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Influence of nitrogen levels on herbage yield and economy of promising entries of oat (*Avena sativa* L.) Under Chhattisgarh plains

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Abstract
In order to find out performance of promising entries of oat under different nitrogen level, the present research work entitled "Influence of nitrogen levels on herbage yield and economic of promising entries of oat (*Avena sativa* L.) Under Chhattisgarh plains" was conducted during *Rabi* season of 2020-21 at Agriculture Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). The soil was clay loam having neutral reaction (pH 7.0), low available soil nitrogen (150.52 kg ha^{-1}), medium available soil phosphorous (16.23 kg ha^{-1}) and high exchangeable soil potassium (364 kg ha^{-1}). The experiment consisted with ten promising entries of oat as a main plot treatment and three nitrogen levels *viz.* 60, 90 and 120 kg N ha^{-1} as sub plot treatment was laid out in split plot design with three replications. The ten promising entries of oat were OL-1874-1, Kent, OL-1876-1, RO-11-1-3, JO-06-23, SKO-241, RO-11-1, OS-6, RO-11-1-2, and HFO-806. The crop was sown 20th November, 2020 with a seed rate of 100 kg ha-1 and harvested at 50% flowering. The crop was fertilized with 100:40:20 kg N: P2O5: K2O ha^{-1}. The 60% nitrogen and whole quantity of phosphorous and potassium was applied as basal and remaining 40% N was given at 40 days after sowing. Among different promising entries of oat, OL-1874-1 gave the highest yield of herbage (448.9 q ha^{-1}), dry fodder (94.2 q ha^{-1}) and per day productivity, gross return (Rs 67333 ha^{-1}), net return (Rs 41234 ha^{-1}) and Benefit: Cost ratio (2.58). Among nitrogen levels, yield *viz.* herbage yield (345 q ha-1), dry fodder yield (76.27 q ha-1) and productivity (3.88 and 0.86 q ha-1 day-1), respectively and economic of gross return (Rs 51737 ha-1), net return (Rs 25227 ha-1) and Benefit: Cost ratio (1.95) increased with increasing levels of from application of 60 to 120 kg N ha-1.

Keywords: Fodder oats, economics, N levels, promising entries, yield

Introduction
India is an agricultural region with agriculture and husbandry employing 65 to 70% of the population. Animals and their by-products are important for human life, to satisfy these demands livestock play a critical role in agriculture and the Indian economy. Livestock contributes to food security, family income, soil productivity and long-term agricultural production but in Chhattisgarh, low grade roughages such as rice or wheat straw are provided to animals without being processed to boost their quality, which has a direct impact on the Animals growth and milk production. Green fodder not only aids digestion, but also provides an abundance of Vitamin 'A' and essential minerals such as Ca and Fe as well as energy for the animals. However, among the numerous fodder crops, oat may be able to meet the cattle's year-round green and nutritious fodder requirements. The global oat field is 9.51 million hectares with an output of 23.41 million metric tonnes (USDA, 2018) [7]. The oat (*Avena sativa* L.) is a belongs to the Poaceae family. Green fodder has a protein content of 10-12% and a dry matter content of 30-35%. All animals prefer it as a feed and its straw is soft. It is also a good feed for dairy cows and young animals. Oats can be grown in a wide variety of climatic conditions due to their large varietal diversity. Many improved oat varieties have emerged in recent years with high yield capacity and the ability to produce both green fodder. Vegetative growth of crop is primarily determined by its genotype, nutrient supply mechanism, soil ability to supply nutrients to the crop and plant capacity to take and use nutrients in a given amount of time. These cultivars react well to high fertilizer applications. As a result, providing balance fertilization, which is one of the accepted practices for improving the yield and nutritive value of forage crops will result in a significant increase in yield of these varieties per unit area per unit time.

Nitrogen is the most important resource for fodder production, since it is absorbed in vast quantities by the crop. Oat responses well to nitrogen application, which produces more tonnage per unit area per unit time under optimal environmental conditions. Nitrogen is mostly used in protein synthesis, although it is structurally made up of chlorophyll molecules along with carbohydrate and fatty acids. It aids in the development of protoplasm, which is the physical foundation of plant life. The optimum nitrogen application is more critical because it not only increases yield but also improves the quality of the produce. However, among the numerous factors influencing production, varieties and nitrogen requirements have a major effect on forage oat productivity. Thus, it is critical to pick and identify suitable oat varieties as well as their nitrogen requirements, in order to achieve higher fodder yields in various agro-climatic zone.

Materials and Methods

Field experiment was conducted during *rabi* season of 2020-21 at the Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). Raipur is situated in the central part of Chhattisgarh at 21º16'N latitude, 81º36' E longitude and at an altitude of 298 m above mean sea level. The soil of the experimental plot was clay loam in texture named as kanhar having neutral in reaction (pH 7.0) with low nitrogen (150.52 kg ha^{-1}), medium phosphorous (16.23 kg ha^{-1}) and high potassium (364 kg ha^{-1}). The climate of the region is sub-humid to semi-arid. The experiment was carried out ten promising entries of oat in main plot and three different level of nitrogen *viz.* 60, 90 and 120 kg N ha^{-1} were arranged in sub plot in split plot design with three replications. The ten promising entries of oat were OL-1874-1, OL-1876-1 (PAU, Ludhiana); RO-11-1-3 (MPKV, Rahuri); JO-06-23 (JNKVV, Jabalpur); SKO-241 (SKUAST-K, Srinagar); RO-11-1-2 (MPKV, Rahuri); and HFO-806 (CCS HAU, Hisar); and at national check Kent, OS-6 and at zonal check RO-11-1. The promising entries of oat was sown on 20th November, 2020 with a seed rate of 100 kg ha^{-1} of each entries in rows 25 cm and harvested at 50% flowering (07th Feb to 4th March 2021). The basal application of 40 kg ha^{-1} P2O5 and 20 kg ha^{-1} K2O was given to the crop. Nitrogen was given as per treatment.

Result and Discussion

The effect of nitrogen levels on herbage yield and economic of promising entries of oat with respect to herbage yield, dry fodder yield, herbage and dry fodder productivity and economics is presented in table 1.

Effect on Yield parameters of promising entries

High tonnage of the crop is prime objective for growing of forage crops. Different varieties of oat showed significant difference in herbage and dry fodder yield. It is noticed from the data that herbage yield, dry fodder yield and herbage and dry fodder productivity were greatly influenced due to different entries. With respect to various Promising entries, entry OL-1874-1 proved its superiority in producing maximum yield of herbage (499 q ha^{-1}) and dry fodder yield (94.30 q ha^{-1}) which was significantly superior over rest of the entries including checks. The herbage and dry fodder productivity is also maximum with entry OL-1874-1 (4.99 and 1.05 q ha^{-1} day^{-1}), respectively in comparison to all the entries tested. The higher herbage yields under OL-1874-1 at harvest stage may be because of more dry matter accumulation through leaves, shoots and whole plant (Shikha and Singh 2018) [6].

Effect on yield parameters on N levels

The yield of an agricultural crop strongly depended on the supply of mineral nutrients, particularly N. The abundant supply of nutrient (nitrogen) may have increased protoplasmic constituents and accelerated the process of cell division and elongation which might have resulted in luxuriant vegetative growth and thereby higher biomass and dry matter yield (Kumari *et al.*, 2014) [3]. As a results of which, nitrogen yielded better response of herbage yield. Similar results were also observed by Roshan *et al.* (2012) [5]. There was progressive increase of herbage yield in response to increasing N supply. Nitrogen fertilization had significant effect on different N levels, the increasing level of N from 60 to 120 kg ha^{-1} significantly increased the herbage yield, dry fodder yield and herbage and dry fodder productivity. The highest herbage yield (344.51 q ha^{-1}), dry fodder yield (76.27 qha^{-1}), herbage productivity (3.88 q $ha^{-1}day^{-1}$) and dry fodder productivity (0.86 qha^{-1} day^{-1}) was observed due to application of 120 kg N ha^{-}1. The highest dry fodder yield with higher nitrogen rates also reported by Midha *et al*. (2015) [4] and Godara *et al*. (2016) [2].

Economic analysis of the treatments

Agronomical research aimed in obtaining maximum monetary gains apart from crop yield Thus, the assessment of economic factors *viz*, cost of cultivation, gross monetary return, net monetary return and benefit: cost ratio is very important to find out the effect of treatments and their practical utility to the farmers.

Effect on promising entries

The finding indicated that the cost of cultivation did not vary due to different entries but Gross monetary returns is the value of the produce obtained under different entries. As the herbage yield (the economic produce) varied due to the different promising entries, hence GMR also differed with these entries. The entry OL-1874-1 gave the maximum GMR (Rs 67333 ha-1) than other entries. Net monetary returns is the actual monetary advantage under a particular entries, which is determined by deducting the cost of cultivation from the GMR of the same promising entry. Data given in Table 1 clearly shows that the entry OL-1874-1 being top yield fetched the maximum net profit of Rs. 41234 ha^{-1} than all other entries. It indicated that the yield potential of different varieties influenced their NMR. The finding indicated that the entry OL-1874-1 had maximum benefit: cost ratio (2.58) among all the entries tested in the experiment. The more profitability under this entry may be due to its higher yield potential as well as gross monetary returns and accordingly the ratio was reduced with JO-06-23, HFO-806, OL-1876-1, RO-11-1-2, RO-11-1, RO-11-1-3, Kent, OS-6 and SKO-241, respectively.

Effect on N levels

The variations in nitrogen levels enhanced the cost as per application of nitrogen. The cost of cultivation was common i.e. Rs 26099 ha^{-1} in all the promising entries, which was increased by Rs 25683, 26103 and 26510 ha-1 with the application of 60, 90 and 120 kg N ha^{-1}, respectively. Thus,

the cost of cultivation was maximum (Rs. 26510 ha-1) with 120 kg N ha-1 under all the promising entries. Application of nitrogen (120 kg ha-1) gained the maximum GMR of Rs 51737 ha^{-1} which declined as Rs 49212 and 45566 ha-1 with decrease in application of nitrogen as 90 and 60 kg ha-1, respectively. It is apparent from the data (Table 1) that the NMR recorded under different N levels increased from Rs 19883 to Rs 25227 ha^{-1} with increase in nitrogen level from 60 to 120 kg ha^{-1}. Increase in green fodder yields due to corresponding increase in nitrogen levels resulted in enhancing GMR and ultimately the net profit under these treatments. The benefit: cost ratio of profit over each rupee of investment every incremental dose of N as 60, 90 and 120 kg ha^{-1} resulted in an increase in the ratio as 1.77, 1.89 and 1.95, respectively. It shows that application of higher doses of nitrogen was more remunerative due to increase in green fodder and gross monetary
returns. Godara *et al.* (2016) [2] reported that the application of 120 kg N in oat crop produced the highest net return and benefit: cost ratio (Rs 41785 ha^{-1} and Rs 1.48 ha^{-1}) than 80 kg N ha-1 (net return Rs 36918 ha-1 and benefit: cost ratio 1.33). Dabhi *et al.* (2017) [1] at Anand revealed that the maximum net return (Rs 44972 ha^{-1}) was obtained by adding 120 kg N ha^{-1}, followed by 100 kg N and 80 kg N ha^{-1} (Rs 41124 and 35920 ha^{-1}).

Table 1: Yield and economics of various promising entries of oat under different nitrogen levels

Treatment	Herbage yield q ha $^{-1}$	Dry fodder yield q ha $^{-1}$	Herbage productivity q ha^{-1} day^{-1}	Dry fodder productivity q ha^{-1} day^{-1}	Cost of cultivation Rs ha^{-1}	Gross monetary return Rs ha^{-1}	Net return Rs ha^{-1}	Benefit: cost ratio
Promising entries								
OL-1874-1	449	94.30	4.99	1.05	26099	67333	41234	2.58
Kent	262	53.90	3.08	0.63	26099	39278	13178	1.50
OL-1876-1	357	68.70	3.97	0.76	26099	53569	27470	2.05
RO-11-1-3	295	63.00	3.68	0.79	26099	44194	18095	1.69
JO-06-23	405	87.30	4.35	0.94	26099	60722	34623	2.33
SKO-241	249	56.10	2.37	0.62	26099	37389	11289	1.43
RO-11-1	294	62.30	3.68	0.78	26099	44083	17984	1.69
OS-6	250	65.50	2.94	0.66	26099	37430	11331	1.43
RO-11-1-2	307	67.10	3.61	0.79	26099	46069	19970	1.76
HFO-806	389	86.10	4.01	0.89	26099	58319	32220	2.23
S.Em ±	7.83	1.73	0.09	0.02	--	1176	1176	0.05
CD (P=0.05)	23.28	5.13	0.26	0.06	--	3496	3496	0.13
Nitrogen levels (kg ha^{-1})								
60	304	64.57	3.42	0.73	25683	45566	19883	1.77
90	328	70.46	3.69	0.79	26103	49212	23109	1.89
120	345	76.27	3.88	0.86	26510	51737	25227	1.95
S.Em ±	3.40	0.85	0.04	0.01	--	510	510	0.02
CD (P=0.05)	9.72	2.44	0.10	0.03	--	1459	1459	0.06

Conclusion

In light of results obtained from this experiment, it can be concluded that promising entry of oat OL-1874-1 produced the maximum herbage yield, dry fodder yield, herbage productivity, dry fodder productivity with application of 120 kg N ha^{-1}.

The highest gross return, net return and benefit: cost ratio was also obtained in promising entry OL-1874-1 and 120 kg N ha^{-1}.

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