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Research Paper

Nitrogen management in forage oat (*Avena sativa*) under North Gujarat Agro-climatic conditions

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) seasons of 2013–14 to 2016–17 under North Gujarat Agro-climatic conditions at Sardarkrushinagar, Gujarat, to study the effect of nitrogen management on performance of forage oat (*Avena sativa* L.) at Sardarkrushinagar, Gujarat. Application of 140 kg N/ha resulted in significantly more tillers/plant (3.22), leaves/plant (10.98), leaf length (41.47 cm), leaf width (1.49 cm), green and dry fodder yield (58.25 and 10.29 t/ha) of oat crop over rest of the treatments, i.e. N_1 (80 kg N/ha) N_2 (100 kg N/ha) and N_3 (120 N/ha). The same treatment of N realized the maximum net monetary returns (₹53,444/ha) and benefit: cost ratio (2.58). Among the different time of nitrogen application treatments, 50% N basal and 50% N after the first cut i.e. 45 days after sowing (DAS), resulted in significantly more tillers/plant (3.03), green (51.79 t/ha) as well as dry (9.64 t/ha) fodder yields than 50% N basal + 50% N after 30 DAS and 50% N as basal + 25% N after 30 DAS + 25% after the first cut i.e. 45 DAS, and the maximum net returns (₹44,282/ha) and B:C ratio (2.32) was obtained by the treatment of 50% N as basal and 50% N after the first cut i.e. 45 DAS of oat crop.

Key words : Benefit: cost ratio, Nitrogen, Oat, Time of nitrogen application

In India, the main livelihood source of farmers is livestock rearing. This is an old-age traditional way for increasing income, generating employment and alleviating rural poverty amongst rural farming community, especially in arid and semi-arid regions of India, where the crop farming is limited. The total area under cultivated fodder is only 8.4 million ha (5.23%) which is static since the last 2 decades. The fodder production in the country is not sufficient to meet the requirements of the growing livestock population and also the forages offered to animal are mostly of poor quality. At present, the country faces a net deficit of 33% green fodder and 11% dry crop residues. This gap in demand and supply may further rise due to consistent growth of livestock population at the rate of 1.23% in the coming years (GoI, 2007). In Gujarat, the total area under forage production is 7.96 thousand ha and total animal population is about 18.44 million and their optimum fodder requirement is 42.2 million tonnes, whereas only 20.0 million tonnes of fodder is made available in normal year. Looking the above scenario from 1995 to 2010, forage production is declining day by day. Thus, fodder and concentrate feed production is not enough to meet the feed requirements of animals and there is a wide gap between the actual requirements and availability of feeds and fodders for the present population of livestock. Without ensuring an adequate supply of fodder, the achievement of targeted growth of livestock sector in the coming year look almost impossible. Therefore, it is essential to maximize the quantity and quality of fodder production per unit area and time by proper management of grassland, pasture and also by utilizing the proper agro-techniques for fodder crop production.

Among different winter-season cereals, fodder oat (*Avena sativa* L.) is an important fodder crop which can be successfully grown under both irrigated and rainfed conditions with a rainfall of 500 mm and an optimum temperature range of 16–32°C. It ranks fifth in terms of world production of cereals and is widely used as a companion crop for under-seeding of forage legumes (Dost, 1997). The crop produces fodder which is rich source of energy, protein, vitamin B_1, phosphorus, iron and other minerals, at the time when other better-quality fodder are scarce in arid and semi-arid area.

Nitrogen is the most limiting nutrient for plant growth.

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It is an essential component of organic compounds such as amino acids, proteins, nucleic acids, hormones and chlorophyll (Wilkins and Jones, 2000). Amongst various nutrients, oat responds well to quantity of nitrogen and its time of application, which produces more tonnage in per unit area per unit time under favourable environmental conditions. Since information is meager on oat cultivation in North Gujarat, an experiment was planned to find out the effect of nitrogen levels and time of nitrogen application on green and dry fodder yield of forage oat.

MATERIALS AND METHODS

The field experiment was conducted with forage oat 4 years during the winter (*rabi*) seasons of 2013–14 to 2016–17 at Sardarkrushinagar, Gujarat. Geographically it lies at 24° 92 N, 72° 192 E, 154 m above mean sea-level situated in the arid and semi-arid region of North Gujarat. The average rainfall of the region is 550 mm. The average temperature during summer is 39°C, while during winter 8°C. December and January months are the coldest months of the year. The soil was loamy sand, low in organic carbon (0.20 %) and available nitrogen (135 kg/ha), medium in available phosphorus (51 kg/ha) and high in potassium (283 kg/ha), with *p*H value of 7.5. The experiment was laid out in a factorial randomized block design with 3 replications. The treatments consisted of 4 levels of nitrogen, i.e. N_1 (80 kg N/ha), N_2 (100 kg N/ha), N_3 (120 kg N/ha) and N_4 (140 kg N/ha), and 3 treatments comprising time of nitrogen application, i.e. M_1 (50% N basal + 50% N at 30 DAS), M_2 [(50% N basal + 50% N at 45 DAS (after first cut)] and M_3 [(50% basal + 25% at 30 DAS + 25% at 45 DAS (after first cut)]. The oat variety 'Kent' was sown in the first fortnight of November at a distance of 30 cm row spacing with keeping seed rate of 100 kg/ha. The package of practices of the S.D. Agricultural University for the cultivation of the winter (*rabi*) fodder oat (var. 'Kent') was followed in cultivation and management. Nitrogen applied in the form of urea as per treatments and phosphorus applied uniformly to all plots as a basal dose, i.e. 60 kg P_2O_5/ha in the form of diammonium phosphate. Observations were recorded on growth and yield parameters, viz. plant height, tillers/plant, leaves/plant, leaf length and leaf width, separately on each cutting and worked out average value. Green fodder yield and dry fodder yield were recorded during each cutting and tabulated total yield obtained from both the cut. All the data were statistically analyzed by applying the procedure of factorial randomized block design.

RESULTS AND DISCUSSION

Yield attributes

Effect of nitrogen: Yields attributes are major factor contributing towards forage yield of oat crop. The mean of 4 years data presented in Table 1 showed that significant differences were observed in the yield attributes due to different levels of nitrogen. Significantly higher value of yield attributes, i.e. tillers/plant, leaves/plant and leaf length were obtained under treatment N_4 (140 kg N/ha) over other treatments, whereas treatment N_2 and N_3 were found statistically at par with each other. Significantly higher leaf width was obtained by treatment N_4 than N_1 and N_2 treatments and it remained statistically at par with N_3. Application of different levels of nitrogen were failed to produce significant variation for plant height. However, the maximum plant height was recorded with 120 kg N/ha. This might be due to higher dose of nitrogen attributed synthesis of food materials, resulting in greater cell division. Therefore, yield attributes increased with concomitantly increased levels of nitrogen. These results are in close conformity with the findings of Bhilare and Joshi

Table 1. Influence of nitrogen levels and time of nitrogen application on plant height and yield attributes of fodder oat (pooled data of 4 years)

Treatment	Plant height (cm)	Tillers/ plant	Leaves/ plant	Leaf length (cm)	Leaf width (cm)
Nitrogen level (N)					
N_1, 80 kg N/ha	92.1	2.65	9.45	38.75	1.39
N_2, 100 kg N/ha	94.8	2.83	9.98	39.85	1.43
N_3, 120 kg N/ha	96.1	2.95	10.29	40.37	1.49
N_4, 140 kg N/ha	94.8	3.22	10.98	41.47	1.49
SEm±	1.10	0.06	0.14	0.33	0.01
CD (P=0.05)	NS	0.17	0.39	0.93	0.04
Time of N application (M)					
M_1, 50% N basal + 50% N at 30 DAS	93.9	2.82	9.98	39.76	1.43
M_2, 50% N basal + 50% N at 45 DAS (after 1st cut)	94.5	3.03	10.31	40.57	1.46
M_3, 50% basal + 25% at 30 DAS + 25% at 45 DAS (after 1st cut)	94.9	2.89	10.25	40.00	1.45
SEm±	0.90	0.05	0.12	0.29	0.01
CD (P=0.05)	NS	0.15	NS	NS	NS

(2008) and Jehangir *et al.*, (2013).

Effect of time of nitrogen application

On the basis of pooled data, numbers of tillers were not influenced significantly (Table 1). Treatment M_2 [50% N basal + 50% N after first cut (45 DAS)] resulted in numerically higher number of tillers/plant over rest of treatments. Time of nitrogen application had no significant effect on plant height, leaves/plant, leaf length and leaf width. Tallest plants were attained under M_3 [(50% basal + 25% at 30 DAS + 25% at 45 DAS (after first cut)] and leaves/plant, leaf length and leaf width were found maximum under M_2 treatment [50% N basal + 50% N after first cut (45 DAS)].

Green and dry fodder yield (t/ha)

Effect of nitrogen: The average of 4 years data of green and dry fodder yields showed that the green and dry fodder yields were significantly affected by to different levels of nitrogen (Table 2). Significantly higher green and dry fodder yields were observed under the treatment N_4 (140 N kg/ha) over rest of the treatments. Thus, forage oat is highly responsive to nitrogen nutrition and the crop responded to higher level of N application up to 160 kg/ha (Pradhan and Mishra, 1994; Joon *et al*., 1995; Singh *et al*., 1998). Green and dry fodder production also influenced by the increasing levels of nitrogen owing to their corresponding increase in number of tillers/plant thereby more photosynthetic area which ultimately increased the green and dry fodder production by plants. Our findings confirm the results of Mahale *et al*. (2004), Bhilare and Joshi, (2008), Sharma (2009) and Jehangir *et al.*, (2013).

Effect of time of nitrogen application: The total green and dry fodder yields were significantly influenced by various time of nitrogen application (Table 2). Significantly higher green and dry fodder yields were obtained under the treatment M_2 [50% N basal + 50% N after first cut (45 DAS)], whereas treatment M_1 (50% N basal + 50% N after 30 DAS) and M_3 [(50% N basal + 25% N at 30 DAS + 25% at 45 DAS (after first cut)] were at par with each other. This might be owing to adequate nitrogen supply after the first cut which fulfils the requirement of newly sprouted tillers, which enhanced the cell-division and cell enlargement and tillers/plant and helped to enhance green and dry fodder yields.

Economics

Data pertaining to economics of crop as influenced by level of nitrogen and time of nitrogen application treatments are furnished in Table 2. The highest net monetary returns and benefit: cost (B : C) ratio were accrued through the application of 140 kg N/ha. The lowest net returns of with B : C ratio were realized with the treatment N_1 (80 kg N/ha). The highest net realization of ₹44,282/ha and benefit: cost ratio value of 2.32 were accrued from the treatment M_2 [50% N basal + 50% N after first cut (45 DAS)] and the lowest with the treatment M_1. This might be owing to efficient utilization of nitrogen under the treatment M_2 which led to give higher yield with this level ultimately reflected in higher net realization and B: C ratio.

Table 2. Green and dry fodder yields of fodder oat as affected by different nitrogen levels and time of nitrogen application (pooled data of 4 years)

Treatment	Green fodder yield (t/ha)			Dry fodder yield (t/ha)			Economics	
	First cut	Second cut	Total yield	First cut	Second cut	Total yield	Net returns (×10³ ₹/ha)	Benefit: cost ratio
Nitrogen level (N)								
N_1, 80 kg N/ha	24.63	19.38	44.01	3.59	4.33	7.92	32.9	1.99
N_2, 100 kg N/ha	27.22	20.84	48.06	3.96	4.79	8.74	39.0	2.18
N_3, 120 kg N/ha	28.55	21.87	50.42	4.19	5.06	9.24	42.0	2.25
N_4, 140 kg N/ha	33.38	24.86	58.25	4.67	5.62	10.29	53.4	2.58
SEm±	0.73	0.64	0.88	0.11	0.17	0.20	–	–
CD (P=0.05)	2.04	1.80	2.46	0.30	0.48	0.57	–	–
Time of N application (M)								
M_1, 50% N basal + 50% N at 30 DAS	29.48	19.63	49.12	4.25	4.41	8.66	40.3	2.20
M_2, 50% N basal + 50% N at 45 DAS (after 1st cut)	28.42	23.36	51.79	4.10	5.54	9.64	44.3	2.32
M_3, 50% basal + 25% at 30 DAS + 25% at 45 DAS (after 1st cut)	27.43	22.22	49.65	3.95	4.90	8.85	40.9	2.22
SEm±	0.63	0.56	0.76	0.09	0.15	0.18	–	–
CD (P=0.05)	NS	1.56	2.13	NS	0.41	0.49	–	–

Kakol *et al*. (2003) also observed similar results.

On the basis of 4 years pooled data, it can be concluded that the application of 140 kg N/ha in 2 installments 50% N basal + 50% N after first cut (45 DAS) results in higher green and dry fodder yields along with higher monetary returns and B : C ratio under North Gujarat Agro-climatic condition.

REFERENCES

Bhilare, R.L. and Joshi, Y.P. 2008. Response of oat (*Avena sativa* L.) to nitrogen levels under different cutting management. *Journal of Maharashtra Agricultural Universities* **33**(3): 312–314.

Dost, M. 1997. End of Assignment report on fodder component. PAK/86/027. FAO/UNDP, Gilgit, Pakistan.

Government of India. 2007. *Report of the Working Group on Animal Husbandry and Dairying for the 11th Five Year Plan (2007–2012).* Planning Commission, Government of India, New Delhi.

Jehangir, I.A., Khan, H.U., Khan, M.H., F. Ur-Rasool, Bhat, R.A., Mubarak, T., Bhat, M.A. and Rasool, S. 2013. Effect of sowing dates, fertility levels and cutting managements on growth, yield and quality of oats (*Avena sativa* L.). *African Journal of Agricultural Research* **8**(7): 648–651.

Joon, L., Singh, S.H. and Sharma, K.L. 1995. Effect of levels and time of nitrogen application on grain yield of multi-cut oat. *Indian Journal Agronomy* **35**(1): 191–198.

Kakol, N.B., Alagundagi, S.C. and Hosamani, S.V. 2003. Effect of seed rate and nitrogen levels on forage yield and quality of oat. *Indian Journal of Animal Nutrition* **20**(2): 149–154.

Mahale, B.B., Nevase, V.B. and Throats, S.T. 2004. Effect of cutting management and nitrogen levels on forage yield of oats. *Journal of Soils and Crops* **14**(2): 469–472.

Pradhan, L. and Mishra, S.N. 1994. Beneficial effect of nitrogen on crude protein content and yield. *Indian Journal of Agronomy* **39**(2): 233–236.

Sharma, K.C. 2009. Integrated nitrogen management in fodder oats (*Avena sativa* L.) in hot arid ecosystem of Rajasthan. *Indian Journal of Agronomy* **54**(4): 459–464.

Singh, R., Sood, B.R., Sharma, V.K. and Rana, D.S. 1998. Effect of cutting management and nitrogen on forage and seed yields of oat (*Avena sativa* L.). *Indian Journal of Agronomy* **43**(2): 362–366.

Wilkins, R.J. and Jones, R. 2000. Alternative home-grown protein sources for ruminants in the United Kingdom. *Animal Feed Science and Technology* **85**: 23–32.