) a total rainfall of 40.9 mm in 1995 and 12.8 mm in 1996 was recorded. The highest mean monthly temperature ranges from 41.9 to 42.8°C in May and minimum temperature was 6.6 to 8.2°C in January. Although the total rainfall for both years was above the long-term average (275 mm) but was poorly distributed in relation to the

Table 1. Plant height of grasses at harvest as affected by different treatments (mean data of 1995 and 1996)

Spacing (cm)	N (kg/ha)				
	N_0	N_{10}	N_{20}	N_{40}	Mean
			Cenchrus ciliaris (*sole*)		
50 × 50	130.0	140.6	142.5	146.5	139.9
100 × 50	119.4	123.3	125.7	135.9	126.1
Mean	124.7	131.9	134.1	141.2	
			Lasiurus sindicus (*sole*)		
50 × 50	112.5	115.2	122.3	126.4	119.1
100 × 50	116.8	123.2	127.5	136.7	126.1
Mean	114.6	119.2	124.9	131.5	
			C. ciliaris intercropping		
50 × 50	120.2	122.7	123.6	125.6	123.1
100 × 50	128.5	129.4	129.9	133.9	130.4
Mean	124.3	126.1	126.8	129.8	
			L. sindicus intercropping		
50 × 50	102.5	108.3	113.7	117.4	110.5
100 × 50	98.7	104	113.9	123.4	110.0
Mean	100.6	106.2	113.8	120.4	

grand growth period.

RESULT AND DISCUSSION

Growth

The plant height (mean data of 1995 and 1996) revealed that different spacings and fertilizer application significantly affected it at harvest (Table 1). Highest plant height of 146.5 cm and 135.9 cm was recorded at 50 cm × 50 cm spacing with 40 kg N/ha in *Cenchrus ciliaris* and *Lasiurus sindicus* respectively. Increasing doses of N increased the plant height of grasses at both the row spacings. But closer row spacing gave higher plant height than wider row spacing in *C. ciliaris*. Maximum plant height in *L. sindicus* was recorded in wider spacing (100 cm × 50 cm) than closer spacing (50 cm × 50 cm). In intercropping of grasses also the response to increasing rates of N was positively correlated with plant height. The highest plant height of *Cenchrus ciliaris* and *Lasiurus sindicus* in intercropping system was recorded at 40 kg N/ha in 100 cm × 50 cm spacing which was due to only that the moisture could not become the limiting factor due to water adsorption system of different strata of both the grasses. Similar results were also determined by Bhimaya and Ahuja (1967).

Table 2. Effect of nitrogen × spacing on dry-forage yield of grasses in sole and in intercropping system during 1995 and 1996

Spacing (cm)	N (kg/ha)									
	1995					1996				
	N_0	N_{10}	N_{20}	N_{40}	Mean	N_0	N_{10}	N_{20}	N_{40}	Mean
	Cenchrus ciliaris *(sole)*									
50 × 50	45.00	43.16	45.00	50.67	45.96	38.66	47.66	48.33	49.00	45.66
100 × 50	37.67	45.20	42.33	48.00	43.30	26.00	26.66	38.65	38.33	32.33
Mean	41.33	43.68	45.16	49.33		32.33	37.16	43.49	43.66	
CD (P = 0.05)	9.54					5.34				
	Lasiurus sindicus *(sole)*									
50 × 50	27.16	29.50	28.33	29.00	28.62	25.60	27.36	27.83	32.30	28.27
100 × 50	18.50	29.50	28.83	29.00	28.62	21.00	23.33	25.00	26.30	23.90
Mean	22.83	29.41	27.66	27.83		23.30	26.84	26.41	29.80	
CD (P = 0.05)	6.23					4.95				
	C. ciliaris + L. sindicus *intercropping*									
50 × 50	43.26	45.00	49.17	45.33	46.44	31.33	42.67	48.33	47.00	42.33
100 × 50	29.17	27.00	30.67	37.16	31.00	33.66	31.33	32.00	41.33	34.58
Mean	36.21	36.00	44.92	41.24		32.49	37.00	40.17	44.17	
CD (P = 0.05)	9.30					4.20				

Dry forage yield

Sole cropping: The dry-forage yield in sole cropping of *Cenchrus ciliaris* was not affected significantly by the increasing level of N at 50 cm × 50 cm spacing, with a highest dry forage yield at 40 kg N/ha in *C. ciliaris.* It was significantly higher than wider spacing during 1995. The same trend was also observed in 1996 (Table 2). This was only due to higher plant height of grasses at closer spacing than at wider row spacing which increased dry-forage yield. In *Lasiurus sindicus,* highest dry-forage yield was recorded at 50 cm × 50 cm spacing with 40 kg N/ha during both the years (Table 2). Chakravarty and Verma (1970) also reported that the application of N increased the fodder production of grasses up to 40–70%. The closer row spacing (50 cm × 50 cm) resulted higher dry matter than wider row spacing in treatments without nitrogen application.

Inter cropping : The highest total forage yield was recorded with 20 kg N/ha at 50 cm × 50 cm spacing, whereas in wider spacing it was highest at 40 kg N/ha during 1995. In 1996 the highest total forage yield of C. ciliaris was recorded at 50 cm × 50 cm spacing with 20 kg N/ha which was significantly higher than grass grown at 100 cm × 50 cm spacing at same level of N (Table 2). Shankernarayan et al. (1977) also reported that application of 30 kg N/ha increased the dry-forage yield over the control and found the optimum of 30 kg N/ha.

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