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Study on Nitrogen management through nano urea and conventional urea in wheat (*Triticum aestivum* L.)

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Abstract
AVT trial on fodder oats was conducted during *rabi* 2022-23 at the ICR farm, Assam Agricultural University, Jorhat, Assam. The aim of the experiment was to assess the performance of different fodder oats entries with different doses of nitrogen. In the trial, five fodder oat entries (HFO-917, HFO-1014, JO-03-513, JHO-20-2, and OL-1931), along with two national checks (UPO-212 and JHO-822), were evaluated. The entries were tested under three nitrogen levels (70, 105, and 140 kg/ha) to assess their response. 50% of N was applied as basal (during sowing) and remaining 25% as 1^{st} top dressing (30 DAS) and 25% as 2^{nd} top dressing (after 1^{st} cut, 61 DAS). The experiment was conducted in split plot design with entries in main plot and different doses of nitrogen in subplot and replicated thrice. Findings revealed that highest leaf stem ratio (1.85), no. of tillers/m row length (115.00), no. of leaves (6.67) was demonstrated by JHO-20-2 among all the entries. However, HFO-917 recorded higher plant population/m row length (29.78) which was at par with HFO-1014 (27.33) and JHO-20-2 (26.78). Among the nitrogen treatments, application of 140 (kg/ha) showed higher plant (87.76 cm) which was at par with 105 (kg/ha) with a height of 92.84. Among the entries, highest green fodder yield was showed by JHO-20-2 (363.75 q/ha). Meanwhile, OL-1931 showed higher dry matter yield of 44.18 q/ha which was at par with JHO-20-2 (44.18 q/ha). JHO-20-2 showed highest seed yield of 11.54 q/ha. Application of 105 kg/ha of N gave highest seed yield of 10.33 (q/ha). For crude protein%, 140 kg/ha of N showed 10.45% which was at par with 105 kg/ha (10.37%).

Keywords: Crude protein, entries, fodder oat, nitrogen, nourishment

Introduction
Green fodder is an environmentally friendly source of nourishment for dairy animals. It is highly pleasant and digested. It also aids in maintaining good health and enhancing the breeding efficiency of animals. Increased use of green fodder in the ration of livestock may cut cost the of milk production. Fodder from usual cereal crops like maize, sorghum and oats are rich in energy while leguminous crops like lucerne, berseem and cowpea are rich in proteins. These leguminous crops are a good supply of major and micro minerals, which are vital for rumen bacteria as well as animal systems. Green fodder crops are recognized to be a cheaper source of nutrients as compared to concentrates and include hence useful in bringing down the cost of feeding and reducing the requirement for the acquisition of feeds/concentrates from the market. In order to put into reality methods that show the financial advantages of growing high-yielding fodder crop varieties through field days and hands-on demonstrations, it is crucial to increase knowledge of fodder production technology (Ghosh *et al*., 2022) [3]. It can be preserved as hay or silage for use during lean seasons when there is an excess. However, over-exploitation and poor management of resources like fuelwood, timber, and feed are causing major problems for India.

In case surplus fodder is available in some seasons it can be kept in form of silage or hay for the lean season. India is presently under enormous stress on the basis of large-scale exploitation for the mismanagement of fuelwood, timber and feed.

Oat (*Avena sativa* L.) is one of the most significant produced winter fodder crops. During winter season, livestock such as cattle, buffalo, goat, etc. depend mostly on rice straw, by-products and semi-dried grasses found in barren fields resulting to the low output and productivity of livestock. Thus, to alleviate the acute lack of green fodder during the lean period of winter season oat fodder may be planted successfully in rice fallow fields in both plain and hilly places (Luikham *et al*. 2015) [6]. It is usually fed as green but the surplus is processed into silage or hay to use throughout fodder deficit periods (Suttie and Reynolds, 2004) [9]. Oats are quick growing, palatable, succulent and nutritious (Suttie and Reynolds, 2004) [9] and constitute a great combination when given along with other winter fodder legumes such as berseem, lucerne, pea and vetch. Stevens *et al*. (2004) [8] discovered that oats are effectively adapted to a wide spectrum of soil types but perform better on acid soils. They are generally produced in cool damp settings and can be sensitive to hot, dry conditions from head emergence through to maturity (Suttie and Reynolds, 2004) [9]. There is a rising need to explore new entrants of fodder oat varieties to uncover genotypes with improved adaptability, larger biomass, and better fodder quality. Since productivity is tightly tied to nutrient availability, investigating the influence of varied nitrogen dosages on these novel types is vital for maximizing their growth potential. Evaluating varietal performance under diverse nitrogen regimes can help estimate optimal nutrient requirements, enhance nitrogen-use efficiency, and encourage sustainable fodder production. Such research will aid in producing high-yielding, hardy fodder oat cultivars and guide farmers in adopting precise nutrient management strategies for better yield and overall farm profitability. With this objective, an AVT was carried out to evaluate the performance of diverse fodder oat entries under varying nitrogen dose levels.

Materials and Methods

The experiment was conducted at ICR Farm, Assam Agricultural University, Jorhat, Assam during *rabi* season (2022-23). Oats are a versatile crop, valued for both their grain and forage production. The research aimed to determine how varying N levels influenced the forage yield of these promising entries, with implications for optimizing their agricultural performance. AVT on dual purpose oat was conducted to access the performance of nitrogen fertilizer on yield and quality of dual-purpose oat entries. In the trial, five entries (HFO-917, HFO-1014, JO-03-513, JHO-20 2 and OL-1931) along with two national checks (UPO-212 and JHO-822) were also evaluated. The three nitrogen levels (70, 105 and 140 kg/ha) were imposed on entries to see the response. 50% of N was applied as basal (during sowing) and remaining 25% as 1st top dressing (30 DAS) and 25% as 2nd top dressing (after 1st cut, 61 DAS). The experiment was conducted in split plot design with entries in main plot and replicated thrice. Total rainfall received during crop growth period was 56.80 mm. The layout of the experiment was based on split-plot design with three replications. Seed rate of 100 kg/ha was taken for sowing. Under growth parameters, plant height (cm), no. of tillers/m row length, no. of leaves, no. of leaves, plant population/m were considered whereas under yield parameters, green fodder yield (q/ha), dry matter yield (q/ha), crude protein yield (q/ha), seed yield (q/ha), crude protein (%) were evaluated accordingly. The data recorded in the experiment for each parameter were subjected to analysis of variance for split-plot design (SPD) given by Panse and Sukhatme (1954) [7].

Results and Discussion

Among the entries, higher plant height was showed by OL-1931 (88.98) which was at par with JHO-20-2(88.23 cm), HFO-917 (87.69 cm) along with two others (Table 1). However, highest leaf stem ratio (1.85), no. of tillers/m row length (115.00), no. of leaves (6.67) was demonstrated by JHO-20-2 among all the entries. This might be due to its superior genetic vigour, efficient nutrient utilization, and enhanced tillering ability, which collectively promote greater leaf production, higher biomass allocation to leaves, and improved overall growth performance. However, HFO-917 recorded higher plant population/m row length (29.78) which was at par with HFO-1014 (27.33) and JHO-20-2 (26.78). This might be due to better seedling emergence, higher germination efficiency, and stronger early establishment, enabling more plants to survive and maintain uniform stands, ultimately resulting in greater plant population/m. Similar findings were also reported by Dangi, S., 2021 [2] and Kumar *et al.* (2021) [5].

Among the nitrogen treatments, application of 140 (kg/ha) showed higher plant (87.76 cm) which was at par with 105 (kg/ha) with a height of 92.84. The same trend was followed for no. of leaves where application of 140 (kg/ha) showed more no. of leaves (6.19) which was at par with 105 (kg/ha) with a value of 6.05. This might be due to improved nitrogen availability enhancing chlorophyll formation, vegetative growth, and cell division, thereby promoting taller plants and greater leaf development under higher nitrogen levels without causing excessive nutrient imbalance. However, there was no significant difference among leaf stem ratio, no. of tillers/m row length and plant population. Similar results were reported by Bhilare, R.L. and Joshi, Y.P (2008) [1] and Kumar *et al.* (2021) [5].

Table 1: Effect on growth parameters of fodder oats

Entries	Plant height (cm)	Leaf stem ratio	No. of tillers/m row length	No. of Leaves	Plant Population/m
HFO-917	87.69	1.52	78.22	5.89	29.78
HFO-1014	86.99	1.37	84.00	5.56	27.33
JO-03-513	86.02	1.49	82.22	5.44	24.56
JHO-20-2	88.23	1.85	115.00	6.67	26.78
OL-1931	88.98	1.67	99.33	6.56	28.44
UPO-212 (NC)	78.78	1.49	83.67	5.44	28.22
JHO-822(NC)	83.51	1.52	95.56	6.00	28.78
SE(m) ±	1.88	0.07	6.22	0.307	2.424
C.D. (P=0.05)	3.35	0. 12	11.08	0.546	4.315
Nitrogen levels (kg/ha)					
70	76.63	1.52	87.76	5.57	28.29
105	92.84	1.56	91.67	6.05	27.33
140	87.76	1.59	94.00	6.19	27.48
SE(m) ±	2.93	0.09	8.44	0.188	2.527
C.D. (P=0.05)	6.25	0.18	17.97	0.400	5.382

Among the entries, highest green fodder yield was showed by JHO-20-2 (363.75 q/ha). However, OL-1931 showed higher dry matter yield of 44.18 q/ha which was at par with JHO-20-2 (44.18 q/ha). The same trend was followed in crude protein yield where the former gave 4.57 q/ha whereas the later entry showed 4.55 q/ha. This might be due to differential biomass composition, where JHO-20-2 accumulated more succulent forage, while OL-1931 partitioned greater solids and protein, resulting in comparable dry matter and crude protein yields despite lower green fodder output. However, JHO-20-2 showed highest seed yield of 11.54 q/ha. This might be due to its superior reproductive efficiency, better panicle development, and effective assimilate transfer to seeds, enabling enhanced grain filling and ultimately resulting in higher seed yield compared to other entries. For crude protein percentage, UPO-212 (NC) showed higher value (10.77%) which was at par with JHO-20-2 (10.37%), HFO-917 (10.27%) and HFO-1014 (10.23%). Similar findings were also reported by Iqbal *et al*. (2013) [4] and Dangi, S. (2021) [2].

Among different nitrogen levels, no significant difference was observed in green fodder yield (q/ha). However, application of 140 (kg/ha) of nitrogen showed higher dry matter yield (35.03 kg/ha) which was at par with application of 70 kg/ha of N (38.31 kg/ha). This might be due to balanced nitrogen availability enhancing biomass formation, photosynthate utilization, and structural development, thereby producing comparable dry matter yields even when nitrogen was applied at different levels. Application of 105 kg/ha of N gave highest seed yield of 10.33 (q/ha). For crude protein%, 140 kg/ha of N showed 10.45% which was at par with 105 kg/ha (10.37%). This might be due to sufficient nitrogen supply at both levels to support protein synthesis, enabling similar nitrogen assimilation efficiency and resulting in comparable crude protein percentages across the two nitrogen treatments. Similar findings were also reported by Bhilare, R.L. and Joshi, Y.P (2008) [1] and Iqbal *et al*. (2013) [4].

Table 2: Effect on yield parameters of fodder oats

Entries	Green fodder yield (q/ha)	Dry matter yield (q/ha)	Crude protein yield (q/ha)	Seed yield (q/ha)	Crude protein (%)
HFO-917	204.75	26.83	2.76	8.68	10.27
HFO-1014	224.78	29.49	3.02	8.37	10.23
JO-03-513	248.31	31.92	3.18	8.84	9.94
JHO-20-2	363.75	44.18	4.57	11.54	10.37
OL-1931	349.30	45.01	4.55	10.65	10.12
UPO-212 (NC)	204.98	31.44	3.38	8.51	10.77
JHO-822(NC)	311.47	40.00	4.20	9.36	10.49
SE(m) ±	7.16	0.92	0.16	0.26	0.33
C.D. (P=0.05)	12.74	1.63	0.29	0.46	0.59
Nitrogen levels (kg/ha)					
70	257.22	38.31	3.87	8.32	10.12
105	279.13	33.33	3.47	10.33	10.37
140	281.09	35.03	3.66	9.62	10.45
SE(m) ±	12.72	2.06	0.25	0.27	0.10
C.D. (P=0.05)	27.08	4.39	0.54	0.57	0.22

Conclusion

The JHO-20-2 fodder oat entry exhibited superior growth, productivity, and yield attributes, likely owing to its improved morphological traits, efficient nutrient use, and inherent genetic potential for vigorous biomass production and effective seed formation. Moreover, applying 140 kg/ha of nitrogen further supports overall plant vigour by improving nutrient availability, strengthening vegetative development, and enhancing quality parameters through improved physiological efficiency.

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