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Uma Singh
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Dr. AK Verma
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Dr. SK Jha
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Neha Verma
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Dipendre Pankaj Porte
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Uma Singh
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Quality of oat fodder (*Avena sativa* L.) As influenced by different doses of nitrogen, cutting management and splitting of nitrogen

Uma Singh, Dr. AK Verma, Dr. SK Jha, Neha Verma and Dipendre Pankaj Porte

Abstract
A field trail was carried out to examine the nitrogen and cutting effect on growth, yield and quality of fodder oat (*Avena sativa* L.) during 2018-19. Three levels of nitrogen *viz.* 100, 120 and 140 kg N ha^{-1} in main plot and four cutting management with splitting of nitrogen *viz.* two cuttings (50 DAS and 50% flowering) + 60% N as basal + 40% N at 1st cut, two cuttings + 50% N as basal + 50% N at 1st cut, three cuttings (50 DAS, 35-40 days after 1st cut and 35- 40 days after 2nd cut) + 50% N as basal + 25% N at 1st cut + 25% N at 2nd cut and three cuttings + 40% N as basal + 30% N at 1st cut + 30% N at 2nd cut were laid out in split plot design with three replications. Results revealed that application of 140 kg N ha^{-1} obtained the highest ash content, ash yield, crude fibre content, crude fibre yield, crude protein content as compared to 120 and 100 kg N ha^{-1}. As regards to cutting management and splitting of nitrogen, ash yield, crude fibre content, crude fibre yield, crude protein content were found maximum under three cuttings + $N_{50\%\ B}$ + $N_{25\%\ 1^{st}cut}$ + $N_{25\%\ 2^{nd}\ cut}$.

Keywords: Quality parameters, nitrogen levels, *Avena sativa* L

Introduction
Oat (*Avena sativa* L.) belongs to family poaceae. It can be cultivated with limited irrigation facilities. It produces high yields of nutritive forage. Oat crop have high yielding potential and multicut ability. By utilizing the re-growth and yield potential there is possibility for forage production and seed production making it by a dual purpose crop. Farmers leave the crop for seed production after taking one cut for forage. Proper management of cutting can be increased forage as well as seed yield of oat. There are several factors, which affect the productivity and quality of forage oat. Fertilization and cutting management are the two important factors which influence both productivity and quality of fodder crop Mahale *et al*., 2004. Nitrogen is a important component which is essential for all forage crops. Deficiency and excess supply of nitrogen has adverse effect on growth, development and yield of crop and also hampers the growth, productivity and health of animals. Nitrogen play a vital role in the growth of fodder through the impact on cell elongation, cell division and inter-nodal expansion, it also play a major role in early establishment of the crop.It is an important constituent of proteins and chlorophyll. Due to nitrogen, plants gain green colour and promotes early vegetative growth. It also improves the quality by increasing the protein content of fodder crops. Split application of nitrogen is an important nutrient management strategy because of productive and profitability. Dividing the total nitrogen application into two or more splits can help growers to enhance nutrient efficiency, promote optimum yields and mitigate the losses of nutrients. Splitting of nitrogen may help to reduce its leaching and volatilization losses and improves the efficiency of applied nitrogen. Forage oat especially multi-cut oat cultivars are heavy feeder of nutrients and remove large amount of nutrients from the soil. Therefore, it is need to assess the impact of splitting of nitrogen on performance of oat.

Material and Methods
Site and soil description
The study to estimate the effect of nitrogen levels, cutting management and splitting of nitrogen dose on quality of fodder oat was executed at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2018-19. The experiment site is situated by 21°16'N latitude, 81°36'E longitude and at an altitude of 298 m above mean sea level. Before sowing the crop the experimental soil was analyzed for their physico-chemical properties. Compound soil samples were collected randomly from different spots at the experimental field from a depth of 0-30cm just before preparing the field for sowing.

Soil samples were air dried, powered and sieved through 2 mm sieve. The soil of the experimental plot was clayey in texture having 8.5 pH. Soil organic matter (0.65%), available nitrogen (257 kg ha^{-1}), available phosphorus (18 kg ha^{-1}).

Treatment and experimental design

The treatment comprised of twelve treatments of three levels of nitrogen levels *viz.* 100, 120 and 140 kg N ha^{-1} in main plot and four cutting management with splitting of nitrogen *viz.* two cuttings (50 DAS and 50% flowering) + 60% N as basal + 40% N at 1st cut, two cuttings + 50% N as basal + 50% N at 1st cut, three cuttings (50 DAS, 35-40 days after 1st cut and 35- 40 days after 2nd cut) + 50% N as basal + 25% N at 1st cut + 25% N at 2nd cut and three cuttings + 40% N as basal + 30% N at 1st cut + 30% N at 2nd cut. These treatments were replicated three times in split plot design.

Crop husbandry

Recommended fodder oat variety is RO-19 (Phule Harita). It is a multicut variety. Developed by selection from kent by MPKV, Rahuri. Suitable for winter season under irrigated condition. Average green fodder yield-50 t ha^{-1}, dry matter yield-9.5 t ha^{-1}. The fertilizers were applied as per recommended dose of fertilizers *i.e.* 100 kg N in the form of Urea, 60 kg P_2O_5 as SSP and 40 kg K_2O as Muriate of potash. Full dose of Phosphorus and potash was applied as basal and nitrogen was given as per treatment. Sowing was done with a spacing 25 cm row to row distance. Seed rate @ 100 kg ha^{-1} RO-19 variety.

Procedure for recording quality parameters

Half kilogram (500gm) of fresh plant samples (stem and leaf) was taken from each treatment during each cutting and dried in an oven at 80ºC for 24 hours then make powder then 10gm weight the sample for analysis of quality parameters.

Crude protein

To determine crude protein.1.0gm of oven dried plant material was taken, 30ml of concentrated H2SO4 and 5gm digestion mixture (K_2SO_4:$CuSO_4$:$FeSO_4$(20:2:1) was added and then digested the material in the digestion chamber at 400 ºC for 2-3 hours. The digested mixture was cooled down and dilution was made with the help of distilled water in 250ml volumetric flask.10ml diluted sample was taken from this dilution. Distillation was done in Kjeldahl apparatus and nitrogen evolved as ammonia was collected in a receiver containing 2% boric acid solution and mixed indicator and this was titrated against standard 0.1N H2SO4 till golden yellow color volume of acid use was recorded. The reading was multiplied by 6.25factor to get crude protein (%).

The crude protein yield in q ha^{-1} was calculated by following formula

$$\text{CPY}(q\ ha^{-1}) = \frac{\text{Dry matter yield } (q\ ha^{-1}) \times \text{Crude protein content } (\%)}{100}$$

Crude fibre (%)

To determine crude fibre (%), 1.0gm of oven dried plant material was taken 250ml beker, added 1. 25%H_2SO_4 and distilled water and made the volume up the 200ml then placed it on flam for 30 minutes filtered and washed. Then again added 1.25% NaOH and distilleded water and made volume up to 200ml. Heated again for 30 minutes and residues were washed and filtered again. The residues were put in a pre weighted crucible and it was placed in an oven at 105ºC for drying for 24 hours. After recording the dry weight (W_1) the samples were placed in muffle furnace at 600 ºC till gray or white ash was obtained. Then cool it and the weight of ash (W_2) was recorded and the crude fiber (%) was calculated following formula.

$$\text{Crude fibre } (\%) = \frac{\text{Wt. of dried residue (g)} - \text{Wt. of ash (g)}}{\text{Wt. of dried sample (g)}}$$

Crude fibre yield (CFY) was calculated by following formula.

$$\text{CFY}(q\ ha^{-1}) = \frac{\text{Dry matter yield } (q\ ha^{-1}) \times \text{Crude fibre content } (\%)}{100}$$

Ash (%)

A weight quantity of plant sample (1g) was taken in a pre weighed silica crucible and crucible are oven dried. The crucible with the sample was ignited at 550 for 3 hours in muffle furnace. The residue on ashing was taken as total ash and was expressed on dry matter basis.

$$\text{Total Ash } (\%) = \frac{\text{(Wt. of crucible + ash after cooling - Wt. of crucible)}}{\text{Wt. of fresh sample}} \times 100$$

The total ash yield was calculated by multiplying the percent total ash with dry matter and shown in q ha^{-1}.

Result and discussion

Result revealed that ash content and ash yield was recorded at each cutting and presented in Table 1. The highest ash content was found under the application of 140 kg N ha^{-1} which was at par with 120 kg N ha^{-1}. Ash yield was significantly higher under the application of 140 kg N ha^{-1} as compared to other levels of nitrogen at each cutting and total. As regards to cutting and splitting of nitrogen, ash content as well as ash yield was not influenced at 1st cutting due to cutting and splitting of nitrogen. Further, at 2nd cutting, maximum ash content was obtained under three cuttings + $N_{40\%B}$ + $N_{30\%1^{st}cut}$ + $N_{30\%2^{nd}cut.}$ However ash yield was significantly higher under two cuttings + N $_{60\%B}$ + $N_{40\%1^{st}cut}$ which was at par with two cuttings + $N_{50\%B}$ + $N_{50\%1^{st}cut}$. Three cuttings + $N_{40\%B}$ + $N_{30\%1^{st}cut}$ + $N_{30\%2^{nd}cut}$ or three cuttings + $N_{50\%B}$ + $N_{25\%1^{st}cut}$ + $N_{25\%2^{nd}cut}$ were comparable and produced significantly higher total ash yield as compared to other treatments. These results are supported by Godra *et al*. (2014) [1].

Crude protein content and crude protein yield was significantly increased due to the application of 140 kg N ha^{-1}. The significant reduction in crude protein content and yield was noticed under the application of 100 kg N ha^{-1}. The increase in nitrogen concentration might have resulted to increase the protein content. These results are supported by Godra *et al*. (2014) [1]. Among cutting and splitting of nitrogen, crude protein content was highest under three cuttings + $N_{50\%B}$ + $N_{25\%1^{st}cut}$ + $N_{25\%2^{nd}cut}$ which was comparable with two cuttings + N $_{60\%B}$ + $N_{40\%1^{st}cut}$ and two cuttings + $N_{50\%B}$ + $N_{50\%1^{st}\ cut}$. Crude protein yield under two cuttings + $N_{60\%B}$ + $N_{40\%1^{st}cut}$ or $N_{50\%B}$ + $N_{50\%1^{st}cut}$ were

comparable and found to be significantly superior over other treatments.

Crude fibre content and crude fibre yield were estimated at 1st cut and 2nd cut. Crude fibre content and yield was not significantly influenced due to different levels of nitrogen at 2nd cut. At 1st cut, application of 140 kg N ha^{-1} found to be significantly superior over other nitrogen levels for crude fibre content and yield. Among cutting and splitting of nitrogen, crude fibre content was maximum under two cuttings + $N_{60\%\ B}$ + $N_{40\%1^{st}cut}$ but it was remained at par with two cuttings + $N_{50\%\ B}$ + $N_{50\%1^{st}cut}$. The highest crude fibre yield was recorded under two cuttings + $N_{50\%B}$ + $N_{50\%1^{st}cut}$ which was at par with two cuttings + $N_{60\%B}$ + $N_{40\%1^{st}cut}$. Crude fibre yield was not influenced significantly due to cutting and splitting of nitrogen at second cut. These results are supported by Godra *et al.* (2014) [1].

Table 1: Effect of nitrogen levels, cutting management and splitting of nitrogen on quality parameter of fodder oat

Ash content (%)			Ash yield (q ha^{-1})				Crude protein (%)			Crude protein yield (q ha^{-1})				Crude fibre (%)		Crude fibre yield (q ha^{-1})	
1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	Total	1st cut	2nd cut	1st cut	2nd cut
Nitrogen levels (kg ha-1)																	
11.3	10.2	6.8	3.2	6.2	3.7	11.2	12.3	9.3	7.9	3.5	6.1	4.4	11.8	18.0	21.3	5.2	14.0
12.0	10.9	7.0	3.7	7.0	4.1	12.8	13.3	10.1	8.2	4.1	7.1	4.8	13.7	18.7	22.3	5.8	15.6
12.8	11.7	7.2	4.7	8.4	4.7	15.4	14.4	10.5	8.4	5.3	8.1	5.6	16.2	19.3	22.4	7.0	17.2
0.3	0.2	--	0.2	0	--	0.4	0.2	0.1	--	0.2	0.4	--	0.4	0.1	0.3	0.2	0.8
1	0.9	--	0.9	1	--	1.6	0.7	0.4	--	0.7	NS	--	1.5	0.4	NS	0.9	NS
Cutting management and splitting of nitrogen																	
12.3	8.5	--	4.0	7.8	--	11.8	13.7	10.0	--	4.4	9.2	--	13.6	19.1	22.5	6.2	20.6
11.9	8.6	--	3.9	8.2	--	12.1	13.2	10.3	--	4.3	9.8	--	14.2	18.8	22.0	6.1	20.9
12.1	12.9	7.2	3.9	6.1	4.1	14.1	13.8	9.7	8.1	4.4	4.6	4.6	13.6	18.5	22.3	5.9	10.6
11.8	13.8	6.8	3.7	6.7	4.3	14.7	12.7	9.9	8.3	4.0	4.8	5.3	14.1	18.2	21.2	5.8	10.2
0.3	0.3	--	0.2	0.2	--	0.3	0.3	0.3	--	0.2	0.3	--	0.5	0.2	0.3	0.2	0.5
NS	0.8	--	NS	0.6	--	1.0	0.8	NS	--	NS	0.9	--	NS	0.5	0.9	NS	1.5
NS	NS	--	NS	NS	--	NS	NS	NS	--	NS	NS	--	NS	NS	NS	NS	NS

Treatment		100	120	140	SEm±	CD (P = 0.05)		Two cuttings (5 DAS & 50% flowering) + 60% N as basal + 40% N at 1st cut	Two cuttings + 50% N as +cut	Three cuttings (50 DAS, 35-40 days after 1st cut & 35-40 days after 2nd cut) + 50% N as basal + 25% N at 1st cut + 25 % N at 2nd cut	Three cuttings + 40% N as basal + 30% N at 1st cut + 30 % N at 2nd cut	SEm±	CD (P = 0.05)	Interaction

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