openaccess Journal
SCIENCE LETTERS 2015 | Volume 3 | Issue 1 | Pages 13-16

Evaluation of different oat *(Avena sativa L.)* varieties for forage yield and related characteristics

Syed Awais Sajid Shah[1]*, Lal Hussain Akhtar[1], Rashid Minhas[1], M. Shahjahan Bukhari[1], Amir Ghani[2], Maqbool Hussain Anjum[3]

[1]Agricultural Research Station, Bahawalpur, Pakistan
[2]Maize and Millet Research Institute, Yousufwala, Sahiwal, Pakistan
[3]Fodder Research Institute, Sargodha, Pakistan

Abstract
The ample provision of quality fodder is essential for sustainable dairy industry. The development of oat varieties possessing higher forage yield potential will help to produce abundant quantities of fodder for cattle. For this purpose, an experiment was conducted to compare the forage yield of twelve oat *(Avena sativa* L.*)* varieties at Agricultural Research Station, Bahawalpur, Pakistan, during the year 2012-2013. Randomized Complete Block Design was used for the layout of the experiment having three replications with plot size of 1.8 m x 6 m. Drill method was used for seed sowing. Data was recorded for plant height, leaf area, tillers per plant, tillers per meter row and green fodder yield. Sgd Oat-2011 was the tallest variety (129.6 cm) while Sgd-4 was the shortest one (82.3 cm). F-411 was found to have a broader leaf area (70.83 cm^2) compared to other varieties. F-411 and DN-8 had maximum number of tillers (12 and 11), respectively, while varieties Sgd-4, F-403 and Sgd Oat-2011 had least tillers (6). Sgd-3 and No-708 produced highest fodder yield (80 tons ha^{-1}) while Hay produced the lowest yield (63.72 tons ha^{-1}). Sgd-3 possessed highest number of tillers per meter row (211) while variety Colabah had less number of tillers per meter row (139). From the results, we found that variety Sgd-3 and No-708 showed better performance than other varieties used in the trial.
Key words: *Avena sativa*, quality, forage yield, abundant fodder, Bahawalpur.

Received June 06, 2013 **Revised** September 10, 2014 **Published online** October 15, 2014
***Corresponding Author** Syed Awais Sajid Shah **Email** awaiskazmi44786@yahoo.com **Phone** +923127008790

***To cite this manuscript*:** Shah SAS, Akhtar LH, Minhas R, Bukhari MS, Ghani A, Anjum MH. Evaluation of different oat *(Avena sativa L.)* varieties for forage yield and related characteristics. Sci Lett 2015; 3(1):13-16.

Introduction

Oat *(Avena sativa* L.) has great importance in Rabi cereal fodder crops and is grown in winter throughout Pakistan both under irrigated and rain fed conditions. It is early maturing, palatable, succulent and energy rich crop. Oat is mostly used as silage or hay during fodder deficit periods [1] and liked by animals due to high palatability and softness. Temperate and cool sub-tropical conditions are congenial for its growth. A well distributed rainfall of 400 mm and an optimum temperature range of 16-32 ^oC during the five months duration are sufficient to meet the requirement of fodder crops [2]. Fodder species and fodder production depend mainly on the climate (temperature, frost, duration of winter, availability of water, distribution of rainfall and growth period length) and soil (structure, texture) conditions [3]. Normally, it is grown alone or intercropped with berseem (*Trifolium alexandrinum*). When berseem and oat are sown together, it provides nutritious feed to mulch animals [4]. The oat is a multicut fodder which has a great role in establishing more productive dairy industry in the country. The need of meat, beef, milk, butter and their by-products is increasing due to fast growing human population in Pakistan. Animals in Pakistan are deficient both in energy and protein by 40% and 60%, respectively [5]. The available fodder supply is 1/3 less than the actual needs of animals [6]. Improved fertilizer management of oats may help to enhance crop quality and thus the potential for producing high quality oat [7]. Oat as a forage crop has the advantage of being winter hardy and serves as a cash crop [8]. The best time for the crop harvest is at 50% flowering stage for better yield. Ideal variety is always one, which possesses general adaptation with higher yield potential [9].

The improved varieties of oat produce three-fold green fodder i.e. 60-80 tonnes per hectare and can feed a double number of animals per unit area as compared to the traditional fodder crops. Hussain et al. [10] reported that oat produced more fodder and less crude protein with advancing crop maturity. The farmers face fodder deficiency in winter when they have only dry stalks of kharif cereal fodder or dry summer grasses. There is a dire need to maximize fodder production per acre which could be increased 2-3 fold by adopting improved varieties and agronomic practices [11].

Selection of the promising oat varieties is one of the most important decisions of a plant breeder. This decision has an impact on the potential yield (forage and grain), seed quality (test weight and protein), disease and insect management and maturity of the crop. The development of improved cultivars of oat has changed the status of the oat crop in Pakistan in less than twenty years; from a minor crop, limited to a few stations to one of the most important cool-

season fodders. Agricultural land is limited, so increase in forage availability should be through increasing the yield per unit area. Introduction of the new oat cultivars along with the expansion of dairy has given impetus to commercial forage growing in the irrigated tracts. Keeping in view the forage needs of the dairy industry of the country, a study was undertaken to evaluate various promising oat lines to identify the higher yielding line for its release as a cultivar for general cultivation.

Materials and Methods

The main purpose of this study was to access 12 lines of oats for forage yield at Agricultural Research Station, Bahawalpur, Pakistan during the years 2012-13. Randomized Complete Block Design (RCBD) was used for laying out a trial having three replications and a net plot size of 1.8m x 6m. Oat lines were sown on 22 Sep. 2012, in 30 cm apart rows with the help of a hand drill, using a seed rate of 85 kg ha^{-1}. The fertilizer was not applied, so it was a totally an organic crop. The crop was harvested at 50% flowering stage. Variety S-2000 was harvested on 25 Feb. 2013, variety F-411 on 26 Feb. 2013, variety DN-8 on 27 Feb. 2013 while all other varieties were harvested on 28 Feb. 2013. Data were recorded for plant height (cm), leaf area (cm^2), number of tillers per plant, No. of tillers per meter row and green fodder yield. The data of all the characters were subjected to ANOVA by using MSTATC statistical package and the means were compared using DMR test [12]. The Pearson correlation among various traits was also computed.

Results and discussions

Plant height (cm)

Height of the plant was taken from the base of the plant to the stem top in centimeters. Variety Sgd Oat-2011 was found to be the tallest variety with the average height of 129.6 cm and variety Sgd-4 was found to be the shortest variety with the height of 82.3 cm (Table 1). It was observed that in spite of being the tallest variety, Sgd Oat-2011 didn't prove to be the high yielding. It may be due to its smaller leaf area and ranked at the bottom. But this variety could be checked for drought resistance as it is having less leaf area. Chohan et al. [13] and Hussain et al. [14] reported significant differences among the oats varieties regarding plant height.

Leaf area (cm^2)

Leaf area was calculated by multiplying leaf length by leaf width from three points i.e. from top, middle and bottom. The resultant was then multiplied by a constant 0.74. F-411 was found to be at the top with maximum leaf area of 70.83cm^2 (Table 1) while variety Sgd Oat-2011 was found to have less leaf area of 51.1 cm^2 (Table 1). F-411 cannot tolerate drought conditions due to its broad leaves with high number of stomatal openings in the leaves. But variety Sgd Oat-2011 having a less leaf area could be the drought resistant variety. Ahmad et al. [15] reported that the variation in leaf area in different varieties may be attributed to variation in genetic makeup of the varieties, soil, heritability status and environmental adaptability.

No. of tillers $plant^{-1}$

Number of tillers $plant^{-1}$ plays a vital role in the increase or decrease of the crop yield. More the number of tillers, higher the yield and vice versa. Varieties F-411 and DN-8 were found to have higher tillering capacity with an average number of 12 and 11, tillers $plant^{-1}$, respectively. While variety Sgd-4, F-403 and Sgd Oat-2011 produced only six tillers per plant (Table 1), being the last two. Significant variation among the oat varieties for number of tillers has been reported by Arif et al. [16] and Naeem et al. [17].

Yield (t ha^{-1})

The fodder yield is the most important trait and the ultimate product of a fodder variety. Variety Sgd-3 and No-708 produced the highest yield of 80 t ha^{-1}. The variety Hay produced the lowest yield of 63.72 t ha^{-1} (Table 1).

The perusal of the data revealed that Sgd-3 and N0-708 proved to be the highest yielding varieties, but as regards other characters, it was found to be an average variety with medium height, leaf area, tillering capacity, which reflects its better nutrient utilizing response except Sgd-3 showing high tillering capacity per meter row. Nawaz et al. [18] also reported significant differences among the oat cultivars regarding green forage yield. Amanullah et al. [19] stated that higher yields of fodder in oat cultivars can be possibly attributed to their greater leaf area, responsible for more photosynthetic activities having high capacity to store assimilative products of photosynthesis.

No. of tillers per meter row

Numbers of tillers per meter row are directly proportional to green fodder yield. Variety Sgd-3 was found to be at the top with 211 tillers while variety Hay was ranked second with 196 tillers. Variety Colabah produced only 139 tillers per meter row (Table 1). Variety Sgd-3 was found to be a vigorous variety

Table 1 Mean values of various traits of oat lines

Varieties	PH (cm)	LA (cm^2)	T/1MR	Y (t/hac)	T/Plant
Hay	108.37c	62.56bcd	196b	63.72g	7.66cdef
Sgd-4	82.3h	55.56ef	189c	68.26ef	6.33ef
F-411	104.27d	70.83a	170f	75.36c	12a
Colabah	108.57c	61.53cde	139j	79.32a	7.33def
S-2000	118.47b	62.63bcd	189.67c	75.85bc	8.33cd
F-403	105.2d	62.93bcd	175.67e	67.31f	6f
Sgd Oat 2011	129.6a	51.1f	155h	71.93d	6f
DN-8	98.57eef	58.9cde	190.33c	69.97e	11ab
Sgd-3	116.47b	57.16de	211a	80.42a	9.33bc
F-415	87.57g	68.56ab	181.67d	74.57c	8cde
Sgd-5	97.57f	67.6ab	150.33i	77.32b	8.66cd
No.708	101e	63.93bc	161.33g	80.52a	8.66CD

PH = Plant height; LA = Leaf area; T/1MR = Tillers per meter row; Y t/hac = Yield (Tons per hectare); T/plant = Tillers per plant

having the high tillering capacity and Sgd-3 was also a high yielding variety while Hay even a the second number in producing tillers per meter row was the lowest yielding variety (Table 2). Significant variation among the oat varieties for number of tillers m^{-1} row has been reported by Arif et al. [16] and Naeem et al. [17].

Table 2 Mean squares for all characters

		PH (cm)	LA (cm^2)	T/1MR	Y (t/hac)	T/Plant
SOV	DF					
Rep	2	0.735	5.41	0.25	0.16	0.78
Var	11	511.1	95.8	1346.6	90.47	10.41
Error	22	0.961	4.15	1.61	0.43	0.41
P value		0.00	0.00	0.00	0.00	0.00
CV		0.94	3.29	0.72	0.89	7.77
RE		0.99	1.02	0.95	0.96	1.05

PH = Plant height; LA = Leaf area; T/1MR = Tillers per meter row; Y t/hac = Yield (Tons per hectare); T/plant = Tillers per plant; SOV = Source of variation; Rep = Replications; Var = varieties; CV = Coefficient of variation; RE = Relative efficiency; DF = Degree of freedom.

Table 3 Pearson correlations between traits in 12 oats varieties

	LA	PH	T /MR	Yield
PH	-0.383	-	-	-
P value	0.021	-	-	-
T /mR	-0.157	-0.075	-	-
P value	0.361	0.659	-	-
Yield	0.208	0.154	-0.33	-
P value	0.222	0.367	0.049	-
T/Plant	0.435	-0.086	0.18	0.313
P value	0.008	0.620	0.293	0.063

LA = Leaf area; PH = Plant height; T 1m R = Tillers in one meter row; T/P = Tillers per plant

Correlations

The plant height (PH) was found to be negatively correlated with leaf area and tillers per meter row while positively correlated with green fodder yield and tillers per plant. Leaf area had positive contents with green fodder yield and tillers per plant. Tillers per meter row had a negative relationship with yield while it was positively correlated with tillers per plant. Yield was positively correlated with tillers per plant. The results revealed that selection for higher tillers per plant and taller plants would be helpful in increasing the green fodder yield in oat (Table 3).

Conclusions

Development of superior crop cultivars is the ultimate goal of the plant breeders to obtain higher production of fodder to replace the existing low yielding oat varieties which will play a vital role in the development of the dairy industry by ensuring the fodder supply during lean period and ultimately increasing the milk and meat production of the country. Keeping in view the forage yield, the varieties Sgd-3 and No-708 seems to be the best one under the agro-climatic conditions of Bahawalpur, Pakistan.

References

[1] Suttie JM, Reynolds SG. Fodder oats. A world over view. FAO, ISBN: 92-5-105243-3 2004. http:/www.fao.org/008/y5765 e/y 5765 e00.htm.

[2] Hussain M, Khan AS, Bakhsh A, Imran M, Ansar M. Variability in fodder production potential of exotic oats (*Avena sativa*) genotypes under irrigated conditions. J Agric Res 2010;48:65-71.

[3] Bruzon V. Feed and fodder consultant. EC/GOP project ALA/01/129. Strengthening of Livestock Services Project 2007.

[4] Younis M, Azam M. Response of different levels of N and P on the forage yield of oat. Pak J Soil Sci 2003;22:64-66.

[5] Sial MA, Aalam MZ. Livestock feed resources scenario of Pakistan. National Seminar on Dairy Production potential and challenges. 29-30 May 1988, Univ. of Agriculture, Faisalabad, Pakistan.

[6] Younas M, Yaqoob M. Food research source of livestock in the Punjab. Pakistan. Livest Res Rural Dev 2005;17:18.

[7] Mohr RM, Grant CA, May WE. Nitrogen, Phosphorus, and Potassium fertilizer management for oats. Better Crops 2004;88:12-14.

[8] Morey DD. Forage production of small grains under maximum favourable condition. Agron J 1961;53:57-59.

[9] Finlay KW, Wilkinson GN. The analysis of adaptation in a plant breeding program. Aust. J Agric Res 1963;14:742-754.

[10] Hussain A, Muhammad AD, Khan S, Bhatti MB. Forage yield and quality potential of various cultivars of oats (*Avena sativa* L.). Pak J Sci Ind Res 1993;36:258-260.

[11] Bhatti B. Fodder production in rain fed areas of Punjab. Fodder Production in Pakistan. Pakistan Agricultural Research Council 1996; pp. 113-114.

[12] Steel RGD, Torrie JH. Principles and procedures of statistics: A Biometrical Approach. McGraw Hill book Co. Inc. New York. 1980.

[13] Chochan MSM, Naeem M, Khan AH, Kainth R, Sarwar M. Forage yield performance of different varieties of oat. Int J Agric Biol 2004;6:751-752.
[14] Hussain A, Khan S, Bashir M, Hassan Z. Influence of environment on yield related traits of exotic oats cultivars. Sarhad J agric 2005;21:209-213.
[15] Ahmad G, Ansar M, Kaleem S, Nabi G, Hussain M. Performance of early maturing oats *(Avena sativa* L.*)* cultivars for forage yield and quality. Pak J Agric Sci 2008;49:918-924.
[16] Arif MK, Naeem M, Chochan MSM, Khan AH, Salahuddin S. Evaluation of different varieties of oat for green fodder yield potential. Asian J Plant Sci 2002;1:640-641.
[17] Naeem M, Chohan MSM, Khan AH, Kainth RA. Green fodder yield performance of oats varieties under irrigated conditions. J Agric Res 2006;44:197-220.
[18] Nawaz N, Razzaq NA, Ali Z, Yousaf M. Performance of different oat (*Avena sativa L.*) varieties under the agro-climatic conditions of Bahawalpur, Pakistan. Int J Agric Biol 2004;6:624-626.
[19] Amanullah PS, Zada K, Perveen S. Growth characters and productivity of oat varieties at Peshawar. Sarhad J Agric 2004;20:5-10.