Forage Res., **43** (1) : pp. 35-38 (2017) **http://forageresearch.in**

AGRONOMIC EVALUATION OF OAT (*AVENA SATIVA* L.) GENOTYPES FOR FORAGE YIELD, QUALITY AND ECONOMICS UNDER VARYING LEVELS OF NITROGEN

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(Received : 23 February 2017; Accepted : 11 May 2017)

SUMMARY

A field experiment was conducted at CCS Haryana Agricultural University, Hisar (Haryana) during winter season (**rabi**) of 2015-16 to study the response of different nitrogen levels on the yield and quality of oat (*Avena sativa* L.) genotypes. Eleven oat genotypes viz., RO-11-1, JO-04-18, OL-1689, SKO-198, SKO-199, RSO-8, OL-1804, OS-406, Kent, OS-6 and OL-125 were tested at three nitrogen levels i. e. 40, 80 and 120 kg nitrogen per hectare. Among the various genotypes, OL-1689 proved to be significantly superior for green fodder (369.3 q/ha) and dry matter yield (71.6 q/ha) to rest of the entries except OS-406 (336.0 q/ha GFY and 67.1 q/ha DMY) which remained statistically at par. Growth parameters, green fodder and dry matter were influenced significantly with increasing levels of nitrogen from 40 to 120 kg/ha, whereas plant height and tillers per metre row length were increased up to 80 kg N/ha only. Crude protein content and its yield increased significantly with increasing levels of nitrogen, maximum with 120 kg N/ha. Among genotypes, the maximum gross returns (Rs. 46162.5/ha), net returns (Rs. 18264.3/ha) and B : C ratio (1.65) were recorded with OL-1689, whereas the application of 120 kg nitrogen/ha recorded the maximum gross returns (Rs. 38625.0/ha), net returns (Rs. 10245.5/ha) and B : C ratio (1.36).

Key words : Oat, forage yield, dry matter, nitrogen, crude protein, net returns

India inhabits about 15% of worlds livestock population on 2 per cent geographical area, which itself is an indicative of the extent of livestock pressure on our resource in comparison to other countries. The low productivity and poor performance of the livestock are mainly due to scarcity of nutritious fodder and feed 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). Oat (*Avena sativa* L.) belonging to family Poaceae is a cereal crop. Oat both as fodder and grain is a good source of protein, fibre and minerals. It is used as a green crop and silage for animals (Chakraborty *et al.*, 2016). Oat can provide nutritious and palatable fodder, grown in the winter season in the North-Western and Central India and now extended to the Eastern region also. For higher herbage yield, vegetative growth of that crop is very important. Although the vegetative growth of any crop is largely dependent on the potential of the genotype, nutrient supply system, inherent capacity of the soil to supply the nutrients to the crop and capacity of the crop plants to take and use the nutrients in unit time. Among all the primary nutrients, nitrogen plays an important 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 (Patel *et al.*, 2007). The soils of Haryana are generally low in nitrogen and if the required amount of nitrogen of any crop is not supplied in sufficient amount then the deficiency of nitrogen will be 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 (Midha *et al.*, 2015). Therefore, it is essential to find out the optimum dose of nitrogen for fetching potential green fodder and dry matter yield of oat. Hence, the present investigation was undertaken

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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 2015-16 at Forage Section Research Farm of CCS Haryana Agricultural University, Hisar (Haryana, India) (29°10' N or 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 summer and severe cold winter. 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 26.2 mm rainfall during crop season. The soil of the experimental field was sandy loam in texture, slightly alkaline in reaction (pH 8.0), low in available nitrogen (149.3 kg/ha), medium in available phosphorus (15.0 kg/ha) and potassium (202.0 kg/ha). The experiment was laid out in split plot design with three replications.The main plot consisted of 11 oat genotypes (RO-11-1, JO-04-18, OL-1689, SKO-198, SKO-199, RSO-8, OL-1804, OS-406, Kent, OS-6 and OL-125), whereas sub-plot had three nitrogen levels (40, 80 and 120 kg N/ha). The sowing was done on 26 November 2015 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 dry weight of these samples, the green fodder yield was converted into dry matter yield (q/ha). Crude protein content (%) and *in vitro* dry matter digestibility (IVDMD) were 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-Kjeldhal method (AOAC, 1995). IVDMD was determined by method of Barnes *et al*. (1971). 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 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 *et al*., 1998). The results are 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 (153.9 cm) was recorded with OL-1689 genotype which was significantly superior over rest of the genotypes. However, lowest plant height (82.6 cm) was recorded with the genotype SKO-198. The maximum number of tillers/m row length (92.9) was recorded with RO-11-1 which was on a par with JO-04-18, OL-1689, SKO-199, RSO-8, OS-406, Kent and OS-6 but significantly superior over rest of the genotypes. However, the lowest number of tillers/m row length (69.3) was recorded with the genotype SKO-198. The green fodder yield was highest with the genotype OL-1689 (369.3 q/ha), which was at par with OS-406 (336.0 q/ha) and superior over rest of the genotypes. The maximum dry matter yield was recorded with OL-1689 (71.6 q/ha), which was at par with OS-406 and OL-1804 except rest of the genotypes. The maximum crude protein content (14.69%) was estimated with genotype RSO-8 which was on a par with OL-1689, SKO-198, OL-1804, OS-406, Kent and OL-125 but significantly superior over rest of the genotypes. The maximum crude protein yield (10.3 q/ha) was estimated with OL-1689 which was on a par with OL-1804 and OS-406. Godara *et al*. (2016) also noticed the variation among the genotypes of oats for fodder yield, growth and quality. Table 2 reveals that amongst genotypes, the maximum gross returns (Rs. 46162.5/ha), net returns (Rs. 18264.3/ha) and B : C ratio (1.65) were fetched by OL-1689 closely followed by OS-406 (gross returns Rs. 42000/ha, net returns Rs. 14101.8/ha and B : C ratio 1.51).

Effect of Nitrogen Levels

Data presented in Table 1 reveal that green fodder (309.0 q/ha) and dry matter yields (62.2 q/ha) were highest with the application of 120 kg N/ha which

TABLE 1
Performance of oat genotypes under different nitrogen levels

Treatment	No. of tillers/mrl	Plant height (cm)	Green fodder yield (q/ha)	Dry matter yield (q/ha)	Crude protein (%)	Crude protein yield (q/ha)	IVDMD (%)	DDM (q/ha)
Genotypes (G)								
RO-11-1	92.9	135.9	289.7	57.3	13.47	7.71	47.27	27.1
JO-04-18	88.7	104.6	272.1	54.4	13.88	7.55	45.67	24.8
OL-1689	90.8	153.9	369.3	71.6	14.40	10.30	50.53	36.2
SKO-198	69.3	82.6	150.9	29.3	14.59	4.27	48.27	14.1
SKO-199	87.9	91.0	195.3	39.3	14.18	5.57	49.23	19.3
RSO-8	91.5	136.0	282.3	57.4	14.69	8.43	47.93	27.5
OL-1804	76.6	141.1	320.2	63.8	14.64	9.34	47.80	30.5
OS-406	92.0	137.8	336.0	67.1	14.49	9.70	49.27	33.1
Kent	90.9	139.8	268.4	54.1	14.28	7.72	50.80	27.5
OS-6	87.3	133.6	284.1	56.6	14.23	8.05	50.07	28.3
OL-125	80.4	141.8	270.3	54.8	14.28	7.82	49.67	27.2
S. Em±	3.3	3.6	14.1	2.8	0.15	0.41	0.13	-
C. D. (P=0.05)	9.4	10.1	40.2	8.0	0.46	1.24	0.38	-
Nitrogen levels (N) (kg/ha)								
40	82.0	118.9	235.0	46.0	13.27	6.09	44.83	20.6
80	87.6	129.2	284.7	57.0	14.14	8.07	47.73	27.2
120	88.9	133.3	309.0	62.2	14.65	9.11	53.48	33.3
S. Em±	1.7	1.9	7.41	1.49	0.11	0.17	0.27	-
C. D. (P=0.05)	4.9	5.3	20.9	4.16	0.34	0.5	0.75	-
Interation (G x N)								
S. Em±	5.8	6.2	24.5	4.91	0.23	0.64	-	-
C. D. (P=0.05)	NS	NS	NS	NS	NS	NS	-	-
C. V. (%)	11.6	8.4	10.3	15.5	6.0	14.8	-	-

IVDMD–*In vitro* dry matter digestibility and DDM–Dry matter digestibility. NS–Not Significant.

were significantly superior over rest of the treatments. The application of 80 kg N/ha significantly increased the green fodder and dry matter yield from 235.0 to 284.7 q/ha and 46.0 to 57.0 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 yields, respectively. Similarly, Midha *et al.* (2015) reported that the application of 80 kg N/ha significantly increased the green fodder yield 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 (133.3 cm) was recorded with the application of 120 kg N/ha which was on a par with 80 kg N/ha but significantly superior over 40 kg N/ha. Maximum number of tillers (88.9/m row length) was recorded with the application of 120 kg N/ha which was on a par with the application of 80 kg N/ha but significantly superior over the application of 40 kg N/ha. Highest crude protein content (14.65%) was estimated with the application of 120 kg N/ha which was significantly superior over the lower doses. The

TABLE 2
Economic returns of oat genotypes as influenced by different nitrogen levels

Treatment	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B : C ratio
Genotypes				
RO-11-1	27898.2	36212.5	8314.3	1.30
JO-04-18	27898.2	34012.5	6114.3	1.22
OL-1689	27898.2	46162.5	18264.3	1.65
SKO-198	27898.2	18862.5	-9035.7	0.68
SKO-199	27898.2	24412.5	-3485.7	0.88
RSO-8	27898.2	35287.5	7389.3	1.26
OL-1804	27898.2	40025.0	12126.8	1.43
OS-406	27898.2	42000.0	14101.8	1.51
Kent	27898.2	33550.0	5651.8	1.20
OS-6	27898.2	35512.5	7614.3	1.27
OL-125	27898.2	33787.5	5889.3	1.21
N levels (kg/ha)				
40	27416.9	29375.0	1958.1	1.07
80	27898.2	35587.5	7689.3	1.28
120	28379.5	38625.0	10245.5	1.36

increase in crude protein content was 13.27 to 14.14 per cent with the application of 80 kg N/ha over 40 kg N/ha and it further improved to 14.65 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 which helps 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. Godara *et al*. (2016) also reported similar results. The maximum crude protein yield (9.11 q/ha) was exhibited with the application of 120 kg N/ha. The increase in crude protein yield was 6.09 to 8.07 q/ha with the application of 80 kg N/ha over 40 kg N/ha and it further improved to 9.11 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. Table 2 reveals that among different nitrogen levels, the maximum gross returns (Rs. 38625.0/ha), net returns (Rs. 10245.5/ha) and B : C ratio (1.36) were obtained with the application of 120 kg N/ha followed by 80 kg/ha (gross returns Rs. 35587.5/ha, net returns Rs. 7689.3/ha and B : C ratio 1.28). The minimum gross returns (Rs. 29375.0/ha), net returns (Rs. 1958.1/ha) and B : C ratio (1.07) were observed with the application of 40 kg N/ha.

CONCLUSION

Based on the results, it can be concluded that among genotypes, OL-1689 proved to be significantly superior for green fodder (369.3 q/ha) and dry matter yield (71.6 q/ha) to rest of the genotypes except OS-406 (336.0 q/ha GFY and 67.1 q/ha DMY). The maximum gross returns (Rs. 46162.5/ha), net returns (Rs. 18264.3/ha) and B : C ratio (1.65) were recorded with OL-1689. Among different nitrogen levels, the maximum green fodder, dry matter, gross returns (Rs. 38625.0/ha), net returns (Rs. 10245.5/ha) and B : C ratio (1.36) were recorded with application of 120 kg N/ha. In crux, the genotypes OL-1689 and OS-406 performed better and application of 120 kg N/ha was the most suitable nitrogen fertilization practice to achieve the maximum yield of green fodder and dry matter.

ACKNOWLEDGEMENTS

The authors are thankful to forage oat breeders of All India Coordinated Research Project on Forage Crops and Utilization, Jhansi for providing the seed of single-cut oat genotypes used in the experiment and necessary guidelines to conduct the agronomy trial under AICRP on FC&U.

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