*Forage Res.,* **48**(4) : pp. 482-486 (2023) **http://forageresearch.in**

# EVALUATING THE EFFECT OF DIFFERENT NITROGEN LEVELS ON FORAGE YIELD AND QUALITY OF PROMISING ENTRIES OF SINGLE CUT OAT

**NAVEEN KUMAR[1,]*, SATPAL, NEERAJ KHAROR AND SUMIT BHARDWAJ**

Department of Genetics & Plant Breeding (Forage Section)
CCS Haryana Agricultural University, Hisar-125 004, Haryana (India)
**(e-mail : nknaveenroyal@gmail.com)*

**(Received : 1 March 2023; Accepted : 30 march, 2023)**

## SUMMARY

A field study was carried out during *rabi* season, 2019-20 at Forage Section Research Farm Department of G&PB, CCSHAU, Hisar to in order to assess the effect of different nitrogen (N) levels on forage yield and quality of promising entries of single cut oat. The experiment included 32 treatment combinations including eight promising entries of single cut fodder oats (Five entries *i.e.* JO-05-09, HFO- 529, HFO-718, SKO-240, OL-1896 + 2 national checks *i.e.,* Kent and OS-6 + 1 zonal check *i.e.* RO-11-1 (North West Zone) and four nitrogen doses (30, 60, 90, and 120 kg N/ha). Findings revealed that entry SKO-240 had the highest growth characteristics, green fodder and dry matter yield. The highest crude protein content (9.28 %) was found with HFO-718 which was significantly higher than all other except RO-11-1, HFO-529 and Kent, whereas crude protein yield was not influenced significantly by different entries. Maximum net returns (61635 Rs/ha) and B: C (2.67) was fetched with entry SKO-240 followed by Kent and HFO-529. Among different nitrogen treatments, 120 kg N/ha level gave highest values for growth parameters, dry matter and green fodder yield. Moreover, 120 kg N/ha level was found to have the greatest crude protein yield and content (9.41 % and 16.68 q/ha respectively), both of which were statistically at par to 90 kg N/ha. With 120 kg N/ha level, the highest net returns and B: C ratio were obtained, followed by lower levels of nitrogen.

**Key words :** Single cut, oat, entries, fodder, nitrogen levels, crude protein

India is home to 200 million cattle and 92 million buffalo, making it a sizable bovine population. This represents 19.5% of the world's cattle population. Despite the enormous number of cows, milk output and productivity are much below average for the world. Any dairy industry's success depends on the availability of nutrient-rich fodder (Surje *et al.,* 2015). According to the Basic Animal Husbandry Statistics report of 2022, India is ranked as the top milk-producing country in the world, with a production of 221.06 million tonnes of milk in 2021-22. This, however, is not a result of the effectiveness of the milking animals, but rather the presence of a sizable population of livestock with subpar milking potential as compared to western nations. Malnutrition, under-nutrition, or combination of both, along with poor genetic potential, also contributes to poor productivity. According to the IGFRI Vision-2050 report, India has a net deficiency of 35.6% green fodder, 11% dry agricultural leftovers, and 44% feeds. The rising demand for fodder and feed to sustain livestock production can be met by increasing productivity of fodder. The availability of quality fodder and feed with better nutritive composition is a decisive factor that controls the productivity and overall performance of livestock. The nutritional composition of fodder and feed directly impacts the health and productivity of livestock. Inadequate and poor-quality feed can lead to a host of health problems in animals, such as reduced weight gain, lower milk productivity, and reduced reproductive efficiency. Low milk productivity is predominantly caused by inadequate and low nutritional quality of fodder and feed. India is facing limitations in terms of the availability of quality green fodder, dry fodder, and other concentrates. Among different *rabi* annual, oat fodder is an energy-rich crop with good regeneration ability and high dry matter content (Kumar *et al*., 2010). Oat (*Avena sativa* L.) is an important forage crop that is widely grown in temperate regions. It is a cool-season annual cereal that is well adapted to diverse soil and climatic conditions. Oat forage is highly palatable, nutritious, and digestible, making it an ideal feedstuff for ruminants. Oat has several uses, including the preparation of hay, silage, and concentrate

[1]Presently working in RRS, Karnal.

feed grain, and is considered the most crucial cereal fodder crop suitable for the Haryana region, with a crude protein content ranging from 10 to 14 percent. Additionally, its adaptability, quick-growing nature, high-yielding potential, and palatable and nutritious value make it popular among various animals. As a succulent cereal, oat provides a good source of protein, carbohydrates, fiber, minerals, and slightly less fats and protein when used as fodder or grain. The yield and quality of oat forage are influenced by several factors, including genetic makeup, environmental conditions, and cultural practices. Among these, nutrient management plays a crucial role in determining the productivity of the crop. Among three macronutrients, nitrogen is the most essential nutrient, along with phosphorus and potassium, that are essential for plant growth and development, and its availability in the soil is a major limiting factor for crop yields (Wang *et al.,* 2023). Adequate N supply can significantly increase forage yields and improve the quality of the crop by increasing crude protein content and reducing fiber concentrations. It is a crucial component of protein and chlorophyll, gives plant deep green color, encourages vegetative growth and rapid early growth, and improves the quality by increasing the protein content of fodder crops (Patel *et al.,* 2007). In addition, nitrogen has a significant role in how potassium, phosphorus, and other crucial nutritional elements utilization by plants. The majority of soils in the Haryana region are lacking in nitrogen, and if the necessary amount of nitrogen is not provided to crops in sufficient quantities, this deficiency can be reflected in the quality and quantity of the resulting forage. In India, the low yield of oat crop can be attributed to various factors such as low soil fertility, inadequate manuring, and cultural practices. Due to the depletion of major and minor elements in the soil, the yield of crops is hampered. The new varieties of the crop require higher amounts of nutrients to realize their inherent yield potential. Proper and optimum application of fertilizers can increase the yield and improve the quality of the produce. The nitrogen content of the fodder is a crucial indicator of forage digestibility. However, an excessive amount of nitrogen can lead to crop lodging and nitrate poisoning in animals. Nitrogen plays a vital role in fodder production, as it is associated with high photosynthetic activity, vigorous growth, and a dark green color of fodder, which helps in carbohydrate utilization and increasing succulence of the fodder. Therefore, finding the optimum dose of nitrogen for obtaining a good yield of newly tested single cut oat entries is essential. In view of these aspects, the present study was undertaken to evaluate the performance of different promising genotypes of single cut oat with varying levels of nitrogen.

## MATERIALS AND METHODS

A field was conducted during *rabi* season, 2019-20 at Forage Section Research Farm of CCSHAU, Hisar (Haryana), India (located 29°10' N latitude, 75°46' E longitude, at an average elevation of 215.2 m above mean sea level). The climate of site was semi-arid and sub-tropical with hot dry summers and severe cold winters. Average annual rainfall is about 450 mm, of which 75 per cent is received in three months, from July to September during South-West monsoon. Weekly weather parameters i.e. temperature (°C), relative humidity (%) and rainfall (mm) during the crop period are depicted in Fig 1. The soil in the experimental field was a sandy loam with a reaction pH of 8.2, a low available nitrogen content (166.3 kg/ha), a medium available phosphorus content (12.6 kg/ha) and potassium content (241.9 kg/ha). The experiment was performed in split plot design with three replications. The main plot included 8 promising entries (Five entries *i.e.* SKO-240, HFO- 529, HFO-718, JO-05-09, OL-1896 + 2 national checks *i.e.,* Kent and OS-6 + 1 zonal check *i.e.* RO-11-1 (North West Zone) of single cut fodder oat whereas sub plot had four nitrogen levels (30, 60, 90, and 120 kg N/ha). Using a seed rate of 100 kg/ha, oat genotypes as per treatment were sown manually on November 25, 2019 in opened furrows spaced 25 cm apart. All the other standard agronomic practices for the cultivation of oat were followed uniformly in all the treatments. All the genotypes were harvested just after 50 per cent flowering. The harvested green fodder from each plot

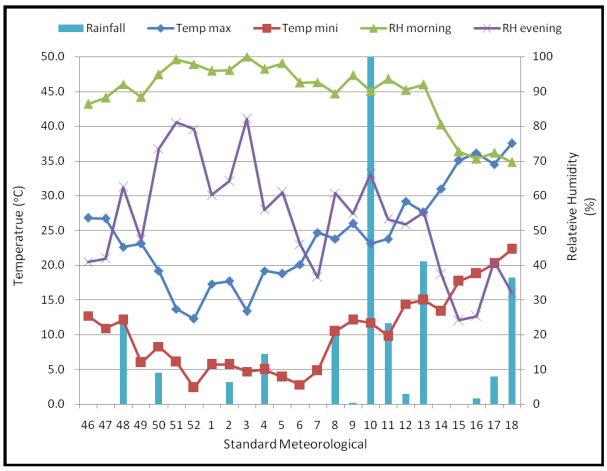


Fig. 1. Weekly weather parameters during *rabi* 2019-20 at the experimental site.

was weighed in situ in kg/plot and then converted into q/ha. A 500g sample was taken randomly from each plot at the time of green fodder at harvest, chopped well and put into paper bag. These bags were aerated by making small holes all over. The samples were first dried in the sun for 15 days and then transferred in an electric hot air oven for drying at a temperature of 60±5°C till constant weight was achieved. Based on these samples, the green fodder yield was converted into dry matter yield (q/ha). Crude protein content (%) was estimated in dried and grinded samples (2 mm sieve size), collected at 50 per cent flowering stage. The crude protein content was calculated by multiplying the nitrogen percentage with 5.83 by conventional micro-kjeldal method (AOAC, 1995). Crude protein yield was calculated by the multiplication of crude protein content with dry matter yield (q/ha). The local market's prevailing input and product prices were used to calculate economics. The trial data were analyzed by using OPSTAT software which is available on CCS Haryana Agricultural University official site (Sheoran *et al*., 1998).

## RESULTS AND DISCUSSION

**Effect of entries :** Data presented in Table 1 revealed that maximum plant height (142.0 cm) was recorded with entry SKO-240. However, lowest plant height (114.8 cm) was recorded with entry OL-1896. Entry SKO- 240 had the maximum number of tillers/ m row length (74.1) which was significantly higher than all other entries. Whereas, lowest number of tillers/ m row length (52.1) was recorded with entry OL-1896. The leaf: stem (L: S) ratio was also measured highest with entry SKO-240 which was significantly higher than all other entries. The entry SKO-240 gave highest per day productivity of green fodder (5.39 q/ ha/day) and dry matter (1.48 q/ha/day) which was statistically at par with entry HFO-718, HFO-529 and Kent (NC). Similarly, the highest green fodder and dry matter yield of oat were recorded with entry SKO-240 (657.6 q/ha and 180.8 q/ha, respectively) which were significantly higher than other entries except HFO-718, HFO-529 and Kent (NC). Entry HFO-718 had the highest crude protein content (9.28 %). While

TABLE 1
Growth, quality parameters and productivity of oat promising entries as affected by nitrogen levels

| Treatments | Plant height at harvest (cm) | No. of tillers/ mrl | L : S ratio | Per day productivity (q/ha/day) | | Green fodder yield (q/ha) | Dry fodder yield (q/ha) | Crude protein content (%) | Crude protein yield (q/ha) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Green fodder | Dry fodder | | | | |
| **Entries-8** | | | | | | | | | |
| OL-1896 | 122.9 | 52.1 | 0.43 | 4.47 | 1.23 | 544.6 | 150.4 | 9.02 | 13.64 |
| HFO-718 | 134.8 | 64.5 | 0.50 | 5.00 | 1.36 | 609.9 | 165.9 | 9.28 | 15.43 |
| RO-11-1 (ZC) | 124.1 | 53.1 | 0.44 | 4.50 | 1.24 | 549.2 | 151.6 | 9.13 | 13.88 |
| HFO-529 | 135.7 | 66.0 | 0.51 | 5.02 | 1.37 | 612.2 | 167.2 | 9.13 | 15.25 |
| Kent (NC) | 136.6 | 66.3 | 0.52 | 5.03 | 1.38 | 613.8 | 168.6 | 9.13 | 15.46 |
| OS-6 (NC) | 131.3 | 61.1 | 0.48 | 4.88 | 1.33 | 595.9 | 162.6 | 8.93 | 14.57 |
| JO-05-09 | 129.5 | 59.0 | 0.47 | 4.81 | 1.32 | 586.6 | 160.6 | 8.92 | 14.36 |
| SKO-240 | 142.0 | 74.1 | 0.56 | 5.39 | 1.48 | 657.6 | 180.8 | 8.85 | 16.01 |
| SEm (±) | 2.42 | 1.6 | 0.01 | 0.13 | 0.04 | 16.0 | 5.3 | 0.08 | 0.54 |
| CD (P=0.05) | 7.40 | 4.9 | 0.03 | 0.40 | 0.13 | 49.1 | 16.3 | 0.23 | NS |
| **Nitrogen levels- 4 (kg/ha)** | | | | | | | | | |
| 30 | 124.1 | 57.4 | 0.41 | 4.39 | 1.16 | 535.8 | 141.9 | 8.58 | 12.17 |
| 60 | 130.0 | 61.0 | 0.47 | 4.79 | 1.33 | 584.1 | 161.7 | 8.95 | 14.44 |
| 90 | 136.3 | 64.3 | 0.52 | 5.10 | 1.42 | 622.7 | 173.0 | 9.25 | 16.01 |
| 120 | 138.1 | 65.5 | 0.56 | 5.27 | 1.45 | 642.3 | 177.3 | 9.41 | 16.68 |
| SEm (±) | 1.95 | 1.1 | 0.01 | 0.09 | 0.03 | 11.2 | 3.4 | 0.08 | 0.34 |
| CD (P=0.05) | 5.55 | 3.2 | 0.02 | 0.27 | 0.08 | 32.0 | 9.7 | 0.22 | 0.96 |
| **Factor(B) at same level of A** | | | | | | | | | |
| SEm (±) | 4.83 | 3.2 | 0.02 | 0.26 | 0.09 | 32.1 | 10.7 | 0.15 | 1.07 |
| CD (P=0.05) | NS | NS | 0.06 | NS | NS | NS | NS | NS | NS |
| **Factor(A) at same level of B** | | | | | | | | | |
| SEm (±) | 5.34 | 3.2 | 0.02 | 0.26 | 0.08 | 31.8 | 9.9 | 0.21 | 0.99 |
| CD (P=0.05) | NS | NS | 0.06 | NS | NS | NS | NS | NS | NS |

entry SKO-240 (16.01 q/ha) had the maximum crude protein yield, there was no statistically significant difference between it and the other entries. (Table 1). Economic analysis given in Table 2 revealed that highest net returns (61635 Rs/ha) and B: C ratio (2.67) was fetched with entry SKO-240 followed by Kent (NC).

**Effect of nitrogen levels :** Data presented in table 1 revealed that maximum plant height (138.1 cm) was recorded with the application of 120 kg N/ ha which was statistically at par with 90 kg N/ha. The application of 120 kg N/ha also resulted in the highest number of tillers/m row length (65.5), which was statistically at par to 90 kg N/ha. Similarly, the highest leaf: stem (L: S) ratio was also measured with the application of 120 kg N/ha which was significantly higher than other doses. With 120 kg N/ha, which was statistically at par to 90 kg N/ha, the maximum daily production of dry matter (1.45 q/ha/day) and green fodder (5.27 q/ha/day) was observed. As nitrogen is an important constituent of protein and chlorophyll. It imparts dark green colour to the plants, promotes vegetative growth and rapid early growth (Godara *et al.,* 2016). This will lead to better crop growth with increase in levels of nitrogen. According to Sheoran *et al.* (2017), raising nitrogen levels from 40 to 120 kg/ha had a substantial impact on the number of tillers/m row length, whereas plant height was increased up to 80 kg N/ha only. Likewise, the application of 120 kg N/ha resulted in highest green fodder and dry matter yield (642.3 q/ha and 177.3 q/ ha, respectively) which were significantly higher than lower levels but at par with 90 kg N/ha (Table 1). As nitrogen is one of the most important nutrient it occupies prominent role in plant metabolism. It increases physiological indices by improving leaf production and expansion rate that ultimately achieve more interception of photo synthetically active radiation and consequently more total biomass accumulation (Kumar *et al.,* 2017). According to Midha *et al*. (2015), the application of 80 kg N/ha significantly increased the green fodder and dry matter yield over the treatment of 40 kg N/ha, from 253.4 to 360.5 q/ha and 52.8 to 73.5 q/ha, respectively. The maximum crude protein yield and content were found at 120 kg N/ha (16.68 q/ha and 9.41%, respectively), which were statistically at par to 90 kg N/ha but significantly higher than lower levels. (Table 1). Protein content was increased with increased in amount of nitrogen application and this may be ascribed due to synthesis of amino acid and protein in plant. Higher crude protein at 120 kg N/ha was attributed to higher uptake of nitrogen which is constituent of amino acids and protein. Kumar *et al.* (2021), Godara *et al.* (2016) and Midha *et al.* (2015) also reported improvement in protein content with increase in nitrogen levels. The increase in crude protein yield was owing to increase in protein content as well as dry matter yield of crop since the protein yield proportionally increased with the increase in dry matter yield. Similarly, Patel *et al.* (2022) also revealed that plant growth, yield and quality parameters of forage oat were increased significantly when fertilised with 140 kg N/ha. Moreover, the application of 120 kg N/ha generated the highest net returns (58802 Rs/ha) and B: C ratio (2.57), which were then followed by nitrogen application at lower levels. (Table 2).

TABLE 2
Economics of oat promising entries as affected by nitrogen levels

| Treatment | Cost of cultivation (Rs./ha) | Gross returns (Rs./ha) | Net returns (Rs./ha) | B : C ratio |
|---|---|---|---|---|
| **Entries-8** | | | | |
| OL-1896 | 37000 | 81684 | 44684 | 2.21 |
| HFO-718 | 37000 | 91484 | 54484 | 2.47 |
| RO-11-1 (ZC) | 37000 | 82386 | 45386 | 2.23 |
| HFO-529 | 37000 | 91833 | 54833 | 2.48 |
| Kent (NC) | 37000 | 92062 | 55062 | 2.49 |
| OS-6 (NC) | 37000 | 89383 | 52383 | 2.41 |
| JO-05-09 | 37000 | 87990 | 50990 | 2.38 |
| SKO-240 | 37000 | 98635 | 61635 | 2.67 |
| **Nitrogen levels- 4 (kg/ha)** | | | | |
| 30 | 36460 | 80364 | 43904 | 2.20 |
| 60 | 36820 | 87619 | 50799 | 2.38 |
| 90 | 37180 | 93403 | 56223 | 2.51 |
| 120 | 37540 | 96342 | 58802 | 2.57 |

## CONCLUSION

Entry SKO-240 performed best in respect of green fodder, dry matter yield and monetary returns, whereas HFO-718 for crude protein content. Application of 120 kg N/ha was best in case of green fodder yield, dry matter yield, crude protein content, crude protein yield and monetary returns which was on a par with 90 kg N/ha.

## REFERENCES

AOAC, 1995: Official Methods of Analysis, 16th edn. Association of Official Analytical Chemists, Arlington, U. S. A, ID No. 984.13.

Godara, A. S., Satpal, B. S. Duhan and S. K. Pahuja, 2016: Effect of different nitrogen levels on forage yield,

quality and economics of oat (*Avena Sativa* L.) genotypes. *Forage Res*., **41**(4): 233-236.

IGFRI Vision, 2050: Indian Grassland and Fodder Research Institute, Jhansi (U. P.), India.

Kumar, A., R. K. Arya, and S. K. Pahuja, 2010: Effect of cutting and fertilizer management on seed quality parameters of oat (*Avena sativa* L.). *Forage Res*., **35**: 198-200.

Kumar, Naveen, B. R. Kamboj, Todar Mal and Mohinder Singh, 2017: Physiological indices and biomass accumulation of wheat as influenced by nitrogen scheduling under rice residue retained situation. *Int. Arch. App. Sci. Technol*., **8**(4): 42-47.

Kumar, Naveen, Satpal and Kharor, Neeraj, 2021: Response of promising entries of single cut fodder oat to different nitrogen levels. *Forage Res*., **46**(4): 374-378.

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

NDDB, 2022: Basic Animal Husbandry Statistics, DAHD&F, GoI.

Patel, A. S., T. N. Barevadia, M. R. Patel, A. C. Sadhu, and H. P. Parmar, 2007: Effect of nitrogen and different management practices on growth and seed production of oat (*Avena sativa* L.). *Forage Res*., **41**: 104-108.

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.

Sheoran R. S., Satpal, U. N. Joshi, B. S. Duhan, P. Kumari, S. Arya and D. S. Phogat, 2017: Agronomic evaluation of oat (*Avena sativa* L.) genotypes for forage yield, quality and economics under varying levels of nitrogen. *Forage Res*., **43**(1): 35-38.

Sheoran, O. P., D. S. Tonk, L. S. Kaushik, R. C. Hasija and R. S. Pannu, 1998: Statistical Software Package for Agricultural Research Workers. Recent Advances in information theory, Statistics & Computer Applications by D. S. Hooda & R. C. Hasija, Department of Mathematics Statistics, CCS HAU, Hisar (139-143).

Surje, D. T., Barma, S. D., Satpute, S. B., Kale, V. A., Das, A., De D. K., 2015: Variability and Cause Effect Analysis for Fodder and Grain Yield Characters in Oat (*Avena sativa* L.) Genotypes. *Forage Research*. **41**: 85-91.

Wang, Y., Liu, K., Liang, G., Jia, Z., Ju, Z., Ma, X. and Q. Zhou, 2023: Comprehensive Evaluation of Low Nitrogen Tolerance in Oat (*Avena sativa* L.) Seedlings. *Agronomy*, **604**(13): 1-13. https://doi.org/10.3390/ agronomy13020604.