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Productivity of oat (*Avena sativa*) under different cutting management and split application of nitrogen

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ABSTRACT

A field experiment was conducted during *rabi* season for three consecutive years (2006-2009) at Navsari, Gujarat to assess the seed production potential of oat (*Avena sativa* L.) under three cutting management viz., No cut, one cut at 30 DAS and one cut at 45 DAS and three times of nitrogen application viz., Two equal splits at basal and 30 DAS (60+60 kg N/ha), three splits at basal, 30 and 45 DAS (60+30+30 kg N/ha) and three equal splits at basal, 30 and 45 DAS (40+40+40 kg N/ha). Among cutting management practices, no cut treatment produced higher seed (2.33 t/ha) and straw (11.05 t/ha) yields than cutting at 30 and 45 DAS. However, highest green fodder yield (14.38 t/ha) was recorded with cutting at 45 DAS. Net returns (₹46,642/ha) and B: C ratio (2.10) was higher with no cutting treatment. Application of nitrogen in three equal splits (40+40+40) gave significantly higher seed (2.15 t/ha) and straw (10.04 t/ha) yields which were at par with three splits (60+30+30), whereas green fodder yield (12.26 t/ha) was found significantly higher when nitrogen applied in two equal splits. Net returns (₹51,617/ha) and B:C ratios (2.26) were increased when N was given in three equal splits. Consequently for higher productivity and profitability of oat crop, it should be grown without cutting and fertilized with three equal splits of nitrogen (at basal, 30 and 45 DAS).

Key words : Cutting management, Fodder yield, Grain and straw yields, Oat, Time of nitrogen application

India accounts for the 15% of the world's livestock population. The total present forage availability in India is estimated to be only 250 million tonnes against the 1400 million tonnes of green fodder and 440 million tonnes against the need of 950 million tonnes for dry fodder in 2001 (Chotiya and Singh, 2005). The productivity of animals in India especially of milch animals is very low as compared to developed countries, primarily due to less availability of nutritive feed and fodder to animals. The most important hindrance in increasing fodder production is the inadequate availability of quality seeds of improved cultivar of forage crops, range grasses and legumes to the farmers. Oat is one of the most important *rabi* season fodder crop in India and used both feeds and fodder. Therefore, it is essential to increase the grain production through agronomical practices. Among the major plant nutrients, nitrogen plays a pivotal role in quantitative as well as qualitative improvement in the productivity of fodders. Split application of nitrogen may help to reduce it's leaching and volatilization losses and improve the efficiency of nitrogenous fertilizers. Further, the demand of green forage is increasing day by day with the introduction of high yielding milch animal. The non-availability of quality seeds of improved varieties is a crucial factor in popularization of fodder crop. Harvesting of forage crops for fodder at vegetative stage, eliminates the opportunity for producing seed which result scarcity of fodder seeds. There is limited information available pertaining to the agronomic practices of fodder oats on deep black soils of south Gujarat. In this context, the present study was under taken to evaluate the effect of cutting management and time of nitrogen application on green and dry fodder yields, seed yield, quality and economics of oat.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season 2006-07, 2007-08 and 2008-09 at Navsari Agricultural University, Navsari (Gujarat) situated at 20^0 57 N latitude 72^0 54 longitude and has an altitude of about 10 m above the mean sea level. The soil was clay in texture (13.33 % sand, 19.42 % silt and 67.25 % clay) having 7.4 pH, 0.50 % organic carbon, medium in available nitrogen (263 kg/ha) and phosphorus (31.6 kg/ha) and rich in available potassium (346 kg/ha). The experiment was laid out in factorial randomized block design, having nine treatments combinations with four replications. The treatments com-

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prised of three cutting management (C_0: No cut, C_1: One cut at 30 DAS and C_2: One cut at 45 DAS) and time of nitrogen application [N_1: Two equal splits at basal and 30 DAS (60+60 kg N/ha), N_2: Three splits at basal, 30 and 45 DAS (60+30+30 kg N/ha) and N_3: Three equal splits at basal, 30 and 45 DAS (40+40+40 kg N/ha). Oat 'Kent' was sown on 20, 18 and 21 November in 2006-07, 2007-08 and 2008-09, respectively by *kera* method in row 30 cm apart by using 100 kg seed/ha. A basal dose of P (30 kg/ha) applied through single super phosphate was drill uniformly at the time of sowing. Nitrogen was applied as per treatment. Light irrigation was given just after sowing. Five post sowing irrigation were given to crop during all the three years of experimentation. The crop was raised as per the recommended package of practices except the treatment. The crop was harvested in 2nd week of March (10, 15 and 14 March in 2006-07, 2007-08 and 2008-09 of crop season, respectively) in no cut treatment and 3rd week of March (19, 22 and 23 March in 2006-07, 2007-08 and 2008-09 of crop season, respectively) in remaining cutting management treatments. Green fodder was harvested from net plot of the one cut treatments at ground level as per schedule and then crop was allowed to set seed. The seed and straw yields were recorded from net plot of respective treatments. Monetary returns were worked out using, prevailing market price of green forage, straw and seed.

RESULTS AND DISCUSSION

Growth attributes

Over the seasons, cutting management influenced the plant height, number of tillers per metre row length, leaf : stem ratio and dry matter accumulation (g/plant) of oat significantly. At harvest, no cut treatment recorded significantly higher plant height, number of tillers and dry matter production over rest of the cutting treatments (Table 1). This might be due to better growth of the plant in terms of plant height and number of tillers per metre row length and secondly continuous vertical growth of the crop ultimately reflected in higher dry matter production. These results partially confirm the findings of Pradhan and Mohapatra (1995), Chakraborty *et al*. (1999), Bisht *et al*. (1999) and Sharma and Bhunia (2001). Leaf: stem ratio was recorded maximum when cutting was taken at 45 DAS. This was because of higher number of leaves emerge out after cutting under this treatment.

Under split application of nitrogen, three equal splits gave significantly higher value for growth attributes *viz*. plant height, no. of tillers per metre row length, dry matter accumulation and leaf : stem ratio. These might be due to adequate supply of nitrogen throughout the growth period. Moreover, nitrogen being an essential constituent of various amino acids, protein as well as structural constituent of cell, ultimately reflected into higher growth. Similar findings were earlier reported by Sharma and Bhunia (2001) and Rana *et al.* (2002).

Yield attributes and yield

The oat crop grown for seed production without cutting recorded significantly higher attributes *viz*., grains/panicle, panicle length, grain weight/plant (g) and 1000-grain weight, because of betterment of growth attributes *viz*., plant height, number of tillers and dry matter accumulation. Similarly, the cutting management practices significantly influenced the green fodder, straw and grain yield.

Table 1. Effect of cutting management and split application of nitrogen on growth and yield attributes and quality of oat crop at harvest (Pooled over 3 years)

Treatment	Plant height (cm)	No. of tillers/ metre row length	Leaf: stem ratio (%)	Dry matter (g/plant)	Grains/ panicle	Panicle length (cm)	Grain weight/ plant (g)	1000-seed weight (g)	Protein (%)	Germination (%)
Cutting management (C)										
C_0: No Cutting	146.2	108.3	77.6	3.48	42.9	27.8	1.64	37.7	9.7	88.6
C_1:Cutting at 30 DAS	130.7	108.2	80.4	3.24	32.6	25.9	1.20	36.7	9.4	80.3
C_2:Cutting at 45 DAS	120.5	96.2	81.0	2.93	26.8	22.4	0.96	35.7	8.9	67.8
SEm ±	3.15	2.61	0.87	0.06	1.44	0.55	0.049	0.24	0.12	0.75
CD (P=0.05)	9.19	7.61	2.53	0.19	4.21	1.59	0.14	0.70	0.34	2.20
Time of nitrogen application (N)										
N_1: (60+60) two equal split	126.3	98.5	77.6	3.12	29.6	24.0	1.09	36.1	8.9	77.0
N_2: (60+30+30) at Basal, 30 DAS & 45 DAS	133.1	106.5	80.3	3.17	35.2	25.5	1.30	36.8	9.4	79.5
N_3: (40+40+40) At Basal, 30 DAS and 45 DAS	138.0	107.7	81.0	3.36	37.6	26.7	1.41	37.3	9.6	80.2
SEm ±	3.15	2.61	0.87	0.06	1.44	0.55	0.049	0.24	0.12	0.75
CD (P=0.05)	9.91	7.61	2.53	0.19	4.21	1.59	0.14	0.70	0.34	2.20

Among the treatments, when crop was harvested for green fodder at 30 DAS and then left for seed production gave significantly higher seed and straw yield than cut for green forage at 45 Days. The superiority could be ascribed to better higher growth and yield attributes *viz*., plant height, numbers of tillers, grains per panicles and 1000 grain weight. However, green fodder yield was significantly higher when the crop was cut at 45 DAS. But this treatment produced the lowest seed yield. Higher green fodder yield was due to more crop duration in 45 days of cutting than 30 days cutting. When crop was raised for seed (grain) production, no cut treatment produced maximum seeds and straw yields. The increase in seed yield was 11.3 and 29.8% over cut at 30 and 45 DAS respectively. The magnitude of increase in straw yield no cut was 13.7 and 44.1% over cutting at 30 and 45 DAS, respectively. These findings are in conformity with Midha *et al*. (1999), Bisht *et al*. (1999) and Sharma and Bhunia (2001).

Split application of nitrogen had significantly influenced yield attributes, grain yield and dry and green fodder yields of oat. Crop fertilized in three equal splits of nitrogen at basal, at 30 and 45 DAS recorded maximum values of all the yield parameter and found significantly superior to N_1 treatment but it remained statistically on par with N_2 treatment. The better development, of almost all the growth and yield parameter under N_3 and N_2 treatments ultimately resulted into higher seed as well as straw yields with both these treatments over N_1. This might be due to reduced leaching losses under split applications than the single application at sowing and better reserve of nitrogen during the maximum utilization period of crop growth and development which resulted in adequate food supply to sink and ultimately reflected into better development of yield attributes. The maximum green fodder yield (12.26 t/ha) was significantly higher when nitrogen was applied in two splits (N_1) over rest of the treatments. Whereas, treatment receiving nitrogen in three equal split (40+40+40 kg/ha) gave significantly higher straw and seed yields, which was statistically on par with N_2 (three splits 50% at basal, 25% at 30 DAS and 25% at 45 DAS). The treatments N_3 and N_2 induced 9.62% and 6.31% increase in seed yield and 15.33 and 13.37% in straw yields, respectively over N_1. This result was correlated with those reported by Midha *et al*. (1999).

Quality

Among the cutting management, protein content and germination percentage was found maximum under no cut treatment (C_0) over the other treatments. Split application of nitrogen significantly increased crude protein content and germination percentage. Highest value of crude protein content with three equal splits of nitrogen could be

Table 2. Seed, straw and green fodder yields and economics of production of oat as influenced by different treatments

Treatment	Seed yield (t/ha)			Straw yield (t/ha)			Green fodder yield (t/ha)			Cost of cultivation (₹/ha)	Net returns (₹/ha)	Net B:C ratio
	06-07	07-08	08-09	06-07	07-08	08-09	06-07	07-08	08-09			
Cutting management (C)												
C_0: No Cutting	2.58	2.13	2.26	11.7	10.3	11.2	–	–	–	22,191	46,642	2.10
C_1:Cutting at 30 DAS	2.17	2.01	2.09	9.92	9.64	9.61	9.26	8.81	7.88	24,191	46,334	1.92
C_2:Cutting at 45 DAS	1.89	1.74	1.76	7.45	7.79	7.77	14.83	14.28	14.04	24,191	42,889	1.77
SEm±	0.054	0.052	0.060	0.264	0.193	0.155	0.163	0.240	0.176	-	-	-
CD (P=0.05)	0.159	0.150	0.175	0.770	0.565	0.452	0.492	0.723	0.530	-	-	-
N_1: (60+60) Two equal split	2.08	1.86	1.95	8.59	8.69	8.69	12.76	12.27	11.75	22,591	47,442	2.10
N_2: (60+30+30) At Basal, 30 DAS & 45 DAS	2.25	1.99	2.02	10.01	9.47	9.81	11.94	11.58	11.05	22,791	50,539	2.22
N_3: (40+40+40) At Basal, 30 DAS & 45 DAS	2.29	2.04	2.13	10.46	9.57	10.04	11.44	10.79	10.08	22,791	51,617	2.26
SEm±	0.054	0.052	0.060	0.264	0.193	0.155	0.200	0.294	0.215	-	-	-
CD (P=0.05)	0.159	NS	NS	0.770	0.565	0.452	0.602	0.886	0.649	-	-	-

Prevailing prices of output

Oat seed	₹25,000/t	Nitrogen	₹11.00/ kg
Green fodder	₹1,000/t	Phosphorus	₹20.60 /kg
Straw	₹1,500/t		₹100/day/ labour

attributed to availability of N as per requirement of crop which synthesized more carbohydrates which ultimately promote increased protein synthesis (Table 1).

Economics

No cut (C_0) treatment fetched higher net realization of ₹46,642 with BCR of 2.10 (Table 2) over rest of the cutting treatments. N application in 3 equal splits (three equal split at basal, at 30 DAS and at 45 DAS) secured maximum net realization of ₹51,617 with BCR of 2.26, which was closely followed by net realization of ₹50,539 with BCR of 2.22 under N_2 (three split 50% at basal, 25% at 30 DAS and 25% at 45 DAS) treatment.

From the three years study, it may be concluded that cultivation of oat 'Kent' without cutting and N application in three equal splits i.e. 40+40+40 kg N/ha as basal, 30 and 45 DAS is best for achieving higher and profitable seed and straw yield.

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