



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(7): 894-898
Received: 14-04-2026
Accepted: 18-05-2026

MN Muchhadiya
M.Sc. Scholar, Department of
Agronomy, NM College of
Agriculture, NAU, Navsari,
Gujarat, India

Dr. KA Shah
Associate Professor, Departments
of Agronomy, Navsari Agricultural
University, Navsari, Gujarat, India

Rakhi S Gandhar
M.Sc. Scholar, Department of
Agronomy, NM College of
Agriculture, NAU, Navsari,
Gujarat, India

S Sudipta
M.Sc. Scholar, Department of
Agronomy, NM College of
Agriculture, NAU, Navsari,
Gujarat, India

Corresponding Author:
Dr. KA Shah
Associate Professor, Departments
of Agronomy, Navsari Agricultural
University, Navsari, Gujarat, India

Effect of date of sowing, nitrogen levels and time of cutting on growth, yield and economics of fodder oat (*Avena sativa* L.) under south Gujarat condition

MN Muchhadiya, KA Shah, Rakhi S Gandhar and S Sudipta

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i7l.6034>

Abstract

A field experiment was conducted during *rabi* season of the year 2024-25 at the college farm, Navsari Agricultural University, Navsari to study the “Effect of date of sowing, nitrogen levels and time of cutting on growth, yield and economics of fodder oat (*Avena sativa* L.) under south Gujarat condition.” The experiment was laid out in randomized block design with factorial concept, replicated thrice. Total twelve treatment combinations comprising two sowing dates (3rd week of November and 1st week of December), three nitrogen levels (60, 80 and 100 kg N ha⁻¹) and two cutting time (cut at 55 and 70 DAS). The results obtained from the experiment showed that fodder oat sown during the 3rd week of November produced significantly higher plant height at harvest (72.39 cm), number of tillers m⁻¹ row length at harvest (128.29), dry matter accumulation (2.93 g plant⁻¹), green fodder yield (237.58 q ha⁻¹) and dry fodder yield (68.07 q ha⁻¹) than sown during 1st week of December. Gross return (₹ 95,032 ha⁻¹), net return (₹ 56,630 ha⁻¹) and B:C ratio (2.47) were also found maximum under the same treatment. Application of 100 kg N ha⁻¹ recorded significantly higher plant height at harvest (73.83 cm), number of tillers m⁻¹ row length at harvest (133.58), leafiness percentage (75.34%), dry matter accumulation (3.43 g plant⁻¹), green fodder yield (248.08 q ha⁻¹) and dry fodder yield (76.44 q ha⁻¹) over other nitrogen levels. The gross return (₹ 99,232 ha⁻¹), net return (₹ 59,526 ha⁻¹) and B: C ratio (2.50) were also recorded highest with application of 100 kg N ha⁻¹. Cutting at 70 DAS produced significantly higher plant height at harvest (77.29 cm), dry matter accumulation (3.14 g plant⁻¹), green fodder yield (247.97 q ha⁻¹) and dry fodder yield (72.02 q ha⁻¹) as compared to cutting at 55 DAS. The gross return (₹ 99,188 ha⁻¹), net return (₹ 59,526 ha⁻¹) and B: C ratio (2.50) were also incurred maximum under the same treatment.

Keywords: Fodder oat, date of sowing, nitrogen, time of cutting, yield, economics

Introduction

Livestock is an integral component of Indian agriculture and contributes significantly to fodder security and the rural economy. India possesses about 15 per cent of the world's livestock population, comprising 193.46 million cattle, 109.85 million buffaloes, 74.26 million sheep and 148.88 million goat and 9.06 million pigs (Anon., 2024a). The livestock sector contributed 4.66 per cent of the total GVA during 2022-23 (Anon., 2024b). However, the productivity of livestock is largely constrained by the inadequate availability of quality fodder.

In India, only 4 per cent (8.4 million ha) of the cultivated land is devoted to fodder production (Dhamodharan *et al.*, 2024) [6]. The country faces a net shortfall of 32.15 per cent green fodder, 10.99 per cent dry fodder and the availability of green fodder and dry fodder is 557.3 and 471.9 million tonnes, respectively. In Gujarat, the shortage of green and dry fodder is approximately 25 and 44 per cent, respectively (Anon., 2023). Therefore, increasing fodder productivity through improved agronomic practices has become essential for sustainable livestock production. The mismatch between demand and supply of fodder necessitates the development of appropriate strategies to ensure year-round availability of green fodder. Green fodder scarcity is particularly severe during the *rabi* season, emphasizing the need for high yielding and nutritious cereal fodder crops. Therefore, cultivation of fodder oat can play an important role in over coming winter fodder shortage and improving livestock productivity.

Oat (*Avena sativa* L.) is one of the most important *rabi* cereal fodder crops because of its rapid growth, high biomass production, excellent palatability and superior nutritional value. It contains approximately 6-7 per cent protein, 66 per cent carbohydrates and 11 percent fibre, making it an ideal fodder crop for dairy animals (Patel *et al.*, 2022) ^[22]. Oat is widely cultivated as green fodder, hay and silage and plays an important role in alleviating fodder scarcity during the winter season.

The productivity of fodder oat is greatly influenced by agronomic management practices such as date of sowing, nitrogen levels and time of cutting. Optimum sowing time ensures better crop establishment and biomass accumulation, while nitrogen promotes vegetative growth, tillering and dry matter production. Similarly, cutting at an appropriate stage improves forage yield and profitability. Although fodder oat is cultivated in different parts of India, information on the combined effect of these management practice under south Gujarat condition is limited. Therefore, the present investigation was undertaken to study the response of fodder oat to different sowing dates, nitrogen levels and time of cutting with special emphasis on fodder yield and economics under south Gujarat condition.

Materials and Methods

The experiment was conducted at the College Farm, N. M. College of Agriculture, Navsari Agricultural University (20.57' N latitude and 72.54' E longitude, at an altitude of 10 m above MSL), Navsari, Gujarat, India during *rabi* 2024-25. The soil of the experimental plot was clayey in texture (66.75%) with medium in organic carbon (0.54%), low in available nitrogen (198 kg ha⁻¹) and medium in available phosphorous (33.09 kg ha⁻¹), fairly rich in available potash (374.62 kg ha⁻¹) having pH value of 7.80. Total twelve treatment combination comprised of two date of sowing (3rd week of November and 1st week of December), three nitrogen levels (60, 80 and 100 kg N ha⁻¹) and two cutting time (cut at 55 and 70 DAS) tested in randomized block design with factorial concept, replicated thrice. Fodder oat variety Kent was used and sown at spacing 30 cm between two rows using a seed rate of 100 kg ha⁻¹ on 21st November, 2024 and 6th December, 2024. A full dose of phosphorus was applied as a basal application and the nitrogen application was done in two equal splits at basal and 30 DAS as per treatment. Herbicide viz., pendimethalin 30% EC @ 1.0 kg a.i. ha⁻¹ was applied as pre-emergence. Irrigation was applied in accordance with crop needs. Yield parameters were recorded at harvest and green and dry fodder yield were recorded from each net plot separately, than it converted into hectare with multiplying factor. Leafyness percentage was determined by taking a 1.0 kg fresh fodder sample at harvest from each net plots with using the formula: Leafyness (%) = (Leaf weight/Total plant weight) × 100. A one kg fresh fodder sample from each net plot was sun dried to determine dry fodder yield, which was also expressed as q ha⁻¹. The expenses incurred for all cultivation operations, from preparatory tillage to harvesting, including the costs of inputs such as seeds, fertilizers and herbicides applied to each treatment, were calculated based on prevailing local charges. The gross return was calculated by multiplying the green fodder yield of oat from each treatment with the local market prices. The net return for each treatment was calculated by subtracting the total cost of cultivation from the gross return. B: C ratio was computed by dividing the gross return by the total cost of cultivation. The data collected from various parameters were analysis statistically to draw suitable interference as per the standard ANOVA techniques suggested by Panse and Sukhatme (1985) ^[21].

Results and Discussion

Effect of date of sowing

The data in Table 1 showed that date of sowing caused significant variation in plant height at harvest, no. tillers m⁻¹ row length at harvest, dry matter accumulation plant⁻¹, green fodder yield and dry fodder yield of fodder oat, except for plant height at 30 DAS and leafyness percentage at harvest. Fodder oat sown during 3rd week of November recorded significantly higher plant height at harvest (72.39 cm) and number of tillers m⁻¹ row length at harvest (128.29) over 1st week of December. It was mainly due to favourable climatic conditions, efficient resource utilization and a longer growing period under early sowing, which promoted better vegetative growth and cell elongation resulting in better growth and tiller production. Similar findings have also been reported by Dar *et al.* (2014) ^[5], Murali *et al.* (2021) ^[18] and Naveena *et al.* (2021) ^[20] in fodder oat. Non-significantly but numerically higher plant height at 30 DAS and leafyness percentage at harvest were also observed higher when oat sown during 3rd week of November. The variation in leafyness percentage remained non-significant probably because of both the date of sowing provided relatively favourable conditions which maintained almost similar effect on leaf initiation, leaf expansion and stem development, resulting in comparable leafyness percentage. Moreover, leafyness percentage is more dependent on nutrient availability and stage of crop maturity than slight variation in sowing time, which might have resulted in non-significant differences between the two sowing dates. Oat sown during 3rd week of November produced significantly higher dry matter accumulation (2.93 g plant⁻¹) over sown during 1st week of December. Dry matter accumulation was increase might be due to better temperature regime and suitable climatic conditions prevailing during entire growing season when crop was sown during 3rd week of November (D₁) possibly efficient utilization of available resources such as moisture, nutrients and solar radiation may have promoted physiological and metabolic activities resulted in better leaf area development and vegetative growth. Further, it also enhanced the photosynthetic efficiency and accumulation of assimilates in plant tissues, which ultimately increase in dry matter production in fodder oat. This data is compatible with the result of Dar *et al.* (2014) ^[5] and Kumar *et al.* (2021) ^[11].

Green and dry fodder yield of 237.58 and 68.07 q ha⁻¹, respectively were recorded significantly higher with the fodder oat sown during 3rd week of November as compare to sown during 1st week of December. The per cent increase in green and dry fodder yield of fodder oat sown during 3rd week of November over 1st week of December were 9.67 and 9.65%, respectively. Higher fodder yield under D₁ may be attributed to the cumulative effect of improved growth and yield attributing characters such as plant height, number of tillers m⁻¹ row length and dry matter accumulation plant⁻¹ under favourable climatic conditions. These results corroborate the findings of Jehangir *et al.* (2013) ^[8], Dar *et al.* (2014) ^[5], Jat *et al.* (2015) ^[7], Midha *et al.* (2015) ^[16], Kumawat *et al.* (2017) ^[14], Kadam *et al.* (2019) ^[9], Kumar *et al.* (2021) ^[11] and Kumar *et al.* (2023) ^[12] in early sowing of fodder oat.

The gross return (₹ 95,032 ha⁻¹), net return (₹ 56,630 ha⁻¹) and B:C ratio (2.47) was found higher in fodder oat sown during 3rd week of November. Whereas, lower gross return (₹ 86,656 ha⁻¹), net return (₹ 48,250 ha⁻¹) and B:C ratio (2.26) were recorded in 1st week of December sowing. The higher monetary return and B:C ratio with 3rd week of November sown crop was due to higher green fodder yield produce under the same treatment. Similar trend was found by Jehangir *et al.* (2013) ^[8] and Samal *et al.* (2023) ^[24].

Effect of nitrogen levels

The data furnished in Table 1 showed that different nitrogen levels resulted in significant variation in plant height at harvest, no. of tillers m⁻¹ row length at harvest, leafyiness percentage at harvest, dry matter accumulation plant⁻¹, green fodder yield and dry fodder yield, except the plant height at 30 DAS. An application of 100 kg N ha⁻¹ recorded significantly higher plant height (73.83 cm) at harvest, which was statistically comparable with 80 kg N ha⁻¹ over application of 60 kg N ha⁻¹. Plant height at 30 DAS was also noted higher under the same treatment. Increase in plant height at harvest with increase in the nitrogen fertilizer might be due to the fact that nitrogen plays an important role in cell division and multiplication which helps in promotes the number of internodes and increasing length of the internodes ultimate it resulting in taller plants. These findings are in line with

the results of Midha *et al.* (2015) [16], Naveena *et al.* (2021) [20], Sarkar *et al.* (2022) [25], Kumar *et al.* (2023) [12] and Yadav *et al.* (2023) [28]. The number of tillers m⁻¹ row length at harvest (133.58) was also recorded significantly the highest with an application of 100 kg N ha⁻¹ over rest of the nitrogen levels. This might be attributed due to appropriate dose of nitrogen application enhance the photosynthetic activity, leading to increased synthesis of protoplasmic constituents and accelerated cell division and elongation. Furthru, it also favoured better development of auxiliary buds and tiller initiation, thereby resulting in higher number of tillers m⁻¹ row length in oat. The outcomes are consistent with Dar *et al.* (2014) [5], Midha *et al.* (2015) [16], Satpal *et al.* (2018) [26], Naveena *et al.* (2021) [20], Pravalika and Gaikwad (2021) [23], Kumar *et al.* (2023) [12] and Yadav *et al.* (2023) [28].

Table 1: Effect of date of sowing, nitrogen levels and time of cutting on growth parameters and yield of fodder oat

Treatments	Plant height (cm)		No. of tillers mrl ⁻¹ at harvest	Leafyness percentage at harvest (%)	DMA (g plant ⁻¹)	Fodder yield (q ha ⁻¹)	
	At 30 DAS	At harvest				Green	Dry
Date of sowing (D)							
D ₁ : 3 rd week of November	41.11	72.39	128.29	72.68	2.93	237.58	68.07
D ₂ : 1 st week of December	39.02	66.63	121.22	72.22	2.56	216.64	62.08
S. Em. ±	0.96	1.89	1.94	0.54	0.05	5.02	1.90
C.D. (5%)	NS	5.54	5.71	NS	0.15	14.73	5.57
Nitrogen levels (N)							
N ₁ : 60 kg ha ⁻¹	38.70	64.03	117.97	69.38	2.09	205.20	54.45
N ₂ : 80 kg ha ⁻¹	40.47	70.67	122.72	72.64	2.72	228.05	64.33
N ₃ : 100 kg ha ⁻¹	41.02	73.83	133.58	75.34	3.43	248.08	76.44
S. Em. ±	1.18	2.31	2.38	0.66	0.06	6.15	2.32
C.D. (5%)	NS	6.79	7.00	1.94	0.19	18.04	6.82
Time of cutting (C)							
C ₁ : Cutting at 55 DAS	39.52	61.74	124.56	73.28	2.35	206.25	58.12
C ₂ : Cutting at 70 DAS	40.60	77.29	124.94	71.62	3.14	247.97	72.02
S. Em. ±	0.96	1.89	1.94	0.54	0.05	5.02	1.90
C.D. (5%)	NS	5.54	NS	1.59	0.15	14.73	5.57

Leafyiness percentage increasing with each successive increase in nitrogen levels and it (75.34%) was recorded significantly the highest under the application of 100 kg N ha⁻¹ over 60 kg N ha⁻¹. The maximum leafyiness percentage under higher nitrogen levels may be because of nitrogen being an essential constituent of proteins and chlorophyll encouraged rapid cell division, leaf initiation and leaf expansion, resulting in the development of tender and succulent foliage. Further, nitrogen supply also improves metabolic activities and delayed leaf senescence, thereby increasing leaf proportion and ultimately improving leafyiness percentage in the crop. An application of nitrogen levels significantly influences the dry matter accumulation of fodder oat. Dry matter accumulation (3.43 g plant⁻¹) was also recorded significantly higher with an application of 100 kg N ha⁻¹ over 60 kg N ha⁻¹ (2.09 g plant⁻¹). The dry matter accumulation was increased under higher nitrogen levels because of adequate nitrogen supply promoted the formation of healthy and active foliage, which increase photosynthetic surface area and accumulation of carbohydrates other organic compounds in plant tissues ultimately led to greater biomass production and dry matter accumulation in fodder oat. This data is compatible with the result of Dar *et al.* (2014) [5], Kumar *et al.* (2017) [10], Kumar *et al.* (2021) [11] and Sarkar *et al.* (2022) [25].

The data present in Table 1 clearly indicated that each successive increase in nitrogen levels significantly enhanced the green and dry fodder yield of oat. An application of 100 kg N ha⁻¹ produced significantly the highest green fodder yield of 248.08 q ha⁻¹ and dry fodder yield of 76.44 q ha⁻¹ over 60 kg N ha⁻¹. The percentage increase in the green and dry fodder yield of oat was up to the tune

of 20.90 and 40.38 per cent under the application of 100 kg N ha⁻¹ over 60 kg N ha⁻¹. The improvement in green and dry fodder yield under higher nitrogen levels may be because of nitrogen plays a vital role in promoting vigorous vegetative growth and improving various growth and yield attributes of fodder oat viz., plant height, number of tillers m⁻¹ row length, leafyiness percentage and dry matter accumulation plant⁻¹, which collectively contributed towards increased green and dry biomass production. These assertions are similar with the findings of Jehangir *et al.* (2013) [8], Satpal *et al.* (2018) [26], Kadam *et al.* (2019) [9], Kumar *et al.* (2019) [13], Pravalika and Gaikwad (2021) [23], Patel *et al.* (2022) [22], Sarkar *et al.* (2022) [25], Kumar *et al.* (2023) [12], Nanda and Nilanjaya (2023) [19] and Yadav *et al.* (2023) [28].

The data presented in Table 2 revealed that an application of 100 kg N ha⁻¹ was registered maximum the gross return (₹ 99,232 ha⁻¹), net return (₹ 59,526 ha⁻¹) and B:C ratio (2.50) whereas, the lower gross return (₹ 82,080 ha⁻¹), net return (₹ 42,897 ha⁻¹) and B:C ratio (2.09) recorded under application of 60 kg N ha⁻¹. These might be due to higher level of nitrogen application increasing the yield and ultimately the income. These findings are parallel to the earlier findings reported by Satpal *et al.* (2018) [26], Patel *et al.* (2022) [22], Nanda and Nilanjaya (2023) [19] and Kumar *et al.* (2023) [12].

Effect of time of cutting

Different time of cutting had substantial impact on plant height at harvest, leafyiness percentage, dry matter accumulation plant⁻¹, green fodder yield and dry fodder yield of oat, except the plant

height at 30 DAS and number of tillers m^{-1} row length at harvest (Table 1). The plant height at harvest (77.29 cm) was recorded significantly higher when fodder oat cut at 70 DAS as compare to cut at 55 DAS. This might be due to the longer growth duration available to the crop without any interruption of physiological activities, which enhanced vegetative development and better internodal elongation ultimately resulted in higher plant height. Similar type of result was also reported by Sharma and Bhunia (2001) [27], Malik *et al.* (2015) [15], Pravalika and Gaikwad (2021) [23] and Patel *et al.* (2022) [22] in fodder oat. Non-significant difference was observed in case of number of tillers m^{-1} row length at harvest due to different time of cutting. This may be because of tiller production is primarily determined during early vegetative growth stage and less influenced by variation in cutting time. These findings are in agreement with the results of Malik *et al.* (2015) [15] in fodder oat. Cutting of fodder oat at 55 DAS recorded significantly higher leafyness percentage at harvest

(73.28%) as compare to cutting at 70 DAS (71.62%). This might be due to the fact that crop remained in the field for a longer duration as the cutting at 70 DAS more assimilates and photosynthates might have been utilized for stem growth, structural development and fibre accumulation, resulting in comparatively lower leaf proportion. Moreover, advancement in crop age also promotes stem thickening and internodal elongation, thereby decreasing the leaf-stem ratio and ultimately reducing leafyness percentage. In contrast, dry matter accumulation ($3.14 \text{ g plant}^{-1}$) was recorded significantly higher under cutting at 70 DAS over cutting at 55 DAS ($2.35 \text{ g plant}^{-1}$). This may be attributed due to longer crop growth duration available under cutting at 70 DAS allowed the crop to intercept solar radiation for a longer duration and more translocation of nutrients and carbohydrates from source to sink contributed to increased deposition of dry matter in plant tissue. These results are in conformity with those of Kumar *et al.* (2017) [10].

Table 2: Effect of date of sowing, nitrogen levels and time of cutting on economics of fodder oat

	Total cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
Date of sowing (D)				
D ₁ : 3 rd week of November	38402	95032	56630	2.47
D ₂ : 1 st week of December	38402	86656	48250	2.26
Nitrogen levels (N)				
N ₁ : 60 kg ha^{-1}	39183	82080	42897	2.09
N ₂ : 80 kg ha^{-1}	39441	91220	51779	2.31
N ₃ : 100 kg ha^{-1}	39706	99232	59526	2.50
Time of cutting (C)				
C ₁ : Cutting at 55 DAS	38402	82500	44098	2.15
C ₂ : Cutting at 70 DAS	38402	99188	60786	2.58

Cutting at 70 DAS produced significantly higher green and dry fodder yield of oat of 247.97 and 72.02 q ha^{-1} , respectively as compare to cutting at 55 DAS. There was 20.22 and 23.92 per cent increasing in green fodder and dry fodder yield, respectively, under the cutting of oat at 70 DAS over at 55 DAS. The higher green fodder yield under cutting at 70 DAS may be attributed due to the crop remained in active growth phase for a longer duration, resulting in increased plant height, number of tillers, dry matter accumulation *etc.*, all together ultimately resulted in higher green fodder yield. Higher green fodder yield coupled with higher dry matter accumulation resulted in higher dry fodder yield under same treatment. These findings pertaining to fodder yield are in accordance with the results reported by Sharma and Bhunia (2001) [27], Jehangir *et al.* (2013) [8], Monika *et al.* (2018) [17], Kadam *et al.* (2019) [9], Patel *et al.* (2022) [22] and Bhakuni *et al.* (2025) [4].

Cutting of fodder oat at 70 DAS incurred higher gross return (₹ 99,188 ha^{-1}), net return (₹ 60,786 ha^{-1}) and B:C ratio (2.58) than cutting at 55 DAS (Table 2). The higher economic returns under cutting at 70 DAS may be due to higher green fodder yield without any appreciable increase in the cost of cultivation. These findings are parallel to the earlier findings reported by Jehangir *et al.* (2013) [8] and Patel *et al.* (2022) [22].

Conclusion

On the basis of one year experiment, it can be concluded that sowing of fodder oat during the 3rd week of November increase all growth and yield attributes, yield and economic returns. Moreover, application of 100 kg N ha^{-1} produced higher plant height, number of tillers m^{-1} row length, leafyness percentage, dry matter accumulation $plant^{-1}$, green and dry fodder yield as well as economic returns. Cutting of fodder oat at 70 DAS proved superior in improving plant height, dry matter accumulation plant⁻¹

¹, green and dry fodder yield and economic returns under south Gujarat condition.

References

- Anonymous. Fodder resource development plan for Gujarat. Jhansi: ICAR-Indian Grassland and Fodder Research Institute; 2023. p. 14.
- Anonymous. Basic Animal Husbandry Statistics Book-2024. Department of Animal Husbandry and Dairying; 2024. <https://dahd.gov.in/sites/default/files/202501/FinalBAHS2024Book14012025.pdf>
- Anonymous. Press Information Bureau. Government of India; 2024. <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2034940>
- Bhakuni K, Sabal SK, Bhattacharjee S, Kumar R, Meena HR, Biswal SKB, et al. Optimizing varietal selection and cutting intervals for enhanced fodder productivity, quality and energy content in multi-cut oats. *Indian Journal of Animal Sciences*. 2025;95(9):789-798.
- Dar NA, Singh KN, Ahmad L, Sofi JA, Bhat ME, Kotru R. Influence of dates of sowing, cultivars and different fertility levels on fodder oat (*Avena sativa* L.) under temperate conditions of Kashmir valley (India). *Range Management and Agroforestry*. 2014;35(1):51-55.
- Dhamodharan P, Bhuvaneshwari J, Sowmiya S, Chinnadurai R. Revitalizing fodder production: Challenges and opportunities. *International Journal of Research in Agronomy*. 2024;7(1):208-217.
- Jat H, Kaushik MK, Tiwari RC, Sharma M. Growth, yield of fodder oat (*Avena sativa* L.) and available soil nitrogen as influenced by irrigation and nitrogen management. *Forage Research*. 2015;41(2):135-136.

8. Jehangir IA, Khan HU, Mubarak T, Mahdi SS, Rasool FU. Productivity of fodder oat (*Avena sativa*) under different sowing times, fertility levels and cutting management in temperate environment. *Indian Journal of Agronomy*. 2013;58(4):603-606.
9. Kadam SS, Solanki NS, Arif M, Dashora LN, Mundra SL, Upadhyay B. Productivity and quality of fodder oats (*Avena sativa* L.) as influenced by sowing time, cutting schedules and nitrogen levels. *Indian Journal of Animal Nutrition*. 2019;36(2):179-186.
10. Kumar BS, Singh RV, Singh A, Dhyani BP, Chand P. Effect of nitrogen levels and cutting management on growth parameters of fodder oat (*Avena sativa* L.). *International Journal of Chemical Studies*. 2017;5(4):1851-1853.
11. Kumar GS, Jayaramaiah R, Koler P, Bhairappanavar ST. Growth, yield and quality parameters of fodder oats (*Avena sativa* L.) under varied dates of sowing and nitrogen application. *Mysore Journal of Agricultural Sciences*. 2021;55(1):37-45.
12. Kumar N, Satpal L, Kharor N, Bhardwaj S. Evaluating the effect of different nitrogen levels on forage yield and quality of promising entries of single cut oat. *Forage Research*. 2023;48(4):482-486.
13. Kumar S, Patel AG, Jat JR, Shakhela RR, Joshi RV. Nitrogen management in forage oat (*Avena sativa*) under north Gujarat agro-climatic conditions. *Indian Journal of Agronomy*. 2019;64(3):397-400.
14. Kumawat SM, Kantwa SR, Desai DH, Arif M, Khinchi V. Responses of dual-purpose oats (*Avena sativa* L.) to sowing date, method and level of zinc with or without thiourea in irrigated arid ecosystem. *Range Management and Agroforestry*. 2017;38(2):215-220.
15. Malik P, Duhan BS, Midha LK. Effect of fertilizer application and cutting schedule on growth and yield parameters in oat (*Avena sativa* L.). *Forage Research*. 2015;40(4):264-267.
16. Midha LK, Duhan BS, Arya S. Performance of promising entries of oat (*Avena sativa* L.) under different nitrogen levels. *Forage Research*. 2015;41(2):122-125.
17. Monika RS, Singh K, Satpal. Effect of cutting management and phosphorus levels on growth, forage and seed yield of multicut oat (*Avena sativa* L.). *Forage Research*. 2018;44(1):8-13.
18. Murali B, Susheela R, Shanti M, Shashikala T. Effect of time of sowing, seed rate, and cultivar on oat green fodder, dry matter and crude protein yield. *Indian Journal of Animal Nutrition*. 2021;38(4):400-406.
19. Nanda G, Nilanjaya. Nitrogen fertilization strategies for forage oat genotypes: Agronomic performance, energy and nitrogen use efficiency, economic assessment and determination of economical N fertilizer rate. *Forage Research*. 2023;49(3):303-309.
20. Naveena BM, Shekara BG, Vishwanath AP, Murthy KK, Chikkarugi NM. Effect of times of sowing and nitrogen levels on growth and seed yield of fodder oats (*Avena sativa* L.). *The Pharma Innovation Journal*. 2021;10(12):2752-2756.
21. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: Indian Council of Agricultural Research; 1985. p. 199-200.
22. Patel GN, Reddy TV, Patel BR. Management of N levels and time of cut in rabi forage oat (*Avena sativa* L.). *Journal of Crop and Weed*. 2022;18(2):284-292.
23. Pravalika Y, Gaikwad DS. 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*. 2021;13(1):452-457.
24. Samal RP, Nanda G, Kumar M, Sattar A. Yield, quality and profitability of fodder oat varieties in response to different dates of sowing. *Forage Research*. 2023;48(4):477-481.
25. Sarkar S, Singh D, Nanda G, Kumar S, Singh SK, Nath H. Impact of genotypes and nitrogen levels on growth and yield of fodder oat (*Avena sativa* L.). *Forage Research*. 2022;48(3):379-386.
26. Satpal RS, Tokas J, Jindal Y. Quality, yield and economics of oat (*Avena sativa* L.) genotypes for fodder under different nitrogen levels. *International Journal of Chemical Studies*. 2018;6(1):1987-1991.
27. Sharma S, Bhunia S. Response of oat (*Avena sativa*) to cutting management, method of sowing and nitrogen. *Indian Journal of Agronomy*. 2001;46(3):563-567.
28. Yadav PS, Jha AK, Pachauri V, Verma B, Shrivastava A, Chouhan M, Rajpoot A. Oat genotypes response to different nitrogen levels under agro-climatic condition of Kymore Plateau zone of Madhya Pradesh. *The Pharma Innovation Journal*. 2023;12(4):2371-2374.