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RESEARCH PAPER

Forage quality of multicut forage sorghum [*Sorghum bicolor* (L.) Moench] variety cofs-29 as influenced by nitrogen levels and cutting intervals

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Abstract : The study was conducted during summer 2014 on loamy sandy soil of Main Forage Research Station, Anand Agricultural University, Anand to study the "Influence of nitrogen levels and cutting management on multicut forage sorghum [*Sorghum bicolor* (L.) Moench] Variety CoFs- 29". The result revealed that , application of 120 kg N ha^{-1} (N4) recorded significantly the highest total green forage and dry matter yield as well as crude protein content, crude protein yield. The values of HCN were found within the permissible toxicity limit in all levels of nitrogen application. The NDF content significantly decreased with the increase in nitrogen levels. Treatment C_4 (first cut at 60 DAS + 2 subsequent cuts at 50 days interval) recorded significantly the highest values in all three cuts for green forage yield, dry matter yield, crude protein yield and crude protein per cent. However, there was a decline in crude protein content over each cut. There was a steady decrease in HCN content in individual cuts in all cutting treatments, treatment of first cut at 60 DAS + 2 subsequent cuts at 50 days interval recorded the lowest HCN content. NDF content increased with each cutting management practice in each cut. Treatment of first cut at 50 DAS + 2 subsequent cuts at 40 days interval recorded significantly lowest NDF content.

Key Words : Crude protein, Cutting management, Dry matter yield, HCN, Multicut, NDF

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INTRODUCTION

The unavailability of fodder has been and continues to be one of the most limiting factors for the livestock industry in India. The productivity and availability of good quality feed and fodder has a prime importance for the development of livestock. However, the present feed and fodder resources are unable to meet of the requirement of country's livestock population. Nitrogen fertilization plays a vital role in improving the yield and quality. It improves crude protein, dry matter content, decrease fibre content among other characters. The availability of green fodder from single cut is short lived while multicut sorghum helps to supply green fodder spread over a long period which alleviates the difficulty of recurring field

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preparation and reseeding. Cutting management schedule plays an important role in the yield and quality of forage. Therefore, to improve the yield and quality of forage sorghum it is pertinent to determine its nitrogen requirement and harvesting time. It is with this background that the following study was undertaken.

MATERIAL AND METHODS

The field experiment was conducted during summer season of 2014 at the Main Forage Research Station Farm of Anand Agricultural University, Anand. The soil was loamy sand with low available N (172.48 kg ha^{-1}), medium in available P (33.92 kg ha^{-1}) and K (214.30 kg ha^{-1}). The experiment was laid out as a Factorial Randomzed Block Design comprising of 4 levels of nitrogen (60, 80, 100 and 120 kg ha^{-1}) and 4 cutting management (C_1: first cut at 50 day + 2 subsequent cuts at 40 days interval, C_2: first cut at 50 day + 2 subsequent cuts at 50 days interval, C_3: first cut at 60 day + 2 subsequent cuts at 40 days interval, C_4: first cut at 60 day + 2 subsequent cuts at 50 days interval) with 3 replications. Seed rate of 15 kg ha^{-1} of forage sorghum variety CoFs- 29 was used in this study. The seeds were treated with thirum before sowing. Half dose of nitrogen (through urea) according to treatments, a uniform dose of phosphorus @ 40 kg ha^{-1} through SSP, $FeSO_4$ @ 25 kg ha^{-1} and $ZnSO_4$ @ 8 kg ha^{-1} were applied at the time of sowing. Remaining nitrogen was top dressed in two equal splits after each cut. The data pertaining to biometrical observations as well as green forage and dry matter yields were recorded at each harvest of the crop.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of nitrogen levels on yield and quality :

Favourable effect of nitrogen application on yield attributes had resulted in significantly higher green forage yield and dry matter yields. Application of 120 kg N ha^{-1} (N_4) recorded significantly the highest green forage yield in all cuts as well as in total green forage yield. Treatment N_4 recorded 25.63, 58.62 and 81.03 per cent higher green forage yield over N_3, N_2 and N_1, respectively (Table 1).

The increase in total green forage yield (Table 1) was achieved due to the positive effect of nitrogen on plant height, number of tillers per metre row and leaf : stem ratio. This was due to the fact that nitrogen

Table 1 : Yield of forage sorghum as influenced by nitrogen levels and cutting management

Treatments	Green forage yield (q ha^{-1})				Dry matter yield (q ha^{-1})			
	1st cut	2nd cut	3 rd cut	Total	1st cut	2nd cut	3 rd cut	Total
Nitrogen levels (N) (kg ha^{-1})								
N_1 : 60	130.03	180.76	254.60	565.40	28.40	40.95	60.97	130.31
N_2 : 80	153.82	210.52	280.93	645.27	35.61	49.78	69.02	154.41
N_3 : 100	180.99	298.56	335.22	814.77	43.82	73.00	83.83	200.64
N_4 : 120	219.65	382.65	421.27	1023.57	54.64	96.36	106.30	257.30
S.E.±	5.09	9.38	7.95	14.31	1.40	2.45	2.24	3.83
C.D. (P=0.05)	14.69	27.09	22.95	41.32	4.05	7.07	6.46	11.06
Cutting management (C)								
C_1	158.52	230.56	286.99	676.07	37.12	55.25	70.29	162.66
C_2	167.67	267.69	312.50	747.86	39.57	65.00	78.09	182.66
C_3	175.68	273.66	333.29	782.63	42.10	65.67	82.24	190.01
C_4	182.62	300.59	359.24	842.44	43.67	74.15	89.51	207.33
S.E. ±	5.09	9.38	7.95	14.31	1.40	2.45	2.24	3.83
C.D. (P=0.05)	14.69	27.09	22.95	41.32	4.05	7.07	6.46	11.06
Interaction								
N x C	NS	Sig.	Sig.	Sig.	NS	NS	NS	Sig.
C.V. %	10.30	12.12	8.52	6.50	11.96	13.05	9.68	7.14

NS= Non-significant

increased the protoplasmic constituents and accelerated the process of cell division and elongation which in turn gave luxuriant vegetative growth. These results are in accordance with those achieved by Dhar *et al.* (2006); Sheoran and Rana (2006); Gupta *et al.* (2008); Trivedi *et al.* (2010) and Rana *et al.* (2012).

Similar trend was also observed for dry matter yield with the application of nitrogen. The highest total dry matter yield of 257.30 q ha^{-1} was recorded in treatment N_4 (120 kg N ha^{-1}). This may be due to higher fertility levels which increased the availability and absorption of nutrients to the plants which resulted in more vegetative growth due to increase in plant height and tillers on the account of enlargement of cells and enhanced photosynthesis, which resulted in higher dry matter yield. These findings are in conformity with those of Trivedi *et al.* (2010) and Rana *et al.* (2012).

Nitrogen application resulted in significant increase in crude protein content, crude protein yield, HCN and a decrease in neutral detergent fibre content in all cuts (Table 2). The increase in crude protein and crude protein yield with increment in nitrogen dose was due to increased absorption of nitrogen since it is well established fact that nitrogen is the main constituent of amino acids, it ultimately increased crude protein content of plants. This is in harmony with the published work of Malik *et al.* (1992); Bhilare *et al.* (2002); Patel *et al.* (2008); Amandeep *et al.* (2010) and Trivedi *et al.* (2010).

As regard to HCN content of green forage sorghum in Table 2, the corresponding mean HCN content with 120 kg N ha^{-1} (N_4), 100 kg N ha^{-1} (N_3), 80 kg N ha^{-1} (N_2) and 60 kg N ha^{-1}(N_1) was 117.24, 106.13, 96.71 and 78.28 ppm, respectively. However, the values of HCN were within the permissible toxicity limit. Forage sorghum varieties with more than 250 ppm of HCN content may prove to be fatal for animals. The results are in agreement with those of Grewal *et al.* (2005); Patel *et al.* (2008); Buldak *et al.* (2010); Trivedi *et al.* (2010) Pandey *et al.* (2011) and Meena *et al.* (2012).

The NDF content significantly decreased with the increase in nitrogen levels from N_1 (60 kg N ha^{-1}) to N_4 (120 kg N ha^{-1}). The lowest NDF content was recorded for N_4 (120 kg N ha^{-1}) as 65.86 per cent while the highest was recorded for N_1 (60 kg N ha^{-1}) as 81.08 per cent in mean analysis.The reduction in NDF content observed with the increase in the level of nitrogen might be due to increase in succulence and enhanced vegetative growth and delayed maturity of the crop. These results corroborate those achieved by Ayub *et al.* (2002); Yadav *et al.* (2007); Amandeep *et al.* (2010) and Saini (2013).

Table 2 : Quality of forage sorghum as influenced by nitrogen levels and cutting management

Treatments	Crude protein (%)				Crude protein yield (q ha^{-1})				HCN (ppm)				Neutral detergent fibre (%)			
	1st cut	2nd cut	3 rd cut	Mean	1st cut	2nd cut	3 rd cut	Total	1st cut	2nd cut	3 rd cut	Mean	1st cut	2nd cut	3 rd cut	Mean
Nitrogen levels (N) (kg ha^{-1})																
N_1 : 60	10.73	10.40	9.34	10.16	3.06	4.28	5.71	13.04	134.79	61.51	38.54	78.28	78.42	84.67	80.17	81.08
N_2 : 80	11.59	11.30	10.16	11.02	4.13	5.63	7.01	16.77	166.18	74.08	49.87	96.71	74.50	81.25	73.08	76.28
N_3 : 100	12.36	11.92	10.27	11.51	5.41	8.70	8.61	22.72	181.15	82.66	54.57	106.13	69.75	74.00	69.92	71.22
N_4 : 120	12.68	12.34	11.48	12.17	6.94	11.90	12.21	31.05	197.73	92.15	61.85	117.24	63.67	67.42	66.50	65.86
S.E. ±	0.11	0.14	0.13	0.07	0.19	0.30	0.25	0.46	2.43	1.32	1.44	1.01	0.72	0.88	0.89	0.54
C.D. (P=0.05)	0.33	0.41	0.36	0.21	0.55	0.87	0.71	1.34	7.02	3.80	4.15	2.92	2.08	2.54	2.56	1.57
Cutting management (C)																
C_1	11.57	11.35	10.13	11.02	4.38	6.42	7.24	18.03	181.02	81.15	53.27	105.14	69.75	75.25	70.08	71.69
C_2	11.78	11.67	10.46	11.30	4.73	7.69	8.32	20.73	171.75	75.74	50.85	99.45	71.00	77.08	72.58	73.56
C_3	11.94	11.18	10.07	11.07	5.10	7.52	8.40	21.01	165.98	79.39	53.30	99.56	72.42	76.25	71.92	73.53
C_4	12.07	11.76	10.58	11.47	5.34	8.89	9.58	23.81	161.10	74.11	47.42	94.21	73.17	78.75	75.08	75.67
S. E. ±	0.11	0.14	0.13	0.07	0.19	0.30	0.25	0.46	2.43	1.32	1.44	1.01	0.72	0.88	0.89	0.54
C.D. (P=0.05)	0.33	0.41	0.36	0.21	0.55	0.87	0.71	1.34	7.02	3.80	4.15	2.92	2.08	NS	2.56	1.57
Interaction																
N x C	NS	NS	NS	NS	NS	NS	NS	Sig.	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	3.31	4.31	4.24	2.19	13.39	13.60	10.22	7.68	4.96	5.88	9.73	3.51	3.48	3.97	4.24	2.55

NS= Non-significant

Effect of cutting management on yield and quality:

Treatment C_4 (first cut 60 DAS + Subsequent 2 cuts each at 50 days interval) was significantly superior in recording the highest green forage yield of 182.62, 300.59, 359.24 and 842.44 q ha^{-1} respectively, during first, second and third cuts as well as total cuts (Table 1). The increase in green forage yield with delayed harvesting was mainly due to increase in growth parameters *viz*., plant height, number of tillers as well stem diameter, number of leaves and higher leaf area though not all mentioned was recorded in this investigation. The treatments with 50 days interval performed better than those with harvesting at 40 days. Similar trends were observed in dry matter, the increase in dry matter with the advancement in age was due to more deposition of fibrous materials in plant parts The increase in green forage and dry matter yield by extending the period of harvesting has also been reported by Ram and Singh (2001); Ayub *et al*. (2002); Joshi *et al*. (2007); Ayub *et al*. (2009) and Amandeep *et al*. (2010).

Among the various cutting management treatments, C_4 (First cut at 60 DAS + Subsequent 2 cuts each at 50 days interval) was found significantly superior recording 12.07, 11.76, 10.58 and 11.47 per cent at first, second and third cut and in mean, respectively. It was at par with C_3 and C_2 in first cut, C_2 and C_1 in second cut and C_2 in third cut and the mean. However, there was a steady decline in crude protein content in all cuts (Table 2). The high protein content observed in first cut was attributed to more nitrogen absorption by the plant in early stages of growth and also less dry matter accumulation. This resulted in higher nitrogen content in the plant at younger stages and hence, more protein content. Crude protein yield was highest with treatment C_4.The increase in crude protein yield was attributed to more green fodder and dry matter yield. The results substantiate the findings of Ram and Singh (2001); Ayub *et al*. (2002 and 2009) and Amandeep *et al*. (2010).

The results of this study showed that the level of HCN content progressively decreased significantly with the advancement of growth stages of the crop (Table 2). The enzyme activity may have then decrease with the advancement of crop growth. The results corroborate those achieved by Chaturvedi and Devender (2010) and Zahid *et al*. (2012).

Results pertaining to NDF content of sorghum (Table 2) revealed that harvesting stage was quite significant on NDF content of forage sorghum. In first cut, treatment C_1 and C_2 being statistically at par recorded the lowest NDF content being 69.75 and 71.00 per cent, respectively. In second cut, NDF content was non-significant, while in third cut C_1 had lowest NDF content (70.08 per cent) followed by C_3 and C_2 being at par with values of 71.92 and 72.58 per cent, respectively. Treatment C_4 (First cut at 60 DAS + subsequent 2 cuts each at 50 days interval) recorded the highest NDF content in all cuts. The increase in NDF with delayed harvesting and advancement in plant age was due to more synthesis of structural carbohydrates and deposition of fibrous material. Ram and Singh (2001); Ayub *et al*. (2002 and 2009) and Amandeep *et al*. (2010) reported similar findings.

Interaction effect on yield and quality:

The interaction between different nitrogen levels and cutting management on green forage yield of sorghum was found to be significant in second, third cut and total of cuts of green forage and dry matter yield (Table 1). Treatment combination (N_4C_4) was found significantly superior in respect to green forage yield of 434.30 and 448.64 q ha^{-1} during second and third, cut, respectively. However, this treatment combination did not differ significantly from N_4 C_3 in second cut and N_4 C_3 and N_4 C_2 in third cut. A similar trend was observed in total green forage yield. This may be attributed to the accelerated the process of cell division and elongation through more availability of nitrogen which in turn gave luxuriant vegetative growth and delayed harvesting. Significant interaction was only observed in total dry matter yield.

Interaction of different nitrogen levels and cutting management levels on crude protein yield of sorghum was found significant. Treatment combination N_4 C_4 (120 kg N ha^{-1} and first cut at 60 days after sowing + 2 subsequent cuts at 50 days interval) was significantly superior in recording maximum total crude protein yield.

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