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RESEARCH PAPER

Effect of nitrogen levels and cutting management on growth and yield of multicut forage sorghum [*Sorghum bicolor* (L.) Moench] variety cofs-29

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Abstract : A field experiment was conducted during summer season of 2014 at Anand to study the effect of nitrogen levels and cutting management on multicut forage sorghum [*Sorghum bicolor* (L.) Moench]. Plant height, number of tillers per metre row, leaf : stem ratio, green forage and dry matter yields was recorded with successive increase in N levels upto 120 kg ha^{-1}. The application of 120 kg N ha^{-1} gave significantly higher growth and yield characters over 60, 80, 100 kg N ha^{-1}. Statistically highest green forage and dry matter yields were obtained with application of 120 kg N ha^{-1}. Cutting management of first cut at 60 days after sowing and 2 intervals at 50 days produced significantly higher green and dry matter yields as well as growth and yield characters. Based on the findings, nitrogen level of 120 kg N ha^{-1} and cutting management of first cut at 60 days after sowing + 2 subsequent cuts at 50 days interval was found to be the better combination for obtaining higher yields of sorghum under middle Gujarat conditions.

Key Words : Cutting management, Green forage, Growth, Nitrogen, Yield

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INTRODUCTION

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 of the country are only able to meet 46.6 per cent of the requirement.

The low productivity of livestock is a matter of concern, which is primarily due to insufficient fodder and feed resources. Forages are the mainstay of animal wealth and their production. The scarcity of green forages and grazing resources in the country has made the livestock to suffer continuously with malnutrition resulting in their production potentiality at sub optimum level as compared to many developed nations.

Chemical fertilizers play an important role in fodder crop production. Nitrogen is an essential constituent of protein and chlorophyll and imparts dark green color to the plants. Nitrogen promotes shoot elongation, tillering

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and regeneration after defoliation and governs to a considerable degree the utilization of potassium, phosphorus and other elements in the plant.

Sorghum crop exhausts more nutrients than other forage crops and being a cereal crop, its requirement is in higher amount of nitrogen. Application of nitrogen element lower the fibre, lignin and neutral detergent fibre content of forage, thereby improve the succulence and palatability

Sorghum in its early stage is more succulent and with enhancement of growth there is decrease in the content of protein, minerals and fat content; on the contrary, dry matter content increases. So cutting time is an important management practice which not only influences the yield, but also quality of forages. The quality of fodder in terms of protein content and digestibility is improved due to frequent cuts. There is no specific research information on agro techniques for higher productivity of multicut forage sorghum (CoFS-29) for Gujarat. Hence, the study was conducted to study the effect of nitrogen levels and cutting management on multicut forage sorghum.

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 Randomized 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 growth characters 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:

Increasing levels of nitrogen from 60 to 120 kg ha^{-1} progressively increased growth and yield characters *viz*., plant height, number of tillers and leaf : stem ratio (Table 1). Significantly highest plant height, number of tillers and leaf : stem ratio were obtained with application of 120 kg N ha^{-1} in all cuts as well as the mean of all cuts. The increase in growth and yield characters was due to the fact that nitrogen plays an important role in increasing protoplasmic constituents which accelerates the process of cell division, cell elongation, cholorophyll synthesis and meristematic activity, which increased the number and length of internodes ultimately resulting better growth. The results are in compliance with the findings of Joon *et al*. (1993); Patel (1998); Kumar and Sharma (2002); Singh *et al*. (2005); Verma *et al*. (2005) and Gupta *et al*. (2008).

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 2). The increase in total green forage yield 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 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 Patel (1998); Ram and Singh (2003); 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 ultimately 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 Bhilare *et al.* (2002); Trivedi *et al.* (2010) and Rana *et al.* (2012).

Effect of cutting management :

Significantly taller plants were recorded under treatment C_4 (First cut at 60 DAS + Subsequent 2 cuts each at 50 days interval). The highest plant height in

Table 1 : Growth and yield parameters of forage sorghum as influenced by nitrogen levels and cutting management

Treatments	Plant height (cm)				Number of tillers per metre row length				Leaf : stem ratio			
	1st cut	2nd cut	3 rd cut	Mean	1st cut	2nd cut	3rd cut	Mean	1st cut	2nd cut	3rd cut	Mean
Nitrogen levels (N) (kg ha^{-1})												
N_1 : 60	119.90	141.73	156.91	139.51	72.17	77.50	86.42	78.69	0.243	0.230	0.233	0.235
N_2 : 80	137.57	148.48	167.49	151.18	76.50	83.25	94.25	84.67	0.247	0.238	0.250	0.245
N_3 : 100	145.27	153.79	181.28	160.11	81.75	86.92	104.83	91.17	0.257	0.248	0.253	0.253
N_4 : 120	153.46	164.24	202.06	173.25	89.50	105.75	111.33	102.19	0.275	0.265	0.260	0.267
S.E. ±	2.70	2.41	3.78	1.86	1.55	2.03	1.77	0.99	0.008	0.008	0.006	0.004
C.D. (P=0.05)	7.80	6.95	10.93	5.38	4.47	5.88	5.11	2.86	0.024	0.024	0.019	0.012
Cutting management (C)												
C_1	134.27	147.48	170.57	150.77	76.58	84.92	97.08	86.19	0.249	0.241	0.241	0.244
C_2	134.87	153.61	182.88	157.12	79.92	88.50	100.08	89.50	0.257	0.247	0.250	0.251
C_3	142.75	150.17	172.02	154.98	80.33	86.75	96.50	87.86	0.253	0.243	0.249	0.249
C_4	144.29	156.98	182.28	161.18	83.08	93.25	103.17	93.17	0.262	0.250	0.257	0.256
S.E. ±	2.70	2.41	3.78	1.86	1.55	2.03	1.77	0.99	0.008	0.008	0.006	0.004
C.D. (P=0.05)	7.80	6.95	10.93	5.38	4.47	5.88	5.11	2.86	NS	NS	NS	NS
Interaction												
N x C	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	6.73	5.48	7.41	4.13	6.70	7.98	6.18	3.84	11.13	11.82	8.96	5.63

NS-Not significant

Table 2 : Green forage, dry matter and crude protein yields 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

first, second and third cut were 153.46, 164.24 and 202.06 cm, respectively (Table 1). Number of tillers per metre row exhibited similar trend as that of plant height while leaf : stem ratio was not significantly affected by cutting management. The increase in plant height and tillers may be attributed to the advancement in maturity as well as delay in harvesting. These findings were also supported by Patel (1998) and Ayub *et al.* (2002).

Positive effect of cutting management on growth and yield attributes had resulted in significantly higher green forage and dry matter yield. 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 2). 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 with 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 (2003); Ayub *et al.* (2002); Joshi *et al.* (2007); Ayub *et al*. (2009) and Amandeep *et al.* (2010).

Interaction effect :

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. Treatment combination (N_4 C_4) 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.

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