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Pushpendra Singh Yadav
Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

AK Jha
Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Vivekin Pachauri
Department of Livestock Production and Management, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Badal Verma
Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Arti Shrivastava
Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Monika Chouhan
Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Alok Rajpoot
Guest faculty, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Corresponding Author:
Badal Verma
Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Oat genotypes response to different nitrogen levels under agro-climatic condition of Kymore Plateau zone of Madhya Pradesh

Pushpendra Singh Yadav, AK Jha, Vivekin Pachauri, Badal Verma, Arti Shrivastava, Monika Chouhan and Alok Rajpoot

Abstract
A field investigation was conducted at Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during *Rabi* season of 2016-17 to determine the relative performance of new single cut oat genotypes in combination of nitrogen levels. The treatments consists of five new oat genotypes (JO-03-91, OS-396, UPO-06-1, UPO-06-2 and Kent) and four nitrogen levels (0, 40, 80 and 120 kg/ha) under split plot design replicated thrice. The variety JO 03-91 with 120 kg N/ha proved significantly superior in producing maximum green fodder yield (503.9 q/ha), dry matter yield (121.1 q/ha) and crude protein yield (9.6 q/ha) and maximum monetary advantage (Rs. 53729/ha) and proved most remunerative with benefit: cost ratio of 2.87.

Keywords: Forage crop, green fodder yield, N levels, oat, varieties

Introduction
India has the world's largest cattle population, with 520 million head, or about 15 percent of the global cattle population (Neelar, 2011) [14]. However, with an overall annual forage production of 833 mt, the country only has 4.4 percent of its cultivated land under fodder crops. The country's current feed and fodder resources can only meet 48% of the demand, with a 61.1 percent green and 21.9 percent dry fodder deficit, respectively (Jha *et al*., 2014) [6]. Feed and fodder make up around two thirds of the total cost of livestock production (Kumhar *et al*., 2022) [11]. Therefore, any effort to increase the supply of feeds and fodder and reduce feed costs will lead to improved compensation for livestock farmers (Kantwa *et al*., 2019) [8]. Due to the pressure on food crops from population growth, the potential for additional growth appears to be quite minimal (Jha *et al*., 2023) [7]. The availability of crop residues for animal production is expected to be impacted by the recent crop diversification, in which commercial crops have replaced the traditional cereal crops, notably the coarse grains (Ghosh & Palsaniya, 2014) [4]. Farmers are unable to cultivate fodder crops such as Berseem or Lucerne in drought-stricken areas due to a lack of water. Oats would be a better choice for an alternative feed crop in colder climates. Furthermore, when compared to berseem, it has a lower water requirement and provides a greater amount of nutritious green fodder (Pravalika & Gaikwad, 2021) [19].
Oat (*Avena sativa* L.) is one of the important cereal fodder crop in the temperate climate of the world. Oat is grown in India mainly for its nutritive grain and fodder values especially suited for horses, dairy cows and buffaloes. Under the situation, where water supply is limited and farmer cannot grow legumes like berseem and lucerne, oat promises as a better choice as an alternative fodder crop (Pal & Jain, 2022) [16]. The varieties with its genetic potentials and fertilizers particularly nitrogen are the most important factors that influence the forage productivity and nutritional quality (Irfan *et al*., 2016) [5]. Improved fodder quality with fertilizer application is due to their favorable effects on plant water relations, light absorption, crop density, plant height, leaf area and nutrient utilizations (Aravind, 2011) [2]. Oat has high regrowth ability and it could be enhanced by precision nitrogen management for higher forage productivity (Sharma *et al*., 2018) [24]. The application of nitrogen fertilizer improves the dry matter, biomass yield and quality of forage (Dahipahle & Teklu, 2014) [3].
Being a *graminaceous* fodder, oat responds well to nitrogen application, which produces more tonnage in per unit area per unit time under favorable environmental conditions (Agrawal *et al*., 1993) [1]. However, excess application of nitrogen to oat under certain environmental conditions causes large quantities of nitrate accumulation in plant leaves, which may be toxic to ruminants.

These facts necessitate to determinate the adequate supply of nitrogen to the oat based on field experimentation for realizing the genetic yield potential of newly evolved varieties. A vast varietals diversity of oat enables its cultivation over wide range of oat have been evolved which have high yield potential are grown for producing green fodder as well as seed. These varieties are highly responsive to high doses of fertilizers. Hence, the necessity for selection of suitable varieties and their nitrogen requirements for different agro-climatic regions through well planned varietal cum manorial experiments is self-evident.

Material and Methods

A field experiment was conducted under AICRP on Forage Crops, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during *Rabi* season of 2016-17. The soil of experimental field was clay loam in texture, neutral (7.2) in reaction with low organic carbon (0.44%) and normal electrical conductivity (0.34 dS/m) and analyzing low in available N (228 kg/ha), medium in available P (16.2 kg/ha) and available K (297 kg/ha). Treatments were laid out in split plot design with three replications, keeping four levels of each of N (0, 40, 80 and 120 kg/ha) and varieties (JO 03-91, OS 396, UPO 06- UPO 06-21 and Kent). Sowing was done on November 20, 2016 by using 100 kg/ha of each variety in rows 25 cm apart with uniform dose 40 kg P_2O_5 + 20 kg K_2O /ha. Nitrogen was applied as per treatments. At the harvest, green fodder yield and growth parameters, viz. plant height, tiller number, leaf area index and leaf stem ratio were recorded. The crude protein yield was calculated by a factor of 6.25 formula suggested by Mehrez & Zraslox (1977) [13].

Results and Discussion

Effect on growth pattern and yield attributes

Different growth parameters like plant height, number of tillers per plant, leaf area index, and dry matter accumulation by plant have directly correlated with the green fodder yield. The growth parameters like plant height, number of tillers and leaf area index gradually increased under all treatments with the advancement in growing periods till the harvesting of crop (Table 1). Similarly, the LAI showed rapid rate of increment during the period between 30 DAS to 60 DAS. Increasing level of nitrogen dose from 0 to 120 kg/ha resulted corresponding increase in plant height, LAI and number of tillers, because of nitrogen attributed synthesis of food materials, resulting in greater cell division and cell elongation (Kumar *et al.*, 2001) [9]. Therefore, elongation in plant increased with increasing nitrogen application. Application of 120 kg/ha was also recorded highest LAI and number of tillers/m^2. As regardless the varieties, the varieties JO 03-91 attained maximum plant height, number of tillers and LAI than other genotypes. The quality of fodder is determined by leaf-stem ratio and it was almost comparable among all the varieties, however variety JO 03-91 was numerically superior to others with regard to leaf-stem ratio. The similar finding supported by on growth parameters enhanced greatly by application of nitrogen (Sharma & Verma, 2004) [23].

Table 1: Effect of oat varieties and different nitrogen levels on growth parameters and yield attributes

Treatments	Plant height (cm)	Number of tillers/m^2			Leaf Area Index		Leaf: stem ratio
	Harvest	30 DAS	60 DAS	Harvest	30 DAS	60 DAS	
Varieties							
JO-03-91	138.6	182.80	365.90	380.40	3.56	4.95	1.11
OS-396	133.1	158.00	332.10	346.20	3.24	4.44	1.05
UPO-06-1	143.3	161.40	345.67	371.89	3.42	4.64	1.08
UPO-06-2	130.4	168.00	348.50	363.00	3.40	4.61	1.07
Kent	126.3	154,87	335.80	344.30	3.22	4.16	0.86
SEm±	0.3	1.04	2.20	1.56	0.11	0.12	0.09
CD at 5%	1.1	2.96	3.60	4.76	0.28	0.38	NS
N levels (kg/ha)							
0	125.0	157.20	310.60	316.60	3.00	3.08	1.24
40	132.6	174.60	379.30	384.30	3.12	3.80	1.04
80	137.5	189.40	416.54	432.50	3.48	4.83	0.91
120	142.2	199.80	434.10	444.80	3.72	6.45	0.88
SEm±	0.5	1.1	1.56	1.56	0.12	0.13	0.09
CD at 5%	1.6	3.1	3.60	4.58	0.24	0.34	0.27

Effect on yield

The crud protein, dry matter and green fodder yield significantly influenced by different varieties and nitrogen levels (Table 2). The production of green fodder was directly correlated with various growth parameters and yield attributes of crop. The JO-03-91 produced the highest green fodder yield as well as dry matter yield of 503.9 and 121.1 q/ha respectively followed by UPO-06-2 (467.7q/ha green fodder and 110.3q/ha dry matter yield). Varieties and UPO-06-1 and OS-396 were next to these two in descending order for green fodder yield along with dry matter yields of these varieties. The minimum green and dry fodder yield was found with variety Kent. This variety mainly attributed to their genetic ability and influence of macro and micro environmental conditions. These results are in close conformity with the findings of Pradhan *et al.*, 1994 [18]. Among the different nitrogen levels green, dry matter and crud protein yields correspondingly increased with increase in N levels up to 120 kg/ha. Thus, it is obvious that oat is highly responsive to this nutrient and oat responded to a very level of N application even up to 160 kg/ha depending on the varieties (Rohitashav *et al.*, 1998) [20].

Dry matter production also influenced with increasing levels of nitrogen up to 120 kg/ha mainly due to their corresponding increase in plant height, number of tillers/m^2 and leaf area thereby more photosynthetic area which ultimately increased the sink size and produced more dry matter in plants. These findings are closer with results of Mahale *et al.*, 2004 [12].

The suitable variety and optimum nitrogen level for the cultivation of fodder crop and other crops in the tropics can

vary widely.

Based on research and field tests carried out more than five years ago, the appropriate nitrogen level, irrigation level (Sisodiya *et al.*, 2022) [27] and weed management practices (Verma *et al*., 2022; Sahu *et al*., 2023) [28-29, 22] strategies were established for the cultivation of rice (Verma *et al.*, 2022; Shukla *et al*., 2022) [28-29, 26], wheat (Nirala *et al*., 2022; Patel *et al*., 2023) [15, 17], chickpea (Sahu *et al.*, 2022; Shiv *et al*., 2023) [21, 25] and fodder crops (Kumhar *et al*., 2021; Yadav *et al*., 2023) [10, 30].

Economics

In case of net monetary returns, variety JO-03-91 recorded the maximum net monetary returns (Rs. 53729/ha) as compared to other treatments and 120 kg N/ha nitrogen level is best suited to gain highest returns (Rs. 57910/ha). Variety JO 03-91 with respect of B: C ratio (5.03) being close to UPO 06-2 (4.68) and UPO 06-1 (4.67) and Kent (3.96) resulted into lesser B: C ratio. Application of nitrogen i.e.120 kg N /ha markedly gave maximum B: C ratio 5.18 than other levels.

Table 2: Effect of oat varieties and different nitrogen levels on yield and economics

Treatments	Crude protein yield (q/ha)	Dry matter yield (q/ha)	Green fodder yield (q/ha)	NMR (Rs./ha)	B:C ratio
Varieties					
JO-03-91	9.6	121.1	503.9	53729	5.03
OS-396	7.2	94.1	398.7	39506	3.96
UPO-06-1	8.9	110.3	467.7	39738	3.98
UPO-06-2	8.6	110.9	468.3	48980	4.67
Kent	7.3	93.4	396.9	48855	4.68
SEm±	0.2	1.8	8.8	-	-
CD at 5%	0.5	5.9	28.6	-	-
N levels (kg/ha)					
0	6.4	85.1	366.5	33676	3.66
40	7.6	98.0	417.5	41297	4.17
80	9.2	115.9	485.5	51763	4.84
120	10.0	124.8	518.8	57910	5.18
SEm±	0.1	2.41	4.4	-	-
CD at 5%	0.3	6.9	12.6	-	-

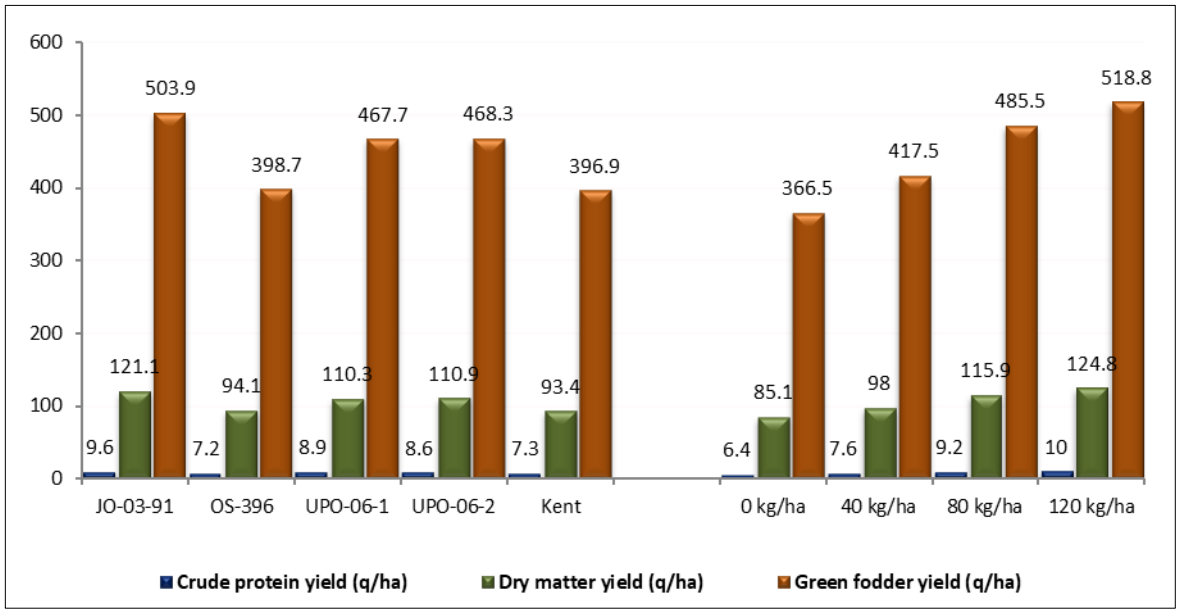

Fig 1: Effect of oat varieties and different nitrogen levels on crude protein yield, dry matter yield and green fodder yield

Conclusion

Based on the current experiment, it can be concluded that combination of variety JO-03-91 with the nitrogen level of 120 kg/ha recorded the highest values of all of the growth parameters, yield attributes, crude protein yield, green fodder yield and dry fodder yield and it is most suitable for the gaining maximum yield.

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