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Nitrogen Fertilization and Fodder Cutting Schedule on Oat (*Avena sativa* L.) Fodder Quality and Economic Returns

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ABSTRACT

A field experiment, employing a split-plot design with three replications, was conducted during the 2019-2020 *rabi* season to evaluate the impact of different oat varieties and nitrogen fertilization regimes on fodder yield and quality. Three oat varieties (RO-19, JHO-851, and UPO-212) were tested in conjunction with four nitrogen application strategies: (T_1) two cuttings (at 55 days after sowing (DAS) and 50% flowering) with 60% of total nitrogen applied basally and 40% at the first cut; (T_2) two cuttings (55 DAS and 50% flowering) with 50% nitrogen basally and 50% at the first cut, (T_3) three cuttings (55 DAS, 35 days after the first cut, and 50% flowering) with 50% nitrogen basally, 25% at the first cut, and 25% at the second cut and (T_4) three cuttings (55 DAS, 35 days after the first cut and 50% flowering) with 40% nitrogen basally, 30% at the first cut, and 30% at the second cut. Statistical analysis revealed that JHO-851 exhibited significantly higher crude protein (%), total ash (%), and plant nitrogen content (%). Regarding nitrogen management, the highest crude protein (%) and total ash (%) were observed under the T_1 treatment (two cuttings, 60% basal N, 40% N at first cut), while the maximum plant nitrogen content (%) was recorded in the T_2 treatment (two cuttings, 50% basal N, 50% N at first cut). Economic analysis demonstrated that the treatment combination of JHO-851 with the T_2 nitrogen management strategy (V_2N_2) resulted in the highest gross income (Rs106,692.7 ha^{-1}), net return (Rs 73,434.71 ha^{-1}), and benefit-cost ratio (2.20 Rs Re^{-1}).

Keywords Cutting schedule, Crude protein, Total ash, Net return, Benefit-cost ratio.

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INTRODUCTION

Fodder oat, is a widely cultivated fodder crop globally, valued for its provision of protein and energy to livestock. This species exhibits adaptability to diverse soil profiles. Optimizing fodder oat production, both in terms of quality and economic viability, is influenced by several agronomic factors, notably nitrogen

(N) fertilization regimes and harvesting schedules (Singh *et al.* 2020).

Nitrogen, a crucial macronutrient for plant growth and development, significantly impacts both the biomass yield and nutritional composition of fodder oats. However, excessive N application can induce detrimental effects such as lodging and diminished fodder quality. Implementing a split N application strategy, fractionating the total N requirement into multiple applications, can enhance nitrogen use efficiency (NUE) and mitigate N losses through leaching and volatilization. This approach facilitates a more gradual N uptake by the plant, minimizing environmental losses.

Furthermore, the number and timing of harvests influence fodder oat quality and economic returns (Bhilare and Joshi 2007). Early-season harvests maximize green fodder yield, although the nutritional quality may be suboptimal. Conversely, delayed harvests result in higher dry matter yields and potentially improved fodder quality. The ideal N fertilization rate and cutting schedule are site- and cultivar-specific, contingent upon climatic conditions (Godara *et al.* 2019), soil characteristics, and the specific oat variety cultivated. Research suggests that a split N application strategy coupled with early-season harvesting can optimize both the quality and economic performance of fodder oat production (Kumar *et al.* 2017).

MATERIALS AND METHODS

The experiment was conducted experimental site, located geographically at 26°47' N latitude, 82°12' E longitude, and an altitude of 113 meters above mean sea level, experiences a subtropical climate. The soil was classified as silt loam with an alkaline pH of 8.8. Analysis revealed low organic carbon content (0.25%), low available nitrogen (190 kg ha^{-1}), medium available phosphorus (16.5 kg ha^{-1}), and medium available potash (238.1 kg ha^{-1}). A split-plot design with three replications was employed. The main plots consisted of three oat varieties (RO-19, JHO-19, and UPO-212). Sub-plot treatments comprised varying nitrogen application regimes across different cutting schedules: 1), Two cuttings (55 days after sowing (DAS) & 50% flowering) with 60% N basally and 40% N at the first cut, 2). Two cuttings (55 DAS & 50% flowering) with 50% N basally and 50% N at the first cut, 3). Three cuttings (55 DAS, 35 days after the first cut, & 50% flowering) with 50% N basally, 25% N at the first cut, and 25% N at the second cut; and 4), Three cuttings (55 DAS, 35 days after the first cut, & 50% flowering) with 40% N basally, 30% N at the first cut, and 30% N at the second cut. Sowing was performed on November 18, 2019, in opened furrows spaced 25 cm apart, using a seed rate of 100 kg ha^{-1}. For quality parameter analysis, 500g fresh plant samples (stem and leaf) were collected from each treatment at each cutting, oven-dried at 80°C for 24 hours, powdered, and a 10g subsample was used for analysis. Economic analysis was performed based on prevailing input costs and output selling prices. Statistical analysis was conducted using Analysis of Variance (ANOVA) following standard procedures (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Crude protein, total ash, and nitrogen content in plants (Table 1) are not significantly influenced by different varieties and significantly affect by fodder cutting and splitting of nitrogen management of oats. A investigation on oat varieties revealed that crude protein content wasn't significantly affected by cutting stage, with JHO-851 exhibiting the highest (12.60%, 10.66%, and 8.66%) and RO-19 the lowest (12.25%, 10.23%, and 8.13%) protein levels across all cuts. Nitrogen application timing influenced crude protein, with the highest levels (12.50%) observed in the two-cut system (55 DAS & 50% flowering) combined with specific nitrogen application strategies. Total ash content wasn't significantly affected by variety, though JHO-851 had the highest (12.80%, 11.70%, and 7.20%) and RO-19 the lowest (10.67%, 10.83%, and 11.83%) ash content at different cuts. Similar to crude protein, nitrogen application timing influenced total ash, with the two-cut system plus specific nitrogen applications showing the highest values. Plant nitrogen content was significantly affected by both variety and nitrogen application, with JHO-851 again exhibiting the highest (2.07%, 2.06%, and 1.89%) content. The two-cut system with specific nitrogen applications also resulted in the highest plant nitrogen content (2.14%).

Table 1. Crude protein (%), total ash (%) and nitrogen content in plant (%) cutting as influenced by splitting of nitrogen on different varieties of oat (*Avena sativa* L.).

Treatments	Crude protein (%) (Ist cut)	(IIndcut)	(IIIrd cut)	Total ash (%) (Ist cut)	(IIndcut)	(IIIrd cut)	Nitrogen content in plant (%) (Ist cut)	(IIndcut)	(IIIrd cut)
Varieties									
RO-19	12.25	10.23	8.13	10.67	10.83	11.83	2.14	1.83	0.00
JHO–851	12.60	10.66	8.66	11.50	11.70	12.80	1.95	2.04	0.00
UPO-212	12.41	10.35	8.19	10.84	10.90	12.00	1.95	1.82	1.67
SEm±	0.13	0.17	0.21	0.20	0.20	0.30	1.83	1.90	1.70
CD at 5%	NS	NS	NS	NS	NS	NS	0.05	0.04	0.03
Fodder cutting and splitting of nitrogen management									
Two cuttings (55 DAS & 50% flowering) + 60% N as basal + 40% N at Ist cut	12.50	9.96	0.00	12.30	12.80	0.00	2.14	1.83	0.00
Two cuttings (55 DAS & 50% flowering) + 50% N as basal + 50% N at Ist cut	12.43	9.78	0.00	11.90	12.60	0.00	1.95	2.04	0.00
Three cuttings (55 DAS, 35 days after 1st cut & 50% flowering) + 50% N as basal + 25% Nat Ist cut + 25% Nat IInd cut	12.40	10.74	8.16	11.80	10.60	12.80	1.95	1.82	1.67
Three cuttings (55 DAS, 35 days after 1st cut & 50% flowering) + 40% N as basal + 30% Nat Ist cut + 30% Nat IInd cut	12.35	10.64	9.16	12.10	10.58	12.20	1.83	1.90	1.70
SEm±	0.15	0.20	0.24	0.30	0.30	0.30	0.05	0.04	0.03
CD at 5%	NS	0.59	0.72	NS	0.80	0.90	0.15	0.13	0.10

Cutting schedules and nitrogen application methods under various varieties of investigation show in Table 2 significant differences in economic parameters. The highest gross income (Rs 106692.7 ha^{-1}) and net return (Rs 73434.71 ha^{-1}), along with the best benefit-cost ratio (2.20), were achieved with the JHO-851 variety, two cuttings (at 55 days after sowing and 50% flowering), and a nitrogen application split as 50% basal and 50% at the first cut. Conversely, the lowest gross income (Rs 91509.42 ha^{-1}), net return, and benefit-cost ratio (1.50) were observed with the UPO-212 variety, three cuttings (55 days after sowing, 35 days after the first cut, and 50% flowering), and a nitrogen application split as 50% basal, 25% at

Table 2. Effect of various treatments on economics at various varieties and cutting management & splitting of nitrogen.

Treatments	Gross income (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio (Rs Re^{-1} investment)
V_1N_1	101392.7	32458	68934.73	2.12
V_1N_2	103326.7	32458	70868.68	2.18
V_1N_3	99566.68	36286	63280.68	1.74
V_1N_4	102470	36286	66184.01	1.82
V_2N_1	104695.8	33258	71437.76	2.14
V_2N_2	106692.7	33258	73434.71	2.20
V_2N_3	102810.2	37086	65724.22	1.77
V_2N_4	105808.1	37086	68722.13	1.85
V_3N_1	93187.71	32658	60529.71	1.85
V_3N_2	94965.15	32658	62307.15	1.90
V_3N_3	91509.42	36486	55023.42	1.50
V_3N_4	94177.8	36486	57691.8	1.58

the first cut, and 25% at the second cut. The highest cost of cultivation (Rs 37086 ha^{-1}) was associated with the JHO-851 variety under three cuttings and a split nitrogen application (50% basal, 25% at the first cut, and 25% at the second cut, or 40% basal, 30% at the first cut, and 30% at the second cut). These findings are supported by similar research reported by Dabhi *et al.* (2017), Sheoran *et al.* (2017), Pravalika and Gaikwad (2021), and Luikham *et al.* (2013).

CONCLUSION

Result concluded that JHO-851 variety with two cuttings (55 DAS & 50 % flowering) and 50% nitrogen as basal + 50% nitrogen at first cut yielded the highest crude protein (%), total ash (%), and nitrogen content in plant (%), resulting in the highest gross income of Rs 106692.7 ha^{-1}, net return of Rs 73434.71 ha^{-1}, and benefit: cost ratio of 2.20 Rs. Re^{-1} investment.

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