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FORAGE YIELD AND QUALITY POTENTIAL OF VARIOUS CULTIVARS OF OATS (*AVENA SATIVA* L.)

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Fifteen exotic and indigenous cultivars and interspecific hybrids of forage oats were evaluated for plant height, number of tillers per plant, number of leaves per tiller, leaf area, green fodder yield, dry matter yield, crude protein and crude fibre content at the National Agricultural Research Centre (NARC), Islamabad during 1985 and 1986. Cultivar No. 725 proved its superiority over all the cultivars/hybrids. This cultivar produced taller plants, a greater number of tillers per plant, more leaves and leaf area, highest green fodder and dry matter tonnage and high quality forage as compared to all the other entries. Therefore, cultivar No. 725 is recommended for general cultivation for maximum quality forage production.

Key words: Oats (*Avena sativa* L), Forage yield, Forage quality.

Introduction

Cultivated oats (*Avena sativa* L. and *Avena byzantina* C. Koch) rank 5th among cereals in world production. Oats are often used as a grazing crop or are harvested for hay or silage. They are also widely used as a companion crop for underseeded forage legumes. Oats are grown mainly in temperate regions and cool sub-tropical environments. It is an important fodder crop for the winter season in Pakistan, both in irrigated and rainfed areas. Most of the area under fodder oats cultivation is near large cities, on Military Dairy Farms and Remount Depots and forage is used to feed cattle and especially horses in the country. Oats can successfully be mixed in berseem (*Trifolium alexandrinum* L.) and lucerne (*Medicago sativa* L.) to produce early and nutritious fodder for livestock due to their rapid growth rate as compared to berseem and lucerne.

The green forage of oats, being sweet and nourishing are well accepted by all livestock. Oats are an especially valuable forage for dairy animals because they reduce the cost of feeding concentrates. Cattle can be maintained in good condition on oats at a time of the year when supply of other feed is both scarce and costly. Many cultivars of oats are of high feed value if cut at the flowering stage or soon after. Broad leaved cultivars give a higher forage yield, but narrow leaved cultivars are most preferred, particularly for horses and cattle.

The demand for meat, milk, butter and other byproducts is increasing due to the rapidly growing human population in Pakistan. Improvement of our livestock industry is therefore urgently needed and quality forage plays a pivotal role in nourishing these animals. Although 1/6th of the total cropped area in Pakistan is put under fodder crops annually, animals are generally underfed, resulting in poor performance. Therefore, to run an efficient livestock industry, higher yielding, more nutritious fodder oat cultivars that can feed more animals are needed.

Very little systematic research has been carried out on oats for their utility as a fodder crop, but workers like Reddy and Rai [1], Kabhapur *et al.* [2], Riveland *et al.* [3], Gill *et al.* [4], Dhumale and Mishra [5], Chaudhry [6] and Balyk and Voronkin [7] have evaluated the suitability of oats as a forage crop under different agro-climatic conditions.

Chaudhary and Mukhtar [8] reported that plant characters in oats such as greater plant height, increased leaf area and greater stem thickness contribute to maximum green fodder production. Toxler *et al.* [9] found that the oat cultivar "Borrus" grown as a fodder catch crop yielded 26 and 60% more dry matter tonnage when planted alone and in a mixture, respectively.

Bhatti *et al.* [10] evaluated 13 promising cultivars of oats and reported that PD2-LV65 and S-81 were superior to all other cultivars in plant height, tillers per plant, stem thickness, leaves per tiller, leaf area, green fodder and dry matter yield under a two-cut system at the National Agricultural Research Centre, Islamabad.

The present study was thus designed to evaluate the quality of high fodder-yielding oats cultivars to overcome the poor performance of livestock due to low yielding cultivars of inferior quality forage.

Materials and Methods

The material was comprised of fifteen exotic and indigenous cultivars and intervarietal hybrids of forage oats, *viz.* S-81, PD2-LV65, Avon PD2-LV65 x Fulgrain, Avon x Early Miller, No. 707, No. 616, No. 656, No. 632, No. 725, No. 677, No. 668, No. 681, SS-1 and S-141. These cultivars/hybrids were planted in a randomized block design with three replica-

tions, in the first week of November 1985 and 1986 at the National Agricultural Research Centre, Islamabad. The trial was harvested in the months of Feb. and Mar. during both years at the 50% flowering stage. The gross plot size of the experiment was 3 m x 6 m while net harvested plots were 1.8 m x 6 m. The rows were spaced 30 cm apart. The recommended dose of fertilizer (i.e., 50-50 N-P kg/ha in the form of nitrophos) was applied at the time of planting and 25 kg/ha nitrogen in the form of urea was applied with irrigation one month after sowing. Five plants were selected at random in each plot for morphological observations. Data were collected for the following morphological observations and quality traits.

1. Plant height in cm (PH).
2. Numbner of tillers per plant (TL).
3. Nujmber of leaves per tiller (LV).
4. Leaf area in cm^2(LA) (length x breadth) x 0.477.
5. Green fodder yield in tonnes/ha (GY).
6. Dry matter yield in tonnes/ha (DY).
7. Crude protein content in percent (CP).
8. Crude fibre content in percent (CF).

The representative green fodder samples from each cultivar and replication were collected at random and dried in an oven at 60°. After drying, the samples were weighed to determine dry matter yield. The dried samples were ground with a Wiley Mill using a 1 mm screen. Crude fibre was determined by the Van Soest method [11]. Crude protein (N% x 6.25) was estimated by the Reardon *et al.* method [12]. Analysis of variance was performed on the data combined over two years.

Results and Discussion

The analysis of variance for various characters showed that there were significant difference among the cultivars for plant height, number of tillers per plant, number of leaves per tiller, leaf area, green fodder yield, dry matter yield, crude protein and crude fibre contents. With the exception of plant height crude protein and crude fibre, these parameters also differ from 1985 to 1986 (Table 1).

Among the oat cultivars that exhibited significant different in plant height, PD2-LV65, No.677, S-81 and No. 725 produced maximum plant heights. All the other cultivars were lower and not significantly different from one another (Table 2).

Oat cultivars PD2-LV65, No. 725 and No. 677 produced both a significantly higher number of tillers per plant and more leaves per tiller than all the other cultivars included in the trial. The minimum number of tillers per plant were observed in SS-I, S-81, Avon, No. 616, No. 688, Avon x Early Miller and No. 681. Maximum leaf area per plant was recorded in cultivar S-81 (156.94 cm^2) followed by PD2-LV65 (115.30 cm^2) and No. 677 (115.04 cm^2). The minimum leaf area was observed in varieties No. 668 and SS-1.

The cultivars PD2-LV65, No. 725 and S-81, which were superior in plant height, number of tillers per plant, number of leaves per tiller or leaf area per plant also produced significantly higher green fodder yields of 82.83, 81.32, 77.02 and 75.06 t/ha, respectively.

The oat cultivar PD2-LV65, which produced maximum plant height, number of tillers per plant, number of leaves per tiller and maximum green fodder yield, also had the highest dry matter yield (12.08 t/ha) while the cultivars/hybrid No. 725, PD2-LV65 x Fulgrain, No. 677, S-141 and No. 668 were statistically similar to PD2-LV65 in dry matter production. The minimum dry matter yield of 8.40 t/ha was produced by interspecific hybrid Avon x Early Miller (Table 2).

The higher forage yield recorded for PD2-LV65 and No. 725 was due to the best performance of yield component characters, particularly increased plant height, more tillers per plant and more leaves per tiller (Table 2). Similar results were observed in oats [2,3,6-10].

In modern dairy technology, yield per se is not sufficient for measuring the feeding values of forage crops. For determination of palatability and digestibility, the nutritive value of forage produced by different cultivars is of vital importance. Crude protein content is positively associated with forage quality and crude fibre content is negatively associated with

TABLE 1. SOURCE OF VARIATION, DEGREE OF FREEDOM AND MEAN SQUARES OF DIFFERENT TRAITS OF OATS CULTIVARS.

		Mean squares							
SV	DF	PH	TL	LV	LA	GY	DY	CP	CF
Replications	2	71.42	0.29	0.52	7.24	70.41	1.49	0.13	0.003
YR	1	160.91	5.17**	59.80**	12334.38**	371.41**	63.84**	0.01	0.000
CV	14	1058.98**	5.12**	2.40**	1873.87**	149.37**	6.51**	4.37**	0.89**
YR x CV	14	85.46	0.43	0.30	162.90	85.91**	1.72	0.01	0.005
Error	58	92.76	0.74	0.66	178.09	30.92	1.77	0.16	0.007

* and ** Significant at 5 and 1 percent levels respectively.
YR, CV, PH, TL, LV, LA, GY, DY, CP and CF are the numbers of years, cultivars, plant height, tillers per plant, leaves per tillers, leaf area, green fodder yield, dry matter yield, crude protein and crude fibre contents respectively.

TABLE 2. AVERAGE PLANT HEIGHT (PH), TILLERS/PLANT (TL), LEAVES/TILLER (LV), LEAF AREA (LA) GREEN FODDER YIELD (GY), DRY MATTER YIELD (DY), CRUDE PROTEIN CONTENTS (CP), CRUDE FIBRE CONTENTS (CF) OF DIFFERENT OATS CULTIVARS.

Cultivars	PH	TL	LV	LA	GY	DY	CP	CF
S 81	122.73 a	5.00 c	6.78 bc	156.94 a	75.06 abcd	8.98 cd	10.94 def	22.85 e
PD2-LV65	129.86 a	7.70 a	8.56 a	115.30 b	82.83 a	12.08 a	10.06 ghi	23.21 cd
Avon	98.41 b	5.06 c	7.28 bc	90.32 de	68.67 cde	9.26 cd	9.65 i	22.48 f
PD2-LV65 x Fulgrain	95.33 b	5.84 bc	7.83 abc	95.66 bcde	72.84 bcde	11.01 abc	11.06 cd	23.14 d
Avon x Early Miller	88.54 b	5.28 c	7.11 bc	107.98 bcde	64.82 e	8.40 d	10.40 efgh	22.85 e
No. 707	96.60 b	5.67 bc	7.11 bc	108.36 bcd	67.44 de	9.67 cd	10.09 ghi	22.59 f
No. 616	100.63 b	5.17 c	6.72 c	94.54 cde	66.98 de	9.77 cd	10.99 de	23.29 bc
No. 656	93.72 b	5.72 bc	7.06 bc	107.30 bcde	70.97 cde	9.53 cd	12.44 a	23.33 abc
No. 632	98.81 b	5.56 bc	7.06 bc	100.90 bcde	71.98 cde	9.44 cd	10.57 defg	22.79 e
No. 725	122.56 a	7.67 a	8.83 a	105.27 bcde	81.32 ab	11.84 ab	11.66 bc	22.32 g
No. 677	123.78 a	6.84 ab	8.00 ab	115.04 bc	77.02 abc	10.83 abc	10.09 ghi	23.37 ab
No. 668	96.13 b	5.17 c	7.11 bc	87.60 e	71.76 cde	10.36 abcd	9.80 hi	22.31 g
No. 681	98.78 b	5.50 c	7.22 bc	89.90 de	71.45 cde	9.41 cd	12.24 ab	23.42 a
SS-1	98.45 b	4.67 c	7.22 bc	87.82 e	71.30 cde	9.83 bcd	10.21 ghi	22.57 f
S-141	96.78 b	5.55 bc	6.89 bc	90.22 de	71.14 cde	10.68 abc	10.33 fgh	22.81 e
LSD (0.01)	14.83	1.32	1.25	20.52	8.55	2.05	0.62	0.13

Means followed by the same letters do not differ significantly at 1% level of probability.

forage intake. The results of determination of these parameters are presented in Table 2.

It is apparent from Table 2 that cultivars No. 656 and No. 681 had the highest crude protein content (12.44 and 12.24% respectively). The variety No. 725 was statistically similar to No. 681 and hybrid PD2-LV65 x Fulgrain was statistically similar to cultivar No. 725 in crude protein content. The cultivars/hybrid No. 616, S-81, No. 632, Avon x Early Miller and S-141 were medium in crude protein content. The variety Avon had the lowest crude protein content.

The highest crude fibre content was observed in cultivar No. 681, followed by No. 677 and No. 656. The varieties No. 725 and No. 668 had minimal crude fibre content. It is well known that the lower the crude fibre content in a feed, the better its intake and digestibility will be, as reported by Muhammad *et al.* [13].

It was concluded from the above results and discussion that oat cultivar No. 725 was superior to all the other cultivars in forage yield and quality. This cultivar produced maximum green fodder and dry matter yields through taller plants, more tillers per plant and higher number of leaves per tiller. It also produced good quality fodder with high crude protein and low crude fibre contents. This cultivar is recommended for general cultivation for maximum forage yield and good quality fodder for livestock. The other high yielding cultivar that is also high in crude protein is PD2-LV65 x Fulgrain. Cultivars S-141, No. 677 and PD2-LV65 are also superior yielding but ranked lower in crude protein and high in crude fibre. No. 668 yielded well and had low crude fibre, but also ranked among the lowest in crude protein. These cultivars can be further utilized in breeding programmes for the replacement of local outmoded cultivars with poor fodder yield and quality potential.

References

1. B.N. Reddy and S.D. Rai, Forage Res., **3**, 153 (1977).
2. M.D. Kabhapur, V.B. Nodaguda, Prithwiraj and B.M. Biradar, Current Research, **1**, 12 (1979).
3. N.R. Riveland, D.O. Erickson and E.W. French, North Dakota Farm Res., **35**, 19 (1977).
4. A.S. Gill, J. T. Karnani and R.K. Maurya, Indian J. Agron., **2**, 217 (1977).
5. D.N. Dhumale and S.N. Mishra, Indian J. Agric. Sci., **49**, 918 (1979).
6. M.H. Chaudhry, Progressive Farming, **3**, 33 (1983).
7. G.S. Balyk and G.P. Voronkin, Seleksia i Semenorodstvo, **12**, 26 (1980).
8. M.H. Chaudhry and M.A. Mukhtar, Pak. J. Agric. Res., **6**, 218 (1985).
9. J. Toxler, J.F. Colland, J. Lehmann and F. Weilenamnn, Mitteilwngen for Die Schweizerische Landwirschft, **28**, 96 (1980).
10. M.B. Bhatti, A. Hussain and D. Muhammad, Pak. J. Agric. Res., **13**, 184 (1992).
11. P.J. Van Soest, Ass. Agric. Chem., **56**, 781 (1973).
12. J. Reardon, J.A. Foreman and R.L. Searcy, Clin. Chem. Acta., **14**, 403 (1966).
13. D. Muhammad, A. Hussain, Sartaj and M.B. Bhatti, Pak. J. Agric. Res. (1989), (in press).