Forage Res., **41** (4) : pp. 233-236 (2016) **http://forageresearch.in**

EFFECT OF DIFFERENT NITROGEN LEVELS ON FORAGE YIELD, QUALITY AND ECONOMICS OF OAT (*AVENA SATIVA* L.) GENOTYPES

A. S. GODARA[1], SATPAL*, B. S. DUHAN[2] AND S. K. PAHUJA

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

(Received : 24 February 2016; Accepted : 26 March 2016)

SUMMARY

A field experiment was conducted at CCS Haryana Agricultural University, Hisar (Haryana) during winter season (**rabi**) of 2014-15 to study the response of different nitrogen levels on the yield and quality of oat (*Avena sativa* L.) genotypes. Twelve oat genotypes viz., RSO 60, RSO 59, SKO 190, UPO 12-1, OS 405, JHO 2012-1, OL 1760, JO 04-14, JHO 2012-2, OL 125, OS 6 and Kent were sown with 40, 80 and 120 kg nitrogen per hectare. Among genotypes, OS 405 produced the maximum plant height, green fodder, dry matter followed by SKO 190. Both these two genotypes of oat remained on a par with each other with respect to green fodder and dry matter production. Genotype SKO 190 produced maximum number of tillers/metre row length which was significantly higher over rest of the genotypes. Kent was found superior in terms of crude protein content (11.36%), while SKO 190 yielded the highest crude protein yield. Growth parameters, green fodder and dry matter were influenced significantly by increasing levels of nitrogen from 40 to 120 kg/ ha. Whereas leaf : stem ratio and tillers/metre row length were increased up to 80 kg N/ ha. Crude protein content and its yield revealed increased trend with increasing levels of nitrogen, maximum with 120 kg N/ha. Among genotypes, the maximum gross returns (Rs. 69645/ha), net returns (Rs. 41955/ha) and B : C ratio (1.52) were recorded with OS 405 and among different nitrogen levels, the maximum gross returns (Rs. 69945/ha), net returns (Rs. 41785/ha) and B : C ratio (1.48) were noticed with application of 120 kg N/ha.

Key words : Dry matter, forage yield, nitrogen, oats

According to 19th livestock census conducted in 2012, India supports 512.05 million of livestock, which includes 37.28 per cent cattle, 21.23 per cent buffaloes, 12.71 per cent sheep and 26.40 per cent goats (DAHD & F, 2012). India inhabits 15 per cent of world's livestock population on 2 per cent geographical area, which itself is an indicative of the extent of livestock pressure on our resources in comparison to other countries. The low productivity and poor performance of the livestock are mainly due to unavailability of nutritious fodder in sufficient quantity. The availability of nutritious fodder is inadequate in the country. India faces a net deficit of 61.1 per cent green fodder, 21.9 per cent dry crop residues and 64 per cent feeds (Sunil Kumar *et al*., 2012). The most important constraint in the fodder production and productivity is the non-availability of improved variety seed of forage crops to the farmers. The supply of nutritious fodder is pre-requisite for the success of dairy sector (Kumar *et al*., 2010). Oat is the most important nutritious and palatable cereal fodder crop grown in the winter season in the North-Western and Central India and now extending to the Eastern regions. In India, it is mainly grown in Haryana, Punjab, Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharashtra, West Bengal and Gujarat where irrigation facilities are available (Joshi *et al*., 2015). For higher green fodder yield, vegetative growth of this crop is very important. Although the vegetative growth of any crop is largely dependent upon the potential of the genotype, nutrient supply system, capacity of the soil to supply the nutrients to the crop and capacity of the plants to take and use the

[1]Department of Agroforestry.
[2]Department of Soil Science.

nutrients in unit time. Among all the primary nutrients, nitrogen plays a pivotal role in quantitative as well as qualitative improvement in the productivity of the crop. Nitrogen is an important constituent of protein and chlorophyll. It imparts dark green colour to the plants, promotes vegetative growth and rapid early growth. It improves the quality by increasing the protein content of fodder crops and governs to a considerable degree, the utilization of potassium, phosphorus and other essential nutrient elements (Patel *et al*., 2007). Almost all the soils of Haryana are deficient in nitrogen and if the required amount of nitrogen of any crop is not supplied in sufficient amount then the deficiency of nitrogen is reflected in the straw and grain. Since nitrogen is a constituent of amino acid and deficiency of nitrogen in grain and straw of the cereals as well in the fodder crops may cause severe disorders in animals and human beings (Midha *et al*., 2015). Therefore, it is essential to find out the optimum dose of nitrogen for fetching good yield of oat. Hence, the present investigation was undertaken to study the performance of different promising genotypes of oat with different nitrogen levels.

MATERIALS AND METHODS

A field experiment was conducted during **rabi** season of 2014-15 at Forage Section Research Farm of CCS Haryana Agricultural University, Hisar (Haryana), India (29°10' N of 75°46' E, at an average elevation of 215.2 m above mean sea level). The site has semi-arid and sub-tropical climate with hot dry summers and severe cold winters. Average annual rainfall is about 450 mm, 75 per cent of which is received in three months, from July to September during south-west monsoon. July and August are the wettest months. The crop received 143.5 mm rainfall during crop season. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction (pH 7.9), low in available nitrogen (178.4 kg/ha), medium in available phosphorus (15.0 kg/ha) and potassium (243.7 kg/ha). The experiment was laid out in split plot design with three replications. The main plot consisted of 12 different oat genotypes (RSO 60, RSO 59, SKO 190, UPO 12-1, OS 405, JHO 2012-1, OL 1760, JO 04-14, JHO 2012-2, OL 125, OS 6 and Kent), whereas sub-plot had three nitrogen levels (40, 80 and 120 kg N/ha). The oat genotypes as per treatment were sown manually on 30 November 2014 in opened furrows at 25 cm apart using the seed rate of 100 kg/ha. 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 was weighed *in situ* in kg/plot and then converted into q/ha. A random sample of 500 g was taken 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. On the basis of 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). Economics was worked out on the basis of prevailing market prices of inputs and outputs in the local market. The experimental data were analyzed by using OPSTAT software available on CCS Haryana Agricultural University home page (Sheoran, 2016). The results were presented at 5 per cent level of significance (P=0.05) for making comparison between treatments.

RESULTS AND DISCUSSION

Effect of Genotypes

Data presented in Table 1 reveal that maximum plant height (130.40 cm) was recorded with OS 405 genotype which was at par with JO 04-14, JHO 2012-2 and OS 6 genotypes. However, lowest plant height (98.78 cm) was recorded with the genotype SKO 190. The maximum number of tillers/m row length (110.67) was recorded with SKO 190 which was significantly superior over rest of the genotypes. However, the lowest number of tillers/m row length (86.22) was recorded with the genotype UPO 12-1. The highest leaf : stem (L : S) ratio was measured with UPO 12-1 and OL 1760 which was at par with OS 405, SKO 190 and JO 04-14 and was seen superior over rest of the genotypes. The green fodder yield was highest with the genotype OS 405 (696.45 q/ha), which was at par with other genotypes like SKO 190, OL 1760 and JO 04-14 and superior over rest of the genotypes.

TABLE 1
Performance of different oat genotypes under different nitrogen levels during **rabi** season of 2014-15

Treatment	Green fodder yield (q/ha)	Dry matter yield (q/h)	Plant height (cm)	Leaf : stem ratio	Tillers/m row length	Crude protein (%)	Crude protein yield (q/ha)
A. Genotypes							
RSO 60	639.78	95.68	106.40	0.42	96.22	10.95	10.48
RSO 59	582.56	87.32	116.56	0.40	96.70	10.68	9.33
SKO 190	690.89	99.03	98.78	0.43	110.67	11.22	11.11
UPO 12-1	622.56	92.28	124.22	0.45	86.22	10.64	9.82
OS 405	696.45	102.97	130.40	0.44	97.90	10.14	10.44
JHO 2012-1	624.90	91.51	118.11	0.41	88.70	11.22	10.27
OL 1760	662.80	98.07	123.20	0.45	90.00	10.41	10.21
JO 04-14	660.80	96.00	129.90	0.43	98.80	9.73	9.34
JHO 2012-2	601.10	85.34	128.40	0.41	92.90	10.48	8.94
OL 125	633.11	92.87	121.89	0.44	90.89	11.22	10.43
OS 6	542.00	79.94	124.78	0.39	92.20	10.68	8.54
Kent	633.89	94.21	120.20	0.40	95.11	11.36	10.70
C. D. (P=0.05)	53.88	7.49	5.86	0.03	7.32	-	-
B. Nitrogen levels (kg/ha)							
40	552.17	83.19	113.30	0.41	90.20	9.71	8.07
80	646.08	94.28	121.61	0.43	96.03	11.05	10.42
120	699.45	101.33	125.81	0.43	97.83	11.42	11.57
C. D. (P=0.05)	26.94	3.75	2.93	0.01	3.66	-	-

The maximum dry matter yield was recorded with OS 405, which was at par with SKO 190, OL 1760, JO 04-14 and RSO 60 except rest of the genotypes. The maximum crude protein (11.36%) was observed with genotype Kent followed by SKO 190, JHO 2012-1 and OL-125, respectively. The maximum crude protein yield (11.11 q/ha) was observed with SKO 190 followed by Kent, RSO 60 and OS 405. Amongst genotypes, the maximum gross returns (Rs. 69645/ha), net returns (Rs. 41955/ha) and B : C ratio (1.52) were fetched with OS 405 closely followed with SKO 190. The minimum gross returns (Rs. 54200/ha), net returns (Rs. 26510/ha) and B : C ratio (0.96) were observed with OS 6.

Effect of Nitrogen Levels

Data presented in Table 1 reveal that green fodder yield (699.45 q/ha) and dry matter yield (101.33 q/ha) was highest with the application of 120 kg N/ha which was significantly superior over rest of the treatments. The application of 80 kg N/ha significantly increased the green fodder and dry matter yield from 552.17 to 646.08 q/ha and 83.19 to 94.28 q/ha, respectively, over 40 kg N/ha. Singh and Dubey (2008) also revealed that application of nitrogen up to 80 kg/ha significantly increased the growth and produced 493 and 98.75 q/ha green and dry matter yield, respectively. Similarly, Midha *et al.* (2015) reported that the application of 80 kg N/ha significantly increased the green fodder and dry matter yield from 253.4 to 360.5 q/ha and 52.8 to 73.5 q/ha over the treatment 40 kg N/ha. The maximum plant height (125.81 cm) was recorded with the application of 120 kg N/ha which was significantly superior over rest of the treatments. The results are in conformity with the findings of Banjara and Banjara (2014). The L : S ratio with the application of 120 kg N/ha was statistically at par with 80 kg N/ha and both these treatments were found significantly superior over L : S ratio obtained with the application of 40 kg N/ha. Maximum number of tillers (97.83/m row length) was recorded with the application of 120 kg N/ha which was at par with the application of 80 kg N/ha but significantly superior over the application of 40 kg N/ha. Highest crude protein content (11.42%) was estimated with the application of 120 kg N/ha followed by the application of 80 and 40 kg N/ha. The increase in crude protein content was 9.71 to 11.05 per cent with the application of 80 kg N/ha over 40 kg N/ha and it further improved to 11.42 per cent with the application of nitrogen at the rate of 120 kg/ha. Application of nitrogen increased the protein content in oat and this may be due to nitrogen helped in the synthesis of amino acid and protein in plant. Higher crude protein at 120 kg N/ha was attributed to more uptake of nitrogen which is constituent of amino acids and protein. Rana *et al.* (2009), Devi *et al.* (2010) and Midha *et al.* (2015) also reported similar results. The maximum crude protein yield (11.57 q/ha) was exhibited with the

TABLE 2

Economic returns of different genotypes of oat as influenced by different nitrogen levels during **rabi** season of 2014-15

Treatment	Gross returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net returns (Rs./ha)	B : C ratio
A. Genotypes				
RSO 60	63978	27690	36288	1.31
RSO 59	58256	27690	30566	1.10
SKO 190	69089	27690	41399	1.50
UPO 12-1	62256	27690	34566	1.25
OS 405	69645	27690	41955	1.52
JHO 2012-1	62490	27690	34800	1.26
OL 1760	66280	27690	38590	1.39
JO 04-14	66080	27690	38390	1.39
JHO 2012-2	60110	27690	32420	1.17
OL 125	63311	27690	35621	1.29
OS 6	54200	27690	26510	0.96
Kent	63389	27690	35699	1.29
B. Nitrogen levels (kg/ha)				
40	55217	27220	27997	1.03
80	64608	27690	36918	1.33
120	69945	28160	41785	1.48

application of 120 kg N/ha. The increase in crude protein yield was 8.07 to 10.42 q/ha with the application of 80 kg N/ha over 40 kg N/ha and it further improved to 11.57 q/ha with the application of nitrogen at the rate of 120 kg/ha. The increase in crude protein yield was due to increase in protein content and dry matter yield of oat crop because the protein yield proportionally increased with the increase in dry matter yield of oat. Amongst the different nitrogen levels, the maximum gross returns (Rs. 69945/ha), net returns (Rs. 41785/ha) and B : C ratio (1.48) were obtained with the application of 120 kg N/ha followed by 80 kg/ha (gross returns Rs. 64608/ha, net returns Rs. 36918/ha and B : C ratio 1.33). The minimum gross returns (Rs. 55217/ha), net returns (Rs. 27997/ha) and B : C ratio (1.03) were observed with the application of 40 kg N/ha (Table 2).

REFERENCES

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

Banjara, A., and G. P. Banjara. 2014 : Growth and yield of fodder sorghum as influenced by nitrogen levels and its methods of application. *Res. J. Agric. Sci*., **5** : 524-526.

DAHD & F. 2012 : *19th Livestock Census, 2012*. Department of Animal Husbandry, Dairying and Fisheries, Government of India. http:// dahd.nic.in/dahd/WriteReadData/Livestock.pdf.

Devi, Uma, K. P. Singh, Meena Sewhag, Suresh Kumar, and Sunil Kumar. 2010 : Effect of nitrogen levels, organic manures and *Azotobacter* inoculation on nutrient uptake of multi-cut oats. *Forage Res*., **36** : 9-14.

Joshi, R. V., B. J. Patel, and K. M. Patel. 2015 : Effect of nitrogen levels and time of application on growth, quality, nitrogen and phosphorus content and uptake for seed production of oat (*Avena sativa* L.). *Forage Res*., **41** : 104-108.

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.

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.

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.

Rana, D. S., Bhagat Singh, and U. N. Joshi. 2009 : Response of oat (*Avena sativa* L.) genotypes to nitrogen levels. *Forage Res*., **35** : 184-185.

Sheoran, O. P. 2016 : Statistical analysis software at the website of CCS Haryana Agricultural University Hisar. *www.hau.ernet.in*.

Singh, S. D., and S. N. Dubey. 2008 : Efficiency of *Azotobacter* to enhance the growth and yield of fodder oat (*Avena sativa* L.) under different levels of nitrogen and FYM. *Forage Res*., **34** : 116-118.

Sunil Kumar, R. K. Agrawal, A. K. Dixit, Arvind K. Rai, and S. K. Rai, 2012 : *Forage Crops and their Management*. Indian Grassland and Fodder Research Institute, Jhansi-284 003 (Uttar Pradesh), India. p. 1.