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Effect of Nitrogen Levels and Time of Application with Cutting Systems on Yield and Protein Content of Oats Forage (*Avena sativa* L.)

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In forage oats, increased vegetative growth and nutritional quality of the produce are the main consideration where livestock production is involved or in dairy milk-shed area during the winter season. The response of forage oats to nitrogen application (80 to 200 kg N/ha) in different soil types has been reported by some workers (Anon., 1973a, Joshi and Prasad, 1979). Sinha (1968) observed higher increase in crude protein (CP) content by applying N (0 to 120 kg N/ha) in three-split-dressing at sowing/tillering/flowering than applying in a single dressing at sowing. Singh *et al.* (1976) suggested that oats should be cut twice (55-60 DAS and 125 DAS/earing stage) for maximum production of good quality fodder. Since, very little work has been reported on forage oats for middle Gujarat region, it needs experimentation to find out the optimum nitrogen level and time of its application under one-cutting and two- cutting systems for getting maximum forage yield and good quality. A field experiment with oats (Var. Kent) was conducted in a randomized block design on sandy loam soil at Forage Research Project Farm, GAU, Anand during Rabi 1982-83. The available nitrogen, phosphorus and potash were 213, 68 and 156 kg/ha, respectively. There were three nitrogen levels (90, 120 and 150 kg/ha) and two cutting systems, i.e. (i) fodder harvesting at early dough stage (111 DAS) -C_1 and (ii) crop cutting before boot-stage (64 DAS) and regrowth cutting at early dough-stage (59 DAS) - C_2. Each dose of nitrogen was applied in different splits as shown below :

Treatments T_1 to T_5 - 90 kg N/ha (Urea)

T_1C_1 : ⅔ BD + ⅓ 30 DAS

T_2C_1 : ½ BD + ¼ 30 DAS + ¼ 60 DAS

T_3C_2 : ⅓ BD + ⅙ 30 DAS + ½ AFC

T_4C_2 : ½ BD + ¼ 30 DAS + ¼ AFC

T_5C_2 : ⅓ BD + ⅙ 30 DAS + ¼ AFC + ¼ DAFC

Where, BD - Basal dressing; DAS - Days after sowing; AFC - After first cut; DAFC - Days after first cut. In a similar way, 120 and 150 kg N/ha (urea) were split for T_6 to T_{10} and T_{11} to T_{15} treatments, respectively. The sowing of oats was done with 25 cm row spacing on 23rd October, 1982 using 100 kg seed/ha. A common dose of superphosphate (30 kg P_2O_5/ha) and muriate of potash (25 kg K_2O/ha) was applied

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TABLE 1

Green forage, dry matter and crude protein yields (q/ha) and crude protein content (per cent) of oats (Var. Kent) at different levels and time of nitrogen application under one (C_1) and two cutting (C_2) systems.

	Treatment		Yield (q/ha)			Crude protein content (%)
			Green forage	Dry matter	Crude protein	
N_{90}	(1)	T_1C_1	525	105.3	14.37	13.14
	(2)	T_2C_1	527	102.4	14.28	14.03
		Mean $N_{90}C_1$	526	103.9	14.33	13.59
	(3)	T_3C_2	683	99.8	14.10	14.87
	(4)	T_4C_2	744	109.9	14.26	13.67
	(5)	T_5C_2	700	102.9	14.79	15.05
		Mean $N_{90}C_2$	709	104.2	14.38	14.53
N_{120}	(6)	T_6C_1	598	116.1	15.32	13.27
	(7)	T_7C_1	640	99.7	14.65	14.82
		Mean $N_{120}C_1$	569	107.9	14.99	14.05
	(8)	T_8C_2	802	114.5	18.26	16.05
	(9)	T_9C_2	790	110.9	16.06	15.15
	(10)	$T_{10}C_2$	756	106.3	17.50	16.48
		Mean $N_{120}C_2$	783	110.6	17.27	15.89
N_{150}	(11)	$T_{11}C_1$	550	107.0	17.12	15.56
	(12)	$T_{12}C_1$	575	104.0	17.32	16.72
		Mean $N_{150}C_1$	562	105.7	17.22	16.29
	(13)	$T_{13}C_2$	796	99.9	17.07	16.91
	(14)	$T_{14}C_2$	871	112.2	21.39	18.64
	(15)	$T_{15}C_2$	771	97.4	16.34	16.57
		Mean $N_{150}C_2$	813	103.2	18.27	17.37
Mean for Nitrogen		N_{90}	636	104.1	14.36	14.15
		N_{120}	697	109.3	16.36	15.13
		N_{150}	713	104.3	17.85	16.94
Mean for Cuts		C_1	553	105.8	15.51	14.64
		C_2	768	106.0	16.64	15.93

C. D. at 5% and 1% level

	Green forage		Dry matter		Crude protein		Crude protein content (%)	
	5%	1%	5%	1%	5%	1%	5%	1%
	20.2	27.0	4.38	5.85	1.08	1.44	0.87	1.17
N levels	25.3	39.0	NS	NS	1.51	2.02	1.26	1.68
$N_{90}/N_{120}/N_{150}/C$ Individual treatment	45.2	60.4	9.93	13.27	2.12	2.83	1.95	2.61

in furrow at the time of sowing. In all nine irrigations were given as and when required. Fresh green forage and dry matter yields were recorded after each cutting. Nitrogen content of plant samples was estimated by Kjeldahl's method (Jackson, 1967) and crude protein content was calculated by multiplying nitrogen per cent with 6.25.

Green forage yield (GFY)

The data (Table 1) indicated that the green forage yield of oats increased significantly with the increase in the rate of N application from 90 to 150 kg/ha. However, the yield produced by 120 kg N/ha was at par with that of 150 kg N/ha treatment. Application of nitrogen @ 120 and 150 kg N/ha resulted in increased yield by 9.6 and 12.0 per cent over 90 kg N/ha, respectively. Two-cutting system gave significantly higher (38.9%) GFY over one-cutting system. It is interesting to note that the application of 150 kg N/ha under two-cutting system produced significantly (at 1% level) higher forage yield than under one-cutting system. Similar was the case for other levels also. The highest GFY (871 q/ha) obtained under two-cutting treatment - $T_{14}C_2$ (150 kg N/ha + ½ BD + ¼ 30 DAS + ¼ AFC) was statistically significant (at 1% level) over all the treatment. Similarly, application of 90 and 120 kg N/ha in three splits under two-cutting system produced reasonably good yields of forage oats (e.g. $T_{14}C_2$: 744 q/ha; T_9C_2 : 790 g/ha). The highest yield obtained under $T_{14}C_2$ as compared to $T_{13}C_2$ and $T_{15}C_2$ can be ascribed to higher amount of nitrogen applied at early stage of the crop growth. It was also true for other N levels under both the cutting systems except at 120 kg N/ha with two cuts. The response of oats to N application upto 100 kg/ha (Bokde, 1968), 120 kg/ha (Saxena *et al.*, 1971) and 200 kg/ha (Joshi and Prasad, 1979) has also been reported by different researchers. Singh *et al.* (1972) obtained the maximum profit with 76 kg N/ha, when applied three-fourths at sowing and one-fourth after the first cut in oats. Singh *et al.* (1976) and Abichandani *et al.* (1973) also observed the higher yields of green forage and dry matter of oats under two cuts than single cut.

Dry matter yield (DMY)

Application of 120 kg N/ha produced significanlty higher dry matter yield of oats as compared to 90 and 150 kg N/ha (Table 1). Cutting systems did not influence in enhancing the dry matter yield. The highest DMY of 116.1 q/ha obtained under treatment T_6C_1 which was significantly superior to rest of the treatments but at par with $T_{11}C_1$, T_4C_2, T_8C_2, T_9C_2, $T_{10}C_2$ and $T_{14}C_2$. The trend in DMY under two-cutting system is not similar to that observed in respect of GFY. It was mainly due to more leafy portion and moisture content at early dough-stage harvesting (first cutting). In general, it can be said that N applied at early stage of the crop growth had beneficial effect in increasing the DMY irrespective of cutting system (Singh *et al.*, 1972).

Crude protein content

Crude protein (cp) content (Table 1) of oats was enhanced significantly (at 1% level) with the application of 150 kg N/ha (16.94%) over 90 kg N/ha (14.15%) and 120 kg N/ha (15.13%). Two-cutting system resulted in significantly higher (8.8%) CP content over one-cutting. Application of 120 kg N/ha under two-cutting system resulted in significantly higher CP content (13.1%) than under one-cutting. Similar was the case with 90 to 150 kg N/ha levels, but differences did not reach to the level of significance. The highest CP value (18.64%) was noticed under two-cutting

treatment - $T_{14}C_2$ (150 kg N/ha : ½ BD + ¼ 30 DAS + ¼ AFC). The trial conducted at Anand revealed that CP content in oats plant increased from 9.9 to 12.4% as the level of N increased from 0 to 120 kg N/ha (Anon., 1973b). Higher increases in CP content (5.43 to 6.35%) have been reported (Sinha, 1968) by applying N (0 to 120 kg N/ha) in three split dressing at sowing/tillering/flowering than applying in a single dressing at sowing.

Crude protein yield (CPY)

Application of 150 kg N/ha to oats produced significantly higher (24.3% and 10.0%) crude protein yield over 90 and 120 kg N/ha (Table 1). Two-cutting system gave significantly higher (15.2%) CPY over one-cutting system at 120 kg N/ha level. Similar was the case with 150 kg N/ha level, but the differences did not reach to the level of significance. The highest CPY (21.4 q/ha) synthesized under the treatment $T_{14}C_2$ (150 kg N/ha : ½ BD + ¼ 30 DAS + ¼ AFC) was significantly (at 1% level) superior over rest of the treatments. Results of the trial conducted at Anand showed that CPY in oats plant increased from 11.02 to 16.07 q/ha as the level of N increased from 0 to 120 kg N/ha (Anon., 1973b). In a varietal trial of oats conducted at Hissar (Anon., 1973a) higher CPY were reported under multicut than single cut management system.

The present study indicated that 150 kg N/ha applied in three splits (½ BD + ¼ 30 DAS + ¼ AFC) to oats (Var. Kent) crop grown on sandy loam soil of Anand (Gujarat under two-cutting system produced the highest green forage, dry matter, crude protein yields as well as crude protein content.

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