Vol. 25, No. 2, pp. 284-290 (2025)
Journal of Agricultural Physics
ISSN 0973-032X
https://doi.org/10.56093/JAP.v25i2.17

Research Article

Growth, Productivity and Profitability of Fodder Oat (*Avena sativa* L.) as Influenced by Cultivars and Nitrogen Levels under Semi-Arid Ecology

DARSHAN[1]*, VISHUDDHA NAND[2], PRAGATI PRAMANIK MAITY[3] AND SUNIL KUMAR PRAJAPATI[4]

[1]*ICAR- Indian Agricultural Research Institute, New Delhi-110012*
[2]*Department of Agronomy, Acharya Narendra Deva University of Agriculture & Technology, Ayodhya-224229, Uttar Pradesh*
[3]*Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012*
[4]*Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi-110012*

ABSTRACT

A field experiment was conducted at GPB Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India, during the *rabi* season of 2019-20. The study employed a split plot design with seven oat genotypes (OL-1876-2, OL-1906, HFO-611, JHO-17-4, JO-10-506, UPO-212, and JHO-822) as main plot treatments and four nitrogen levels (35 kg ha^{-1}, 70 kg ha^{-1}, 105 kg ha^{-1}, and 140 kg ha^{-1}) as subplot treatments, replicated thrice. The results indicated that the oat genotype UPO-212, coupled with a nitrogen application of 140 kg ha^{-1}, produced significantly superior growth parameters, including plant height, number of tillers per plant, leaf-to-stem ratio, leaf area index, and both fresh and dry plant weight. This genotype and nitrogen level combination also yielded the highest green and dry fodder output. Economic analysis revealed that the maximum net return of 153984 INR ha^{-1} and the benefit-cost ratio (3.91) were achieved with the UPO-212 genotype at 140 kg N ha^{-1}. These findings underscore the importance of selecting appropriate genotypes and optimizing nitrogen levels to enhance oat crop productivity and profitability.

Key words: Crop productivity, Profitability, Nitrogen levels, Entries, Dual cut oat

Introduction

Oats (*Avena sativa* L.) are a common winter cereal crop used for fruit, feed, and fodder around the world. It is a member of the *Poaceae* family and ranks sixth in global cereal production, after wheat, maize, rice, barley, and sorghum. The majority of the oats produced worldwide are used as a primary feed for livestock (Pal *et al*., 2021). The ever-rising demand for fodder and feed for sustaining placental mammal production is met by increasing the productivity of fodder. According to the projected scenario, the imbalance between the demand and supply of fodders requires prompt attention to establish appropriate strategies to close the gap (Karnatam *et al.,* 2023). Because of its excellent growth habit, fast regeneration potential, and better palatability with more protein and mineral content, oats are the most important *rabi* season crop grown for animal food under irrigated conditions in the northern and northwestern regions of India. Additionally, oats are utilized for making animal

*Corresponding author,
Email: darshansaroj1996@gmail.com

silage, further enhancing their value in livestock nutrition (Chakraborty *et al.,* 2016; Kumari *et al.,* 2014). The number of cuttings is a crucial component that influences the growth, productivity, and quality of fodder crops, as well as the crop's use of nutrients and natural resources. Multi-cut crops absorb more nutrients than single-cut crops, directly affecting the nitrogen and protein content, as well as other quality metrics, of the crop (Li *et al.,* 2022).

Nitrogen is a critical nutrient for all crops, especially non-legumes, because it is a major component of proteins and chlorophyll. In green plants, nitrogen is essential for various physiological processes, including photosynthesis and growth (Pal *et al.,* 2021). It is also essential for fodder production, as the crop consumes it in large quantities. A sufficient nitrogen supply is related to high photosynthetic activity, vigorous development, and a dark green colour in fodder, as well as being known to aid carbohydrate utilisation and increase fodder juiciness. Nitrogen fertiliser is also a key element influencing the yield and quality of oat forage (Subrahmanya *et al*., 2017; Yadav *et al.,* 2017). Therefore, this study aims to evaluate promising dual-cut oat entries under different nitrogen levels in northern India. The objective is to identify optimal nitrogen management practices that maximize yield and quality, ensuring a reliable supply of high-quality fodder to meet the rising demands of livestock production.

Materials and methods

The experiment was conducted at the GPB Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India, during the *rabi* season of 2019-20. Geographically, Ayodhya (Kumarganj) is located in a subtropical climate, situated at 26°47′ North latitude and 82°12′ East longitude, with an altitude of 113 meters above mean sea level.

The soil at the experimental site was slightly alkaline (pH 8.8), with low organic carbon content (0.25 %), low available nitrogen (190.2 kg/ha), medium available phosphorus (15.5 kg/ha), and medium available potassium (238.1 kg/ha). The experiment was laid out in split plot design consisted of seven oat genotypes as main plot i.e., V_1- OL-1876-2, V_2- OL-1906, V_3- HFO-611, V_4- JHO-17-4, V_5- JO-10-506, V_6- UPO-212 and V_7- JHO-822 and four nitrogen levels as subplot i.e., N_1- 35 kg ha^{-1}, N_2- 70 kg ha^{-1}, N_3- 105 kg ha^{-1} and N_4- 140 kg ha^{-1} which replicated thrice. The seed was sown at a rate of 100 kg/ha on 27th November 2019by using the varieties as per the treatment. Nitrogen was applied as urea according to the treatment. Half the dose of nitrogen was given as a basal dose, and the remaining half was applied after the first cut. The 1st cutting was scheduled for 55 DAS, and the 2nd for 35 days after the first cut.

Observations on growth parameters viz., plant height, number of tillers, leaf: stem ratio and leaf area index were recorded from five selected plants and the mean were calculated, while fresh weight were taken randomly from each plot by using 1m^2 quadrate then sample was dried in sun, thereafter kept in electric oven at 60°C for about 48 hours till the constant weight and dry weight were recorded in kg/m^2 at 55DAS (1st cut) and at 35 days after first cut (2nd cut) of crop. The crop was harvested to determine the green fodder yield of each treatment in each net plot at 55 DAS (1st cut) and 35 days after the first cut (2nd cut). Green fodder was dried in the sun and kept in an oven until constant weight was reached for dry fodder yield, then converted to q/ha. Economics was estimated by considering all the expenditures incurred and the prevailing market price of the produce during the year of experimentation. The data recorded were analyzed statistically as per the procedure given by Cochron and Cox (1970).

Results and Discussion

Growth parameters

Plant height increased with the advancement of crop growth stages, as given in Tables 1 and 2. The maximum plant height, *i.e.,* 67.50 cm on the first cut and 112.50 cm on the second cut, was significantly higher in variety UPO-212, but it was at par with variety OL-1906 in the study. In terms of nitrogen management, significantly maximum plant height, i.e., 64.87 cm on the first cut and 108.12 cm on the second cut, was recorded with a treatment of 140 kg N/ha, which was at par with 105 kg N/ha (Table 1). Nitrogen is involved in increasing the protoplasmic

Table 1. Effect of levels of nitrogen on growth parameters and yield of dual cut oat varieties.

Treatment	Plant height (cm)		Number of tillers /m^2		Leaf: stem ratio/plant		Leaf Area Index	
	Ist cut	IInd cut	Ist cut	IInd cut	Ist cut	IInd cut	Ist cut	IInd cut
Variety								
OL-1876-2	61.98	103.30	376.20	396.00	0.75	0.79	4.40	4.55
OL-1906	63.30	105.50	381.90	402.00	0.77	0.81	4.80	4.90
HFO-611	60.96	101.60	379.05	399.00	0.74	0.78	4.46	4.80
JHO-17-4	59.88	99.80	355.00	377.00	0.72	0.76	4.45	4.75
JO-10-506	62.10	103.50	380.95	401.00	0.76	0.80	4.65	4.82
UPO-212	67.50	112.50	384.75	405.00	0.78	0.82	4.85	5.10
JHO-822	59.10	98.50	354.50	376.35	0.73	0.77	4.55	4.80
SEm±	1.73	2.24	9.75	7.99	0.01	0.02	0.09	0.09
LSD (p=0.05)	5.35	7.75	30.05	23.97	0.05	0.06	0.34	0.32
Nitrogen level								
35kgha^{-1}	58.74	97.90	358.21	377.06	0.71	0.74	4.36	4.54
70kgha^{-1}	61.23	102.04	373.36	393.01	0.74	0.78	4.55	4.73
105kgha^{-1}	63.63	106.05	387.98	408.40	0.77	0.81	4.73	4.91
140kgha^{-1}	64.87	108.12	395.56	416.38	0.78	0.82	4.82	5.01
SEm±	0.87	1.92	5.90	8.10	0.01	0.01	0.08	0.10
LSD (p=0.05)	2.49	5.70	16.84	24.09	0.04	0.03	0.25	0.30

Table 2. Mean weekly meteorological observations during crop Season (November2019 to April 2020)

Month	Metrological week	Temperature (°C)		Mean R.H.(%)	Rainfall (mm)	E.T. (mm/day)	Sunshine (hrs)
		Min.	Max.				
Nov.	45	15.5	29.7	74.0	0	3.3	4.0
	46	13.1	29.4	81.6	0	3.3	6.8
	47	12.5	27.2	75.4	0	3.1	6.2
	48	14.2	26.8	77.5	0	3.2	3.5
Dec.	49	9.7	24.9	70.7	0	3.1	6.2
	50	11.2	23.1	74.4	22	2.9	4.1
	51	8.5	17.6	82.7	0	2.6	3.6
	52	5.3	14.0	84.7	0	1.9	3.9
Jan.	1	9.1	19.3	75.7	7.8	2.1	3.8
	2	8.2	16.5	85.4	6.6	2.0	3.9
	3	10.2	18.6	86.1	21	2.4	3.5
	4	6.4	20.5	78.2	0	3.0	6.5
Feb.	5	7.3	21.8	74.2	0	3.4	6.7
	6	6.2	22.5	70.3	0	3.3	8.1
	7	8.8	22.8	67.3	0	3.6	8.4
	8	12.4	25.4	76.5	53	3.3	4.7
Mar.	9	14.0	26.8	72.6	0	3.6	7.5
	10	13.9	26.2	73.9	61	3.7	6.4
	11	14.7	26.8	72.3	9	3.8	5.7
	12	15.7	29.5	68.4	2	4.9	8.0
	13	16.6	31.9	54.2	0	5.2	8.9
April	14	16.0	34.7	54.2	0	6.4	9.9
	15	18.7	36.6	50.4	0	6.5	9.2
	16	21.5	36.8	55.9	1	6.5	9.3
Mean		12.07	25.39	72.36	7.64	3.63	6.20

constituents and accelerating the process of cell division and elongation, which in turn gives luxuriant vegetative growth for higher productivity (Chauhan *et al.,* 2024; Pathan *et al.,* 2020; Pal *et al.,* 2021; Parvalika and Gaikwad (2021).

The higher tiller counts/m², i.e., 384.75 at the first cut and 405 at the second, were significantly higher for variety UPO-212 compared to others, but it was at par with varieties OL-1876-2, OL-1906, HFO-611, and JO-10-506 at both cuts. It was, however, also at par with varieties JHO-17-4 and JHO-822 at the first cut. In terms of nitrogen levels, the maximum number of tillers (395.56 on the first cut and 416.38 on the second cut) was recorded with 140 kg N/ha, which was at par with 105 kg N/ha and 70 kg N/ha (Table 1). The higher nitrogen level favoured greater oat tillering, although the tillering was more persistent at lower nitrogen level applications at the end of the cycle. This result may be explained by high intraspecific competition under higher nitrogen levels, as promoted by the higher number of tillers (Thamer and Ibrahim*,* 2019).

The maximum leaf: ratio/plant (0.78 at the first cut and 0.82 at the second cut) was significantly recorded with variety UPO-212, but it was at par with varieties OL-1876-2, OL-1906, HFO-611, JO-10-506, and JHO-822 at the first and second cuts. With respect to nitrogen, significantly maximum leaf: ratio/plant (0.78 at the first cut and 0.82 at the second cut) was recorded with 140 kg N/ha, and it was at par with 105 kg N/ha at the first and second cuts and 70 kg N/ha at the first cut (Table 1). This increase in leaf:ratio with increasing N levels might be due to an increase in the number and size of leaves under the treatment. The abundant supply of nitrogen may have increased protoplasmic constituents and accelerated cell division and elongation, resulting in luxuriant vegetative growth (Ahmad *et al.,* 2011; Sharma *et al*., 2019). However, the maximum leaf area index (4.82 at the first cut and 5.10 at the second cut) was recorded with variety UPO-212, which was at par with varieties OL-1906, JO-10-506, and JHO-822 at both cuts. However, it was also at par with HFO-611 at the second cut. In terms of nitrogen levels, significantly maximum leaf area index was recorded under 140 kg N/ha, i.e., 4.82 at the first cut and 5.01 at the second cut, and it was at par with 105 kg N/ha at the first and second cuts and 70 kg N/ha at the first cut (Table 1).

The data for the Leaf area index has been presented in Table 1. Different nitrogen treatment doses were used for different kinds, and the leaf area index increased as the crop grew older until it reached the cutting stage

The different variety affected Leaf Area Index significantly from 55 DAS at Ist cut to IInd cut at 35 days after first cut. The maximum leaf area index (4.85) at Ist cut to at IInd cut (5.1) was recorded with treatment variety UPO-212. Which was at par with treatment variety OL-1906, JO-10-506, JHO-822 at Ist cut and OL-1906, HFO-611, JO- 10-506, JHO-822 at IInd cut and significantly over other rest treatments.

The different dose of nitrogen treatments affected leaf area index significantly from 55DAS at Ist cut to IInd cut at 35 days after first cut. Maximum leaf area index was recorded at Ist cut (4.82) to IInd cut (5.01) with the application of nitrogen treatment of 140 N kg ha^{-1} which was at par with nitrogen dose 105 N kg ha^{-1} at Ist cut and 70 N kg ha^{-1}, 105 N kg ha^{-1} at IInd cut and significantly over other rest treatments.

The abundant supply of nitrogen may have increased protoplasmic constituents and accelerated the process of cell division and elongation which might have resulted in luxuriant vegetative growth (Ahmad *et al.,* 2011).

The maximum fresh weight was recorded significantly for variety UPO-212, i.e., 2.80 kg/m² and 4.38 kg/m² at the first and second cuts, respectively, but was at par with varieties OL-1906, JHO-17-4, and JO-10-506 at both cuts. In terms of nitrogen levels, significantly higher fresh weight (2.94 kg/m² at the first cut and 4.21 kg/m²) was recorded under 140 kg N/ha (Table 2). The abundant supply of nitrogen may have increased protoplasmic constituents and accelerated the processes of cell division and elongation, which might have resulted in luxuriant vegetative growth in terms of plant height, thereby increasing biomass yield (Midha *et al.,* 2015). Moreover, the higher dry weight (0.42 kg/m² at the first cut and 0.78 kg/m² at the second cut) was significantly recorded with variety UPO-212 compared to others, but it was at par with variety

JO-10-506 at the first and second cuts. With regard to the level of nitrogen, the maximum dry weight, i.e., 0.44 kg/m² and 0.75 kg/m² at the first and second cuts, respectively, was recorded with 140 kg N/ha, which was at par with 105 kg N/ha at the second cut (Table 2). The abundant supply of nitrogen may have increased protoplasmic constituents and accelerated cell division and elongation, resulting in luxuriant vegetative growth in terms of dry matter yield (Patel *et al.,* 2022; Pal *et al.,* 2021).

The data recorded on dry fodder yield as affected by different varieties of oat and different nitrogen levels, 55 DAS at Ist cut and IInd cut at 35 days after first cut have been presented in Table 3.

The different variety affected dry fodder yield significantly from 55 DAS at Ist cut to IInd cut at 35 days after first cut. The maximum dry fodder yield (42 q ha^{-1}) at Ist cut to at IInd cut (78 q ha^{-1}) was recorded with treatment variety UPO-212 which was at par with treatment variety OL-1906, JHO-17-4, JO-10-506 and significantly over other rest treatments.

The different nitrogen affected dry fodder yield significantly from 55 DAS at Ist cut to IInd cut at 35 days after first cut. The maximum dry fodder yield (44 q ha^{-1}) at Ist cut to at IInd cut (75 q ha^{-1}) was recorded with the application nitrogen treatment of 140 N kg ha^{-1} which was at par with nitrogen dose 105 N kg ha^{-1} at IInd cut and significantly over other rest treatments.

The abundant supply of nitrogen may have increased protoplasmic constituents and accelerated the process of cell division and elongation, which might have resulted in luxuriant vegetative growth in terms of plant height, thereby higher biomass and dry matter yield (Ahmad *et al*., 2011).

The data recorded on green fodder yield (q ha^{-1}) as affected by different varieties of oat and different nitrogen levels, 55 DAS at Ist cut, and IInd cut at 35 days after first cut have been presented in Table 3.

The different varieties significantly affected green fodder yield from the 55 DAS Ist cut to the 35 days after Ist cut, IInd cut. The maximum green fodder yield at Ist cut (280 q ha^{-1}) to IInd cut (438 q ha^{-1}) and total green fodder yield (760 q ha^{-1}) was recorded with treatment variety UPO-212, which was at par with treatment variety OL-1906, JHO-17-4, JO-10-506 and significantly over other rest treatments.

Table 3. Effect of different level of nitrogen on growth parameters and yield of dual cut oat varieties

Treatment	Fresh weight (kg/m^2)		Dry weight (kg/m^2)		Green fodder yield (q/ha)			Dry fodder yield (q/ha)	
	Ist cut	IInd cut	Ist cut	IInd cut	Ist cut	IInd cut	Total	Ist cut	IInd cut
Variety									
OL-1876-2	2.20	3.18	0.33	0.57	220	318	538	33	57
OL-1906	2.62	3.75	0.39	0.67	262	375	637	39	67
HFO-611	2.45	3.40	0.36	0.61	245	340	585	36	61
JHO-17-4	2.60	3.30	0.39	0.59	260	330	590	39	59
JO-10-506	2.73	3.47	0.40	0.62	273	347	620	40	62
UPO-212	2.80	4.38	0.42	0.78	280	438	760	42	78
JHO-822	2.50	3.30	0.37	0.59	250	330	580	37	59
SEm±	0.06	0.09	0.00	0.02	7.47	22.50	16.46	1.09	2.55
LSD (p=0.05)	0.20	0.30	0.02	0.08	23.02	25.9	50.74	3.35	7.85
Nitrogen levels									
35kgha^{-1}	2.20	2.70	0.33	0.48	220	270	490	33	48
70kgha^{-1}	2.29	3.21	0.34	0.57	229	321	550	34	57
105kgha^{-1}	2.79	4.04	0.41	0.72	279	404	683	41	72
140kgha^{-1}	2.94	4.21	0.44	0.75	294	421	715	44	75
SEm±	0.04	0.05	0.00	0.01	4.80	7.44	9.83	0.62	1.44
LSD (p=0.05)	0.11	0.15	0.01	0.03	13.71	22.11	28.07	1.78	4.13

Table 4. Effect of different level of nitrogen on economics of dual cut oat varieties

Treatment	Total cost (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
		Variety		
OL-1876-2	36,099.9	113,533.7	77,433.8	2.137
OL-1906	37,099.9	139,792.6	102,692.7	2.759
HFO-611	38,099.9	122,183.1	84,083.2	2.200
JHO-17-4	35,599.9	118,089.4	82,489.4	2.309
JO-10-506	37,099.9	136,665.9	99,565.9	2.683
UPO-212	38,599.9	160,271.3	121,671.4	3.143
JHO-822	36,599.9	118,437.8	81,837.9	2.228
SEm±	-	-	-	-
LSD (p=0.05)	-	-	-	-
		Nitrogen level		
35kgha^{-1}	36,346.2	102,625.6	66,279.3	1.819
70kgha^{-1}	36,796.5	114,994.0	78,197.4	2.120
105kgha^{-1}	37,257.6	147,446.0	110,188.3	2.951
140kgha^{-1}	37,713.3	154,348.0	116,634.6	3.086
SEm±	-	-	-	-
LSD (p=0.05)	-	-	-	-

The different nitrogen treatments significantly affected green fodder yield. The maximum green fodder yield (294 q ha^{-1}) at Ist cut to IInd cut (421 q ha^{-1}), and total green fodder (715 q ha^{-1}) was recorded with the application of nitrogen treatment of 140 N kg ha^{-1}, which was at par with nitrogen dose 105 N kg ha^{-1} at IInd cut and significantly over other rest treatments.

Oats produce high forage yield involves the management strategies like- high quality seed recommended seed rate, recommended dose of fertilizer, good management practices, other Climatic conditions like- temperature, humidity, rainfall, sunlight duration, wind, biological factors like-disease resistance, insect resistance, and other factors that influence the green forage yield genetic factor.

The abundant supply of nitrogen may have increased protoplasmic constituents and accelerated the process of cell division and elongation, which might have resulted in luxuriant vegetative growth in terms of plant height, thereby higher biomass and dry matter yield (Ahmad *et al*., 2011)

Productivity

The maximum green fodder yield (280 q/ha at Ist cut,438 q/ha at IInd cut, with a total of 760 q/ha) and dry fodder yield (42 q/ha at Ist cut and 78 q/ha at IInd cut) were recorded significantly with variety UPO-212, which was at par with varieties OL-1906, JHO-17-4 and JO-10-506. With regards to nitrogen levels, significantly higher green fodder yield (294 q/ha at Ist cut, 421 q/ha at IInd cut with total of 715 q/ha) and dry fodder yield (44 q/ha at Ist cut and75 q/ha at IInd cut) were recorded with 140 kg N/ha, as compared to others, but it was at par to 105 kg N/ha (Table 3). The abundant supply of nitrogen may have increased protoplasmic constituents and accelerated the process of cell division and elongation, which might have resulted in luxuriant vegetative growth in terms of plant height, thereby higher biomass and dry matter yield (Godara *et al.,* 2016; Ahmad *et al*., 2011).

Profitability

The maximum gross return (Rs. 193269 ha^{-1}) and net return (Rs. 153984 ha^{-1}) were computed under UPO-212+140 kg N/ha. Jat *et al.* (2014) evaluated the split application of 125 kg N ha^{-1}, which recorded the maximum net profit (Rs. 22695 ha^{-1}) and benefit: cost (1.07), followed by the split application of 100 kg ha^{-1} N, which provided net returns of Rs. 15279 and a benefit: cost ratio of 0.73. However, the application of 120 kg N ha^{-1} markedly increased profitability in terms of gross returns (Rs. 69945 ha^{-1}), net returns (Rs. 41785 ha^{-1}), and benefit-cost ratio (1.48) (Godara *et al.,* 2016) (Table 3).

Conclusion

Based on the results, it can be concluded that among the oat varieties, UPO-212, with the application of 140 kg N/ha, performed better in terms of growth parameters, green fodder yield, and economics. These findings emphasize the importance of selecting the appropriate oat variety and optimizing nitrogen levels to achieve high productivity and quality in oat cultivation. Implementing these strategies can lead to enhanced fodder yield and improved resource-use efficiency, thereby supporting the sustainability and profitability of fodder crop production systems. Future research should focus on long-term studies to further refine nitrogen management practices and explore the environmental impacts of varying nitrogen levels on oat cultivation.

References

Ahmad, A.H., Wahid, A., khalid, F., Fiaz, N. and Zamir, M.S.I. 2011. Impact of organic and inorganic sources of nitrogen and phosphorus fertilizers on growth, yield and quality of forage oat (*avena sativa* L.). *Cercetari Agronomy Moldova* **44**: 39-49.

Chakraborty, J., Arora, R.N., Chhabra, A.K. and Aneja, D.R. 2016. Assessment of relative variability and its distribution pattern in some Avena species. *Forage Research* **42**: 19-23.

Chauhan, S., Anjly, Pathania, A., Saini, A., Guleria, A. and Sahho, C. 2024. Effect of cuttings and nitrogen level on growth & yield of oat: A review. *Journal of Animal & Plant Husbandry* **6**(1): 1-6

Godara, A.S., Duhan, B.S. and Pahuja, S.K. 2016. Effect of different nitrogen levels on forage yield, quality and economics of oat (*Avena sativa* L.) genotypes. *Forage Research* **41**(4): 233-236.

Jat, R.K., Patel, A.G., Shrivan, A., Bijarnia, A.L. and Bhunwal, V. 2014. Response of oat (*Avena sativa* L.) on quality and economics to nitrogen and phosphorus levels under North Gujarat agro-climatic conditions. *Journal of Crop and Weed* **10**(2): 492-494.

Karnatam, K.S., Mythri, B., Un Nisa, W., Sharma, H., Meena, T.K., Rana, P., Vikal, Y., Gowda, M., Dhillon, B.S. and Sandhu, S. 2023. Silage maize as a potent candidate for sustainable animal husbandry development-perspectives and strategies for genetic enhancement. *Frontiers in Genetics* **14**: 1150132.doi: 10.3389/fgene.2023.1150132

Kumari, A., Kumar, P., Ahmad, E., Singh, M., Kumar, R., Yadav, R.K., Datt, C. and Chinchmalatpure, A. 2014. Fodder yield and quality of oat fodder (*Avena sativa*) as influenced by salinity of irrigation water and applied nitrogen levels. *Indian Journal of Animal Nutrition* **31**(3): 266-271.

Midha, L.K., Duhan, B.S. and Arya, S. 2015. Performance of promising entries of oat (*Avena sativa* L.) under different nitrogen levels. *Forage Research* **41**(2): 122-125.

Pal, V., Gill, R. and Kamboj, K. 2021. Effect of different levels nitrogen on fodder quality and yield of oats: A review. *Journal of Emerging Technologies and Innovative Research* **8**(5): 850-852.

Patel, G.N., Reddy, T.V. and Patel, B.R. 2022. Management of N levels and time of cut in rabi forage oat (*Avena sativa* L.). *Journal of Crop and Weed* **18**(2): 284-292.

Pathan, S.H., Damame, S.V. and Sinare, B.T. 2020. Effect of different cutting management on growth, yield, quality and economics of dual-purpose oat, barley and wheat. *Forage Research* **46**: 182-186.

Pravalika, Y. and Gaikwad, D.S. 2021. Effect of different levels of nitrogen application and cutting management on yield, quality and economics of fodder oats (*Avena sativa* L.). *Biological Forum - An International Journal* **13**(1): 452-457.

Sharma, A., Sharma, G.D., Kumar, N., Chahal, A. and Sankhyan, N.K. 2019. Studies on the performance of promising varieties of oat (*Avena sativa* L.) regimes in mid-hill conditions of Himachal Pradesh. *Journal of Pharmaceutical and Phytochemistry* **8**(2): 728-731.

Subrahmanya, D.J., Kumar, R., Tyagi, N., Ram, H., Singh, M., Meena, R.K., Tamta, A. and Pande, A.K. 2017. Yield of fodder maize (*Zea mays*) and its chemical composition under varying plant densities and nutrient management. *Indian Journal of Animal Nutrition* **34**(4): 425-429.

Thamer, W.K. and Ibrahim, S. 2019. Effect of numbers of cutting times on yield components of oat cultivars. *Plant Archives* **19**(1): 639-642.

Yadav, M.R., Kumar, R., Parihar, C.M., Yadav, R.K., Jat, S.L., Ram, H., Meena, R.K., Singh, M. Birbal, Verma, P.A., Kumar, U., Ghosh, A. and Jat, M.L. 2017. Strategies for improving nitrogen use efficiency: A review. *Agricultural Reviews* **38**(1).

Received: 17 October 2025; Accepted: 25 December 2025