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POTENTIAL FODDER PRODUCTIVITY, QUALITY AND RELATIVE ECONOMICS OF MULTI-CUT OAT GENOTYPES UNDER DIFFERENT LEVELS OF NITROGEN

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SUMMARY

A two-factor field experiment consisting of five multi-cut oat genotypes and three nitrogen levels was conducted at Forage Section Research Farm, CCS Haryana Agricultural University, Hisar during winter season (**rabi**) of 2015-16. Oat genotypes JO-4-317 and OL-1802 were compared with three checks viz., Kent, RO-19 and UPO-212. The nitrogen levels were 40, 80 and 120 kg per hectare. Among various genotypes, the test entry OL-1802 proved to be significantly superior for green fodder (460.2 q/ha) and dry matter yield (91.0 q/ha) to rest of the entries except RO-19 (424.1 q/ha GFY and 83.5 q/ha DMY) which remained statistically at par. Number of tillers/m row length, green fodder and dry matter yield were influenced significantly with increasing levels of nitrogen from 40 to 120 kg/ha, whereas plant height was increased up to 80 kg N/ha only. Crude protein content and its yield increased with increasing levels of nitrogen, maximum being with the application of 120 kg N/ha. Among genotypes, the maximum gross returns (Rs. 57613/ha), net returns (Rs. 21535/ha) and B : C ratio (1.60) were recorded with OL-1802, whereas the application of 120 kg nitrogen/ha realized the maximum gross returns (Rs. 58988/ha), net returns (Rs. 22428/ha) and B : C ratio (1.61).

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

India's livestock sector is one of the largest sectors in the world. Livestock population is around 512.05 million (Anonymous, 2014). The average yield of milk and meat in our animals is 20-60 per cent lower than the global average. Production potential of livestock is not realized fully because of constraints related to feeding, breeding, health and management. Deficiency of feed and fodder accounts for half of the total loss, followed by the problems of breeding and reproduction (21.1%), diseases (17.9%) and management (10.5%). Forage based economical feeding strategies are required to reduce the cost of livestock products as the feed alone constitutes 60-70 per cent of the milk production cost. The fodder demand will reach to 1012 mt of green fodder and 631 mt of dry fodder by the year 2050. At the current level of growth in forage resources, there will be 18.4 per cent deficit in green fodder and 13.2 per cent deficit in dry fodder in the year 2050 (Anonymous, 2015).

Oat (*Avena sativa* L.) belonging to family Poaceae is a cereal crop which as fodder and grain is a good source of protein, fibre and minerals. It is used as a green crop and also for making silage for animals (Chakraborty *et al*., 2016). Oat is a crop grown in winter season in the North-Western and Central India and now extended to the Eastern region also. For higher green fodder yield, vegetative growth of this crop is very important. Although the vegetative growth of any crop is largely dependent on the potential of the genotype, nutrient supply system, and capacity of the crop plants to take and use the nutrients in unit time. Among all the primary nutrients, nitrogen plays an 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 (Patel *et al*., 2007). The soils of Haryana are generally low in nitrogen and if the required amount of nitrogen is not supplied then the deficiency of nitrogen will be reflected in the straw and grain. Therefore, it is essential to find out the optimum dose of nitrogen for fetching potential green fodder and dry matter yield of multi-cut oat. Hence, the present investigation was undertaken to study the performance of different promising genotypes of multi-cut 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 situated at 29°10' N latitude, 75°46' E longitude, and altitude 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. The crop received 30.5 mm rainfall during crop season. Fig. 1 represents the weekly weather parameters i.e. temperature - minimum and maximum (ºC), relative humidity of morning and evening (%) and rainfall (mm). 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 four replications. The main plot consisted of five oat genotypes (JO-4-317, OL-1802, Kent, RO-19 and UPO-212), 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. Total two cuts were taken for all the genotypes in all the treatments. First cut was taken 70 days after sowing and second cut was taken at 50 per cent flowering stage. The harvested green fodder from each plot was weighed in situ 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 and digestible dry matter yield were calculated by the multiplication of crude protein content (%) and *in vitro d*ry matter digestibility (%) with dry matter yield (q/ha), respectively. 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).

RESULTS AND DISCUSSION

Effect of Genotypes

Data presented in Table 1 reveal that maximum plant height (89.9 cm) was recorded with OL 1802 genotype which was significantly superior over Kent and UPO-212 except rest of the genotypes. However, lowest plant height (83.2 cm) was recorded in the genotype Kent. The maximum number of tillers/m row length (102.5) was recorded with JO-4-317 which was significantly

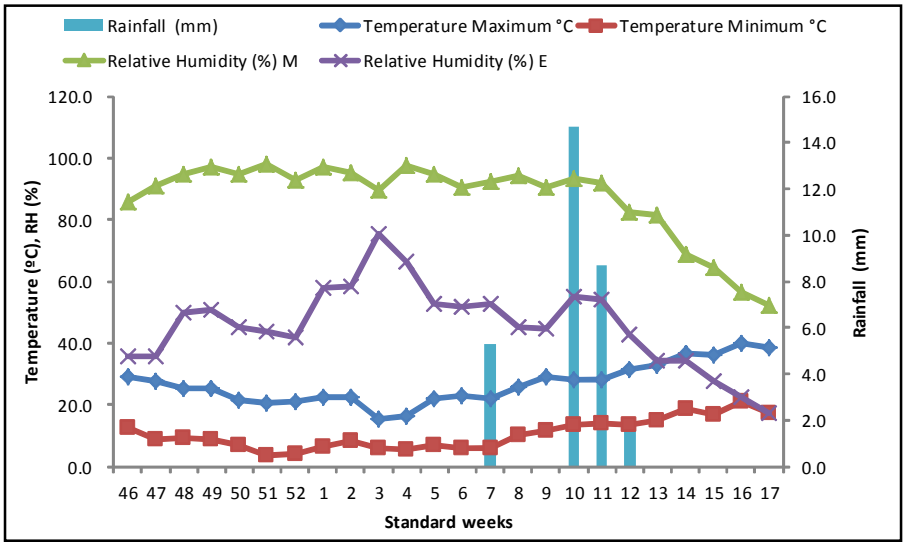

Fig. 1. Weekly weather parameters viz. temperature, relative humidity and rainfall during Rabi 2015-16.

TABLE 1
Performance of multi-cut oat genotypes under different nitrogen levels

Treatments	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 (%)	Digestible dry matter yield (q/ha)
Genotypes (G)								
JO-4-317	102.5	87.9	410.9	79.2	14.34	11.4	57.22	45.3
OL-1802	96.3	89.9	460.9	91.0	13.32	12.1	56.77	51.6
Kent (NC)	99.9	83.2	355.4	70.9	13.59	9.7	61.97	43.9
RO-19 (NC)	90.0	86.8	424.1	83.5	13.23	11.0	56.56	47.2
UPO-212 (NC)	87.4	83.8	393.6	78.2	14.32	11.2	56.70	44.4
S. Em±	0.83	1.45	15.60	2.91	-	-	-	-
C. D. (P=0.05)	2.40	4.19	44.90	8.33	-	-	-	-
N levels (kg/ha)								
40	90.1	82.6	334.0	65.8	12.85	8.5	55.97	36.8
80	96.7	87.1	421.1	84.5	13.58	11.5	58.11	49.1
120	98.8	89.3	471.9	91.4	14.09	12.9	59.44	54.3
S. Em±	0.64	1.13	12.10	2.25	-	-	-	-
C. D. (P=0.05)	1.83	3.25	34.80	6.49	-	-	-	-
Interation (G x N)								
S. Em±	1.40	2.53	27.10	5.08	-	-	-	-
C. D. (P=0.05)	NS	NS	NS	NS	-	-	-	-

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

superior over rest of the genotypes. However, the lowest number of tillers/m row length (87.4) was recorded with the genotype UPO-212. The highest green fodder yield was recorded in the genotype OL-1802 (460.9 q/ha), which was at par with RO-19 (424.1 q/ha) and superior over rest of the genotypes. The highest dry matter yield was also recorded in the genotype OL-1802 (91.0 q/ha), which was at par with RO-19 except rest of the genotypes. The maximum crude protein content (14.34%) was estimated in genotype JO-4-317 closely followed by UPO-212. The maximum crude protein yield (12.1 q/ha) was estimated in OL 1802 followed by JO-4-317. Highest *in vitro* dry matter digestibility (61.97%) was estimated in the genotype Kent followed by JO-4-317 and OL-1802. The range of IVDMD was 56.56 to 61.97 among different genotypes. Digestible dry matter yield ranged from 44.4 to 51.6 q/ha in the genotypes under investigation. Maximum digestible dry matter was recorded in the genotype OL-1802 (51.6 q/ha). Sheoran *et al*. (2017) also noticed the variation among the genotypes of oats for fodder yield, growth and quality. Amongst genotypes, the maximum gross returns (Rs. 57613/ha), net returns (Rs. 21535/ha) and B:C ratio (1.60) were fetched with OL-1802 closely followed with RO-19 (gross returns Rs. 53013/ha, net returns Rs. 16935/ha and B : C ratio 1.47).

Effect of Nitrogen Levels

Data presented in Table 1 reveal that maximum number of tillers/m row length (98.8) were recorded with the application of 120 kg N/ha which were significantly superior over 80 and 40 kg N/ha. Highest plant height (89.3 cm) was recorded with 120 kg N/ha which was at par with 80 kg N/ha but significantly superior over 40 kg N/ha. Highest green fodder and dry matter yields (471.9 and 91.4 q/ha, respectively) were recorded with the application of 120 kg N/ha, which were significantly superior over the lower doses of nitrogen. The application of 80 kg N/ha significantly increased the green fodder and dry matter yields from 334.0 to 421.1 q/ha and 65.8 to 84.5 q/ha, respectively, over 40 kg N/ha. Godara *et al*. (2016) also revealed that application of 120 kg nitrogen/ha produced significantly highest green and dry fodder yields over the lower doses of nitrogen. Maximum crude protein content (14.09%) was estimated with the application of 120 kg N/ha, however, the range of crude protein content was from 12.85 to 14.09 per cent. The increase in crude protein content was 12.85 to 13.58 per cent with the application of 80 kg N/ha over 40 kg N/ha and it further improved to 14.09 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

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

Treatment	Cost of cultivation	Gross returns (Rs./ha)	Net returns (Rs./ha)	B : C ratio
Genotypes (G)				
JO-4-317	36078	51363	15285	1.42
OL-1802	36078	57613	21535	1.60
Kent (NC)	36078	44425	8347	1.23
RO-19 (NC)	36078	53013	16935	1.47
UPO-212 (NC)	36078	49200	13122	1.36
N levels (kg/ha)				
40	35597	41750	6153	1.17
80	36078	52638	16560	1.46
120	36560	58988	22428	1.61

results. The maximum crude protein yield (12.9 q/ha) was exhibited with the application of 120 kg N/ha. The increase in crude protein yield was 8.5 to 11.5 q/ha with the application of 80 kg N/ha over 40 kg N/ha and it further improved to 12.9 q/ha with the application of nitrogen at the rate of 120 kg N/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. Maximum *in-vitro* dry matter digestibility (59.44%) was estimated with the application of 120 kg N/ha followed by the application of 80 and 40 kg N/ha. Digestible dry matter yield increased with increasing levels of nitrogen from 40 to 120 kg/ha being maximum with the application of 120 kg N/ha (54.3 q/ha). Amongst the different nitrogen levels, the maximum gross returns (Rs. 58988/ha), net returns (Rs. 22428/ha) and B:C ratio (1.61) were obtained with the application of 120 kg N/ha followed by 80 kg/ha (gross returns Rs. 52638/ha, net returns Rs. 16560/ha and B : C ratio 1.46 (Table 2).

CONCLUSION

Based on the results, it can be concluded that among genotypes, OL-1802 proved to be significantly superior for green fodder (460.2 q/ha) and dry matter yield (91.0 q/ha) to rest of the entries except RO-19 (424.1 q/ha GFY and 83.5 q/ha DMY). The maximum net returns (Rs. 21535/ha) and B : C ratio (1.60) were also recorded in OL-1802. In terms of quality also, the genotype OL 1802 was superior exhibiting maximum crude protein yield and digestible dry matter yield (12.1 and 51.6 q/ha, respectively). Among different nitrogen levels, significantly highest green fodder and dry matter were recorded with application of 120 kg N/ha. Similarly, maximum crude protein content, crude protein yield, *in vitro* dry matter digestibility and digestible dry matter yield were recorded with the application of 120 kg N/ha. Economic analysis further supported the application of 120 kg N/ha in multi-cut oat fetching the maximum net returns (Rs. 22428/ha) and B : C ratio (1.61). In crux, the oat genotypes OL-1802 and RO-19 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.

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