Range Mgmt. & Agroforestry 39 (2) : 232-236, 2018
ISSN 0971-2070

Fodder yield and quality evaluation of some oat (*Avena sativa* L.) varieties in temperate conditions of Kashmir, India

Nazim Hamid Mir[1], Suheel Ahmad[1]*, D.K. Verma[1], Gul Zaffar[2] and Ansar-ul-Haq[2]
[1]Regional Research Station, ICAR-IGFRI, Srinagar-190007, India
[2]Dryland Agricultural Research Station, SKUAST-K, Srinagar-190007, India
*Corresponding author e-mail: suhail114@gmail.com
Received: 17th October, 2017 Accepted: 6th November, 2018

Abstract
A field experiment was conducted for two successive years during *Rabi* (winter) seasons of 2015-16 and 2016-17 at Regional Research Station, ICAR-IGFRI, Srinagar to evaluate different oat varieties for their yield and quality attributes. The experiment consisted of nine treatments of different oat varieties namely JHO-822, JHO-2000-4, JHO-851, JHO-99-1 and JHO-99-2 from IGFRI-Jhansi, and Sabzar, SKO-20, SKO-90 and SKO-96 from SKUAST-K. The experimental results showed that Sabzar was the superior variety followed by SKO-90 and JHO-99-2 and JHO-99-1 during both the years in respect of almost all the growth parameters *viz.,* plant height, number of tillers/ per metre row length, leaf-stem ratio and LAI, yield (grain) attributes such as seed yield, 1000 seed weight and forage quality parameters.

Keywords: Dry matter, Forage quality, Green fodder yield, Oat varieties

Introduction

The north-western Himalayan state of Jammu and Kashmir is largely agrarian in nature with vast rural population. In the state, agriculture is the primary occupation in plains and low altitude areas with livestock rearing as secondary and the reverse trend is observed at higher altitudes. The livestock population in the state is stated to be 7.8 million and the fodder production is not sufficient enough to meet the requirements of a burgeoning livestock population (Anonymous, 2009). The state produces around 64 lakh MT of green fodder and 35 lakh MT of dry fodder. However, the requirement of green is 139.13 lakh MT and dry fodder is 58.53 lakh MT. Therefore, major challenge is to bridge the gap between forage production and requirement (Ahmad *et al*., 2016). The farmers face fodder deficiency particularly in winter (long lean period) when they have only dry stalks of summer cereal fodders or summer grasses and legumes. Hence, there is a great need of fodder cultivation to compensate fodder scarcity during lean period (Ahmad *et al.,* 2015).

Oat (*Avena sativa* L.) is an important cereal forage crop (Singh and Chauhan, 2017) and rich source of energy, protein, vitamin B_1, phosphorus, iron and other minerals (Kumawat *et al*., 2017). It ranks sixth in the world cereal production following wheat, maize, rice, barley and sorghum (Ratan *et al*., 2016). It is an annual crop and can be planted either in autumn (for late summer harvest) or in the spring (for early autumn harvest). Oat is an important *Rabi* fodder crop in Jammu and Kashmir State, though the present production is not proportionate with the demand (Ahmad *et al*., 2014). In many parts of the world, oat is grown for use as grain as well as for forage and fodder, straw for bedding, hay, haylage, silage and chaff (Abhishek *et al*., 2014). In order to increase the productivity per unit area there is need to develop varieties having higher forage yield potential and quality (Dar *et al*., 2014). Different oat varieties have their characteristic growth habits and phenology, which in turn affects their yield and associated traits (Palsaniya *et al*., 2015; Shah *et al*., 2015). Forage oat varieties having higher productivity, better quality and tolerance to abiotic stress is need of the hour in bridging the gap between demand and supply of green fodder (Ahmad *et al*., 2015). With this background, the present study was undertaken to evaluate several oat varieties for fodder yield and quality under temperate conditions of Kashmir.

Materials and Methods

***Study area*:** A field experiment was conducted for two successive years during *Rabi* (winter) season of 2015-16 and 2016-17 to evaluate the performance of different oat varieties for their yield potential and quality parameters. The geographical location of the site is situated between 33°59'12" N and 74°47'52" E with an altitude of 1640 m above the mean sea level. The climate is temperate with mild hot summer and very cold and

wet winter. The location is a typical *Karewa* upland with no substantial irrigation facilities and hence hardy crops having good tolerance to moisture stress are more suited. The average annual rainfall is nearly 650 mm, which is mainly received during spring season (March-May). Winters are generally wet, frozen with moderate to heavy snowfall. The mean relative humidity (RH) varies from 50% in summer to 75% during rainy season. In the region, the maximum temperature may be as high as 35°C during July to August, while sub-freezing temperatures and frost are common during winters.

Soil sampling and analysis: The analysis of the experimental soil revealed that the soil at the experimental site is clay loam in texture neutral in reaction (pH 7.2) with medium organic carbon (0.65%), medium available nitrogen (300 kg/ha), available phosphorus (16.2 kg/ha) and potassium (297 kg/ha). The electrical conductivity of the soil (0.34 dS/m) was normal.

Treatment details: The experiment consisted of nine treatments of oat varieties namely JHO-822, JHO-2004, JHO-851, JHO-99-1 and JHO-99-2 from IGFRI, Jhansi, and Sabzar, SKO-20, SKO-90 and SKO-96 from SKUAST-K. The treatments were laid out in a randomized block design with three replications. In both the years a uniform dose of 60 kg P_2O_5/ha and 40 kg K_2O/ha was applied as basal to all plots through diammonium phosphate and muriate of potash, respectively. Nitrogen was applied through urea in two split doses as 40 kg at basal and remaining 40 kg at tillering stage. Sowing was done uniformly in all the plots manually by using 100 kg seeds/ ha with a row to row and plant to plant spacing maintained at 30 and 10 cm, respectively. In the first year sowing was done on 01-11-2015 and crop was harvested on 17-05-2016. In the second year crop was sown on 10-11-2016 and harvesting was done on 25-05-2017. The observations were recorded on plant growth parameters, forage yield and forage quality. The plant growth parameters for which these varieties were evaluated included plant height, number of tillers, leaf-stem ratio and leaf area index (LAI). The forage quality was determined after the samples were dried and crushed to a fine powder. The forage quality parameters for which these genotypes were studied included, crude protein content (Jackson, 1973), neutral detergent fibre and acid detergent fibre (Goering and Van Soest, 1970).

***Statistical analysis*:** The pooled data was subjected to analysis of variance and LSD ($P \leq 0.05$) was used to compare means among various genotypes following Snedecor and Cochran (1994).

Results and Discussion

Plant growth parameters: Oat varieties were evaluated for growth, yield and quality parameters and differed statistically in producing tillers and plants of different heights. Sabzar variety had significantly taller plants (144.3 cm) at maturity stage than other varieties (Table 1) but it was at par with SKO-90 (141.7 cm) and SKO-20 (141.6 cm). These two were followed by JHO-99-2 (133.7 cm) and JHO-99-1 (132.3 cm). The minimum plant height (122.8 cm) was noted in cultivar JHO-851 which was found at par with JHO-822 (123.7 cm). Differences in plant height among the varieties were expected due to genetic make-up of the varieties and environmental influences. The significant effect of variety on plant height in present study was in agreement with previous findings (Chohan *et al*., 2004; Hussain *et al*., 2005; Palsaniya *et al*., 2015).

Table 1. Effect of different oat cultivars on plant growth parameters (pooled)

Treatment (variety)	Plant height (cm)	Number of tillers/per metre row length	Leaf area index (LAI)	Leaf stem ratio
JHO-822	122.8	70.6	2.38	0.52
JHO-851	123.7	72.8	2.42	0.50
JHO-99-1	132.3	78.6	2.74	0.61
JHO-99-2	133.7	82.8	2.76	0.62
JHO-2000-4	128.3	81.9	2.27	0.58
Sabzar	144.3	94.4	2.88	0.64
SKO-20	141.6	92.8	2.86	0.64
SKO-90	141.7	90.7	2.84	0.62
SKO-96	133.7	89.9	2.76	0.61
SEm±	3.50	1.41	0.04	0.03
CD ($P \leq 0.05$)	10.42	4.42	0.13	0.11

It is apparent from the perusal of the data in Table 1 that the number of tillers/per metre row length varied significantly among oat genotypes. Maximum numbers of tillers (94.4) were observed in Sabzar which was found statistically at par with SKO-20 (92.8) and SKO-90 (90.7), while the minimum numbers of tillers were observed in JHO-822 (70.6) and JHO-851 (72.8). The data further revealed that Sabzar (2.88) and SKO-20 (2.86) recorded maximum leaf area index followed by SKO-90 (2.84), SKO-96 (2.76), JHO-99-2 (2.76) and JHO-99-1 (2.74). Statistically no significant variation was observed among these varieties. However, lower value of leaf area index (2.27) was recorded in JHO-2000-4 which was statistically at par with that of JHO-822 and JHO-851.

Highest leaf-stem ratio (0.64) was observed in the varieties Sabzar and SKO-20, which was statistically at par with SKO-90, SKO-96, JHO-99-2, and JHO-99-1. However, minimum leaf-stem ratio was observed in JHO-851 (0.50) followed by JHO-822 (0.52). The variation in various growth parameters among the varieties might be due to their genetic constitution and environmental suitability. Similar patterns of growth in oat were also observed earlier (Naeem *et al*., 2002; Siloriya *et al*., 2014).

Crop yield attributes and yield: The yield attributing characters *viz.,* seed yield and 1000-grain weight were recorded and it was observed that these attributes varied significantly among the varieties (Table 2). Based on the results, variety Sabzar had highest seed yield (3.24 t/ha) followed by SKO-20 (3.14 t/ha) and SKO-90 (3.12t/ha) compared to other varieties. Variety JHO-851(2.35 t/ha) being at par with JHO-822 (2.42 t/ha) was noted to exhibit the least value for seed yield among all the varieties. The effect of improved yield attributing characters *viz*., more number of tillers under the varieties Sabzar and SKO-20 ultimately showed increased seed yield. The seed yield of crop had strong possible correlation with number of tillers, weight of panicle and test weight as reported by Lacko-Bortosova *et al.* (2000). The highest values for 1000 seed weight was observed in the variety Sabzar (33.1) followed by SKO-96 (32.8) and SKO-20 (32.7). The least value of 1000 seed weight was observed in JHO-822 (29.4) and JHO-851 (29.7). However the differences in 1000 seed weight for other varieties were non-significant. Sumathi and Balamurugan (2014) also reported highest 1000 seed weight in Sabzar among all other oat varieties.

Green as well as dry fodder yield of oat varieties were influenced significantly with their different genetic constituents. Among different varieties, the highest green fodder yield (41.85 t/ha) was observed in Sabzar followed by SKO-90 (40.50 t/ha) and SKO-20 (39.84t/ha), which was found at par with JHO-99-2 (37.22 t/ha) and JHO-99-1 (36.75 t/ha). The improvement in the fodder yield could be attributed to improved growth parameters *viz*., plant height and tiller number (Hussain *et al*., 2010). However, minimum green fodder yield was recorded in JHO-851(26.85 t/ha) and JHO-822 (27.57 t/ha). Similar trend was observed in dry matter yield of different oat genotypes. Higher values of LAI in Sabzar, SKO-90, SKO-20 and JHO-99-2 might have attributed to better interception, absorption and utilization of radiation energy leading to higher photosynthetic rate, leaf expansion and finally more accumulation of dry matter by the plants, which helped to improve the accumulation of dry matter by the plants and ultimately resulted in higher seed yield. These results were also in conformity with the findings reported earlier (Choudhary *et al*., 2016; Dar *et al*., 2014; Palsaniya *et al*., 2015).

Table 2. Effect of different oat cultivars on yield and yield attributes (pooled)

Treatment (variety)	Seed yield (t/ha)	1000 seed weight (g)	Green fodder yield (t/ha)	Dry matter yield (t/ha)
JHO-822	2.42	29.4	27.57	6.1
JHO-851	2.35	29.7	26.85	5.9
JHO-99-1	2.74	30.8	36.75	6.9
JHO-99-2	2.73	30.7	37.22	7.2
JHO-2000-4	2.67	27.9	33.19	6.8
Sabzar	3.24	33.1	41.85	8.6
SKO-20	3.14	32.7	39.84	8.1
SKO-90	3.12	32.4	40.50	7.4
SKO-96	2.80	32.8	35.84	7.2
SEm±	0.13	0.81	2.01	0.54
CD (P≤0.05)	0.42	2.32	6.05	1.71

Table 3. Effect of different oat cultivars on forage quality (pooled)

Treatment (variety)	Crude protein (%)	Crude protein yield (q/ha)	ADF (%)	NDF (%)
JHO-822	7.50	4.60	42.1	60.4
JHO-851	7.45	4.40	40.3	61.6
JHO-99-1	8.57	5.92	40.9	59.3
JHO-99-2	8.52	6.15	40.7	59.8
JHO-2000-4	8.26	5.62	44.8	61.7
Sabzar	9.71	8.36	39.8	57.4
SKO-20	9.68	7.85	40.2	59.7
SKO-90	9.72	7.20	43.7	58.2
SKO-96	8.94	6.50	40.7	57.9
SEm±	0.74	0.61	0.8	0.6
CD (P≤0.05)	2.25	1.87	2.6	2.0

Forage quality: Data (Table 3) revealed that highest crude protein content (9.71%) was recorded in Sabzar closely followed by SKO-20 (9.68%), SKO-90 (9.72%), but it was found statistically at par with JHO-99-2 (8.52%) and JHO-99-1 (8.57%). However, maximum crude protein yield (8.36 q/ha) was recorded in Sabzar which was found statistically at par with SKO-20 (7.85 q/ha) and SKO-90 (7.24 q/ha). JHO-851 recorded minimum (4.40 q/ha) crude protein yield. Contrary to this, the lowest ADF content was exhibited by Sabzar (39.8%) followed by SKO

-20 (40.2%) and lowest values for NDF were recorded in Sabzar (57.4%) followed by SKO-96 (57.9%). The variation in forage quality might be due to the difference in genetic constitution of different varieties. Ahmad *et al.* (2015) also observed similar values for different forage quality parameters in oat genotypes. Moreover, the results were also in agreement with the earlier findings (Choudhary *et al*., 2016; Dar *et al*., 2014; Palsaniya *et al*., 2015).

Conclusion

Based on the current investigation, Sabzar variety followed by SKO-20 and SKO-90 proved to be superior with respect to various growth parameters *viz*., plant height, number of tillers/per metre row length, leaf-stem ratio and LAI, yield attributes such as seed yield, 1000 seed weight and forage quality parameters. Among the varieties from IGFRI-Jhansi, JHO-99-2 and JHO-99-1 were found relatively better performers. It was concluded that Sabzar, SKO-20, SKO-90, JHO-99-1 and JHO-99-2 are most suitable varieties for oat cultivation under temperate conditions of Jammu and Kashmir.

References

Abhishek, K., S. Ahmad, H.C. Pandey and V. Kumar. 2014. Correlation, path and diversity analysis of oat (*Avena Sativa* L.) genotypes for grain and fodder yield. *Journal of Plant Science and Research* 1: 1-9.

Ahmad, M., G. Zaffar, U. Mehraj, I.A. Jehangir and A.A. Lone. 2015. Stability analysis for forge quality traits in oats (*Avena sativa* L.) over environments. *International Journal of Science and Nature* 6: 590-595.

Ahmad, M., Zaffar, G., Dar, Z.A. and M. Habib. 2014. A review on oat (*Avena sativa* L.) as a dual-purpose crop. *Scientific Research and Essays* 6: 590-595.

Ahmad, S., J.P. Singh, P.A. Khan and A. Ali. 2016. Pastoraliam for strengthening rangeland resources of Jammu & Kashmir. *Annals of Agri Bio Research* 21: 49-54.

Anonymous. 2009. *Digest of Statistics*. Directorate of Economics and Statistics, Planning & Development Department, Government of Jammu & Kashmir, Srinagar pp. 94-100.

Chohan, M., S.M. Naeem, M. Khan, A.H. Kainth and M. Sarwar. 2004. Forage yield performance of different varieties of oat. *International Journal of Agriculture and Biology* 6: 751-752.

Choudhary, M. and G. Prabhu. 2016. Response of fodder oat (*Avena sativa* L.) varieties to irrigation and fertilizer gradient. *Range Management and Agroforestry* 37: 201-206.

Dar, N. A., K.N. Singh, L. Ahmad, J.A. Sofi, M.E. Bhat and R. Kotru. 2014. Influence of dates of sowing, cultivars and different fertility levels on fodder oat (*Avena sativa* L.) under temperate conditions of Kashmir valley (India). *Range Management and Agroforestry* 35: 51-55.

Goering, H. K. and P. J. Van Soest. 1970. *Forage Fiber Analysis (Apparatus, Reagent. Procedure and Some Application)*. Hand book No. 379.ARS, USDA, Washington, DC, USA.

Hussain, A., S. Khan, M. Bashir and Z. Hassan. 2005. Influence of environment on yield related traits of exotic oats cultivars. *Sarhad Journal of Agriculture* 21: 209-213.

Hussain, M., A.S. Khan, A. Bakhsh, M. Imran and M. Ansar. 2010. Variability in fodder production potential of exotic oats (*Avena sativa*) genotypes under irrigated conditions. *Journal of Agriculture Research* 48: 65-71.

Jackson, M. L. 1973. *Soil Chemical Analysis*. Prentice Hall of India (Pvt.) Ltd. New Delhi.

Kumawat, S.M., S.R. Kantwa, D.H. Desai, M. Arif and V. Khinchi. 2017. Responses of dual purpose oats (*Avena sativa* L.) to sowing date, method and level of zinc with or without thiourea in irrigated arid ecosystem. *Range Management and Agroforestry* 38: 215-220.

Lacko-Bartosova, M., H. Smolkova, Z. Galova and R. Scherer. 2000. Quantitative factors and mineral composition of spelt oat varieties in southern Slovakia. *Dinkelsortencandtechnik* 55: 116-118.

Naeem, M., M.A. Khan, M.S.M. Chohan, A.H. Khan and S. Salah-ud-Din. 2002. Evaluation of different varieties of oats for green fodder yield potential. *Asian Journal of Plant Sciences* 1: 640-641.

Palsaniya, D. R., T. Kiran Kumar, G. Prabhu, A. K. Dixit, A.K. Rai and S. Kumar. 2015. Weed dynamics in fodder oat (*Avena sativa* L.) genotypes. *Range Management and Agroforestry* 36: 107-108.

Ratan, N., U.N. Singh and H.C. Pandey. 2016. Yield and quality of oat (*Avena sativa* L.) as influenced by nitrogen and varieties in Bundelkhand region (U.P.) India. *Agricultural Science Research Journal* 6: 27-30.

Shah, S.A.S., L.H. Akhtar, R. Minhas, M.S. Bukhari, A. Ghani and M.H. Anjum. 2015. Evaluation of different oat *(Avena sativa* L.*)* varieties for forage yield and related characteristics. *Science Letters* 3: 13-16.

Siloriya, P.N., G.S. Rathi and V.D. Meena. 2014. Relative performance of oat (*Avena sativa* L.) varieties for their growth and seed yield. *African Journal of Agricultural Research* 9: 425-431.

Singh, D. and A. Chauhan. 2017. Evaluation of oats and barley varieties for fodder yield, quality and nutrient uptake potential under central Gujarat condition. *Range Management and Agroforestry* 38: 89-95.

Snedecor, G. W. and W. G. Cochran. 1994. *Statistical Methods*. 8th edn. East West Press Pvt. Ltd. New Delhi.

Sumathi, S. and P. Balamurugan. 2014. Usefulness of morphological characters for varietal identification in oats (*Avena sativa* L.) *International Journal of Plant Sciences* 9: 7-12.