

Original Research Article

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Effect of Nitrogen Levels and Cutting Management on Nitrogen Content, Protein Content and Protein Yield of Fodder Oat (*Avena sativa* L.)

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ABSTRACT

The field experiment, conducted to evaluate the Effect of nitrogen levels and cutting management on growth, yield and quality of fodder oat (*Avena sativa* L.). A field experiment was conducted during *Rabi* season 2015-16 at Crop Research Centre (Chirauri) of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) to evaluate the effect of nitrogen levels and cutting management on performance of fodder oat and chemical properties of soil. The area lie at a latitude of 29° 40' North and longitude of 77° 42' East with an elevation of 237 meters above mean sea level. The soil of the experimental field was well drained, sandy loam in texture and slightly alkaline in reaction. It was medium in available nitrogen and phosphorus but high in available potassium with an electrical conductivity (1:2, soil: water suspension) of 1.6 dS/m. The treatments comprised 5 nitrogen levels (0, 40, 80, 120 and 160 kg ha⁻¹) and 2 cutting management (single at 50% flowering and double at 60 DAS and 50% flowering), replicated 4 times in a factorial randomized block design. The data on growth, physiology, green forage yield and quality and its contributing traits were calculated on net plot area basis (16 m²), whereas content and uptake in straw along with soil available nutrients and production economic, were recorded as per the standard procedure. The results indicated that nitrogen content, protein content and protein yield were significantly superior at 160 kg nitrogen ha⁻¹. Likewise, double cut shows higher protein content than single cut management, single cut resulted into higher protein yield than their respective counterparts like double cutting (60DAS and 50 % flowering). Nitrogen content in straw not influenced significantly by cutting management.

Keywords

Yield,
Quality, Fodder,
Nitrogen levels.

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Introduction

Livestock population is the largest in India comprising 182.50 million cattle, among these, 61.30 million buffaloes, 76.65 million goats, 41.30 million sheep, 10.0 million pigs and 3.04 million other animals (Jatet *al.*, 2014). India is having the largest livestock population, 15% of the world's livestock population (Neelar, 2011).

Livestock contributing 7% to national GDP and source of employment and ultimate livelihood for 70% population in rural areas. Deficiency in feed and fodder has been identified as one of the major components in achieving the desired level of livestock production. At present, the country faces a net deficit of 63% green fodder, 24% dry crop

residues and 64% feeds (Kumar *et al.*, 2012). The productivity of our livestock often remains low due to inadequate and nutritionally unbalanced supply of feed and fodder. Half of the total losses in livestock productivity are attributed to the inadequacy in supply of feed and fodder.

Deficiency of green fodder will be about 64.9% and for dry fodders up to 24.9% in 2025 A.D. Under such circumstances the only way to bridge the gap between demand and supply of the fodder is to ameliorate the forage resources. Among forages, oat (*Avena sativa* L.) is an important winter feed and forage crop. Owing to its excellent growth habit, better regeneration capacity and good quality forage, it is a promising forage crop. Oat being rich in carbohydrates, vitamins, minerals and total digestible nutrients, is widely used as supplement, hay and silage.

Oat (*Avenasativa* L.) is the important cereal (*Gramineae*) and forage crop, grown during *rabi* season and is next to berseem in nutritive value. It is also rich in energy, protein, vitamin B, phosphorous and iron (Tiwana *et al.*, 2008). It is cultivated in an area of 1021 million ha with an annual production of 233 million tons in the world (Anonymous, 2009). The total area covered under oat cultivation in India is about 1.0 million ha with 350-500 q ha⁻¹ green fodder productivity (IGFRI, 2011). In India, it is grown in Punjab, Haryana, Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharashtra and West Bengal. The crop occupies maximum area in Uttar Pradesh (34%) followed by Punjab (20%), Bihar (16%), Haryana (9%) and Madhya Pradesh (6%).

It is important winter crop in many parts of the world and is grown as multipurpose crop for grain, pasture, forage or as a rotation crop. Oat plant has excellent growth habit, quick

recovery after cutting and good quality herbage. It is a palatable, succulent and nutritious crop. The protein quality of oat is excellent. Oat requires a long cool season for its growth; therefore, it is successfully grown in the northern plains and hilly areas of the country. Oat is mostly fed as green but surplus is converted into silage or hay to use during fodder deficit periods. Oat as a forage crop, has the advantage of being winter hardy and serves as catch crop.

There are several factors, which affect the productivity and quality of forage oat. Nitrogen is a one of the major component to influence the forage growth, yield and quality. Nitrogen play the 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. Nitrogen is useful for the improvement of the leaf area by synthesis of enzymes and chlorophyll and also improves the leaf weight. Nitrogen improves the fodder yield through enhancement of growth parameters like plant height, number of tillers, leaf area index, number of leaves, leaf: stem ratio and dry matter accumulation. It is an essential part of protein and is a constituent of physiologically important compounds like nucleotides, vitamins, enzymes and hormones that promotes growth and development in crop plants (Kumar *et al.*, 2001) and also improve the meristematic activity, it is useful for absorbing of nutrients from the soil efficiently and enhance the protein content of the crop through improvement in synthesis of carbohydrates. Forage oat especially multi-cut oat cultivars are heavy feeder of nutrients and remove large amount of nutrients from the soil. Nitrogen availability to the plant directly influence the forage yield, it is the reason to provide the nitrogen with the split applications. Split application of nitrogen improves the availability of the nutrient to the crop and improves the nitrogen use efficiency.

In general farmers use the nitrogen 120 kg ha⁻¹ with improper doses in oat crop but nitrogen @160 kg ha⁻¹ with split applications gave the higher yields than farmer practices (Chouhan *et al.*, 2014).

Cutting management is the one of the important factor to influence the fodder crop growth, yield and quality. In general cutting management may fallowed in fodder crops for higher yields. Cutting exhibits the effect on nutrient and natural resource utilization by the crop. As compared to single cut multi cut crops absorb more nutrients, which directly influence the nitrogen content, protein content and other quality parameters of the crop.

Cutting is one of the main factor to influence the green and dry forage yield (Patel *et al.*, 2013), because it plays major role in biomass synthesis. In oat crop commonly gave two cuttings are at different stages, but 1st cut at 60 DAS and 2nd cut at 50% flowering gave the better growth and yield (Sharma *et al.*, 2001).

Materials and Methods

The field experiment was conducted at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) during *rabi* season 2015-16. The climate of this region is sub-tropical and semi-arid and climate characterized with summers and extremely cold winters. The mean maximum temperature of this region is about 43^oC to 45^oC is not uncommon during summer while very low temperature (1-2^oC) accompanied by frost may be experienced in December-January. The winters are cool; frost generally occurs towards the end of December and may continue till the end of January. The monsoon generally begins during the third week of June and desists by the end of September. The total precipitation and its distribution in this region various largely about 75 to 85% of it's received

during July to September and few showers are also a common feature during the month of December to January and in late spring season. Mean weekly meteorological data for the season during experimentation period (2015-2016) based on observations collected at meteorological observatory of SVPUA&T, Modipuram, Meerut. Total precipitation of 211.30 mm was received during the experimentation period. The maximum temperature being 32.71^oC was recorded in 13th standard week. While, the minimum temperature was 8.57^oC in 51th standard week and the Relative Humidity ranged from 45.4 to 66.2% recorded, respectively in the morning. Ten treatment combinations comprising of five levels of nitrogen viz., 0 kg ha⁻¹ N(N0), 40 kg ha⁻¹ N (N1), 80 kg ha⁻¹ N (N2), 120 kg ha⁻¹ N (N3) and 160 kg ha⁻¹ and two cuttings, single cut at 50% flowering stage and first cut at 60 DAS and second cut at 50% flowering. Oat seed were drilled by adopting a spacing of 25 cm. Kent cultivar was used in the study.

In plant total nitrogen was determined by kjeldhals method. In a digestion tube 0.5 gm finally powdered plant samples was taken and added 10 ml of concentrated H₂SO₄ + 1gm digestion mixture (K₂SO₄ + CuSO₄.5H₂O), and kept for overnight, than heating was done in digestion chamber till the clear colourless solution appears. Cooled digest was shifted to distillation unit.

The content was distilled for 10 minutes using 40% NaOH and distillate was collected in a conical flask containing 4% Boric acid mixture. The distillate was finally titrated against standardized H₂SO₄, once the colour change from bluish green to permanent pale pink colour note the burette reading.

At each harvest nitrogen content (%) was multiplied with factor 5.73 to convert into protein content (%).The protein yield was calculated as per formula given below:

$$\text{Protein yield (kg ha}^{-1}\text{)} = \frac{\text{Dry matter yield (kg ha}^{-1}\text{)} \times \text{Protein content (\%)}}{100}$$

Results and Discussion

Nitrogen content in straw (%)

Nitrogen content in straw was affected significantly by nitrogen levels but not by the cutting-management. The related data are represented in table 1.

Nitrogen content in the plant was affected significantly by nitrogen levels, nitrogen content of plant decline with the advancement in crop growth. Application of 160 kg N ha⁻¹ resulted in significantly higher nitrogen content than lower levels. Nitrogen content of the plant increased significantly with the successive increment in nitrogen levels. Cutting management exhibited non-significant effect on nitrogen content in plant.

The higher nitrogen content in plants might be due to better root development. The decrease in nitrogen content with age might be due to decrease in nitrogen uptake and dilution with

increased structural carbohydrates content of aging crops. Nitrogen content was higher in double cut than single cut system. Similar result was also reported by verma (I984).

Protein content (%)

Nitrogen levels and cutting management affected the protein content significantly. Interaction effect between nitrogen content and cutting management was found non-significant. The data are represented in table 2.

Protein content was affected significantly by nitrogen levels. Among the all nitrogen levels, 160 kg ha⁻¹ gave the maximum protein content at second cut (11.02 %) which was significantly higher than rest of doses. Moreover, in all other treatments protein content increased significantly with successive increase of nitrogen levels.

Cutting management also exhibited significant effect on protein content. Among the different cutting practices, double cut was gave more protein content than single cut at second cutting.

Table.1 Effect of nitrogen levels and cutting management on nitrogen content (%) in plant

Nitrogen content (%)		
	1 st cut	2 nd cut
Nitrogen levels (kg ha⁻¹)		
N - 0	1.52	1.12
N - 40	1.65	1.43
N - 80	1.79	1.53
N - 120	2.10	1.73
N - 160	2.50	1.92
S.Em(±)	0.010	0.001
CD at 5 %	0.030	0.020
Cutting management		
At 50% flowering	—	1.54
At 60 DAS and 50% flowering	1.91	1.55
S.Em (±)	—	0.005
CD at 5 %	—	NS

Table.2 Effect of nitrogen levels and cutting management on protein content (%) of forage oat

Protein content (%)		
	1 st cut	2 nd cut
Nitrogen levels (kg ha⁻¹)		
N - 0	8.70	6.45
N - 40	9.45	8.25
N - 80	10.25	8.77
N - 120	12.05	9.83
N - 160	14.35	11.02
S.Em(±)	0.08	0.03
CD at 5 %	0.25	0.11
Cutting management		
At 50% flowering	—	8.78
At 60 DAS and 50% flowering	10.96	8.95
S.Em (±)	—	0.02
CD at 5 %	—	0.07

Table.3 Effect of nitrogen levels and cutting management on protein yield (kg ha⁻¹)

Protein yield (kg ha ⁻¹)		
	1 st cut	2 nd cut
Nitrogen levels (kg ha⁻¹)		
N - 0	67.6	589.5
N - 40	117.8	822.6
N - 80	137.5	948.2
N - 120	187.9	1153.0
N - 160	255.3	1385.0
S.Em(±)	2.25	7.05
CD at 5 %	6.55	20.46
Cutting management		
At 50% flowering	—	1195.0
At 60 DAS and 50% flowering	153.22	764.0
S.Em (±)	—	4.45
CD at 5 %	—	12.94

Protein yield (kg ha⁻¹)

Nitrogen levels and cutting management exhibited a significant effect on protein yield. The related data are represented in table 3.

Among the all nitrogen levels, 160 kg ha⁻¹ (1385kg ha⁻¹) gave the maximum protein yield at 2nd cutting, it was significantly higher than protein yield recorded with other nitrogen levels and higher than control plot

(589.5 kg ha⁻¹). Protein yield significantly increased with successive increment in nitrogen levels. Cutting management also exhibited significant effect on protein yield. Among the different cutting practices, single cut gave more protein yield (1195 kg ha⁻¹) which was higher than double cutting practises (764 kg ha⁻¹).

The significantly higher protein yield in single cut system compared to two cut

systems might be due to high dry matter yield in single cut system. Kumar *et al.*, (2001) reported that two cut systems gave significantly more crude protein content because of weighted average value for two cut systems being higher due to much higher crude protein of the first cut. The results are in conformity with the findings of Pisal *et al.*, (1993) and Singh (2004).

In the present investigation nitrogen content, protein content and protein yield increased with nitrogen level. These characters are increased significantly upto 160 kg N kg ha⁻¹ at all the growth stages. The data indicated that nitrogen content was decreased with delay in first cutting. Cutting shows non-significant effect on nitrogen content in the plant. But comparatively double cutting management showed better nitrogen content than single cut.

The data presented revealed that double cut at 60 DAS and 50% flowering gave significantly higher crude protein content than single cutting managements. Crop harvested once at 50 % flowering produced significantly higher crude protein yield than double cutting managements.

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