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Yield and economics of oats (*Avena sativa* L.*)* as influenced by fertilizer and cutting management at different sowing dates

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Abstract
A field experiment was carried out to study the impact of fertility levels and cutting management on yield and economics of fodder oats at different sowing dates during *Rabi* seasons of 2009-10 and 2010-11 on silty clay loam soil. The crop sown on September 30 at par with September 20 and produced significantly higher herbage (green fodder) with the superiority of 41.97 and 43.56 percent over October 10 sowing during 2009-10 and 2010-11, respectively. The net returns of (Rs 34463) and B:C of (1.98) were recorded with September 30 sown crop. Application of 150+70+40 kg N:P_2O_5:K_2O ha^{-1} markedly increased mean green fodder yield by 7.00 and 19.58 per cent over 125+60+30 and 100+50+20 kg N:P_2O_5:K_2O ha^{-1}, respectively. Highest mean net returns (Rs. 32856) and B:C (1.82) were registered with highest fertility level. Double cut crop recorded 14.25 and 16.25 per cent increase in the green fodder yield over single cut crop during 2009-10 and 2010-11, respectively. The crop cut twice on December 15 and at 50 per cent flowering realised the highest mean net returns of Rs. 31105 with the B:C of 1.77.

Keywords: Cutting management, Economics, Forage yield, Oats, Quality

Introduction

Oat (*Avena sativa* L.) is a widely used fodder for the livestock particularly equine and milch animals. It is highly palatable, nutritious and energy rich fodder with average crude protein and crude fibre 6.8 and 39.5 - 40 per cent, respectively (Dar *et al.*, 2007). Besides it possess high regeneration ability. In the state of Jammu and Kashmir, livestock sector has great potential because of non-vegetarian food habits. In the state, the availability of dry fodder from pastures and cultivable land is 3.26 mt and there is a deficit of 1.05 mt (Anonymous, 2008) for 11 million livestock population. The pasture (both alpine and sub-alpine) is mostly inaccessible and the improvement in fodder production therein is a long process. The alternative left is to increase the productivity of fodder on cultivable lands so that fodder shortage is patched up as early as possible. Among various factors, some of the agronomic practices such as determining the optimum sowing dates, cutting management along with nutritional demand for obtaining maximum profitable forage yield per unit area to make the fodder available to livestock especially during lean period of winter was studied.

Materials and Methods

A field experiment was initiated during consecutive *rabi* seasons of 2009-10 and 2010-11 at Shalimar campus of Sher-E-Kashmir University of Agricultural Sciences and Technology, Kashmir on silty clay loam soil, high in organic carbon (0.91), low in available nitrogen (262.89 kg ha^{-1}), medium in available phosphorus (21.03 kg ha^{-1}) and potassium (165.25 kg ha^{-1}) with neutral pH (6.8). The treatments consisting of three sowing dates (September 20, September 30 and October 10), three fertility levels (150+70+40, 125+60+30,100+50+20 kg N: P_2O_5:K_2O ha^{-1}) and two cuttings (single cut and double cut) were laid out in randomized block design with three replications. Oat variety ñSabzaròwas sown as per treatment in rows 23 cm apart @100 kg ha^{-1}. The fertilizers were applied as per treatment with half dose of nitrogen and full dose of phosphorus and potassium in the form of urea, DAP and MOP as basal and the remaining half of nitrogen was top dressed in two equal splits one each at 30 DAS and 1st week of March. The observations on the plant height, number of tillers m^{-2}, green fodder and dry fodder yield were recorded both at 1st cut and 2nd cut. Plant samples collected over 25 cm row length from each plot were sun dried followed by oven drying at 60-65^{o}C to a constant weight. The sample was finely ground and analysed for nitrogen content by Modified Kjeldals method (Jackson, 1967) and was multiplied with 6.25 to calculate the protein productivity. The relative economics was determined as per prevalent market rate of inputs and outputs at the time of study. The data was analysed by the method given by Cochran and Cox (1963).

Results and Discussion

Sowing dates

Analysis of data revealed that the September 30 sown crop at par with September 20 recorded significantly higher mean green fodder yield with the superiority of 42.75 per cent over October 10 sown crop (Table 1). Higher forage yield in early sown crops may be attributed to significantly higher plant height and number of tillers m^{-2} recorded at 1st cut on December 15. Though the late sown crop (October 10) gained rapid pace with respect to plant height and tiller production after 1st cut but could not compensate the yield to remain at par with early sown crops (September 20 and 30). Delayed sowing exposes crop to unfavourable environment and drastically decrease yield. The quality of produce as inferred from crude protein yield was better in September 30 and 20 sown crops, which could be attributed to higher dry fodder yield under early sown crops. Similar results were reported by Reddy *et al.* (2003) and Namgyal (2009).

Fertility levels

The highest fertility level of 150+70+40 kg $N:P_2O_5:K_2O$ ha^{-1} recorded significantly higher total green and dry fodder yield (Table 1). A mean increase of 6.92 and 19.58 per cent in green fodder yield was recorded with150+70+40 kg $N:P_2O_5:K_2O$ ha^{-1} over 125+ 60+30 and 100+50+20 kg $N:P_2O_5:K_2O$ ha^{-1}.The improvement in the yield could be attributed to improved growth parameters viz; plant height and tiller number m^{-2}. Similar findings were observed by Pathan *et al.*, (2007) and Iqbal *et al.*, (2009). The crude protein yield increased significantly up to 150+70+40 kg $N:P_2O_5:K_2O$ ha^{-1}, during both years (Table 1). This could be attributed to vigorous vegetative growth with higher nitrogen content.

Cutting levels

Double cut crop recorded significantly higher green and dry fodder yield than single cut crop (Table 1). Although single cut crop far exceeded the double cut crop with respect to yield attributes at final harvest (50 % flowering), but the total yield realised from 1st and 2nd cut under double cut was higher. Similar findings have also been reported by Singh and Dubey (2007). The data further indicated that the quality of the produce was significantly better in double cut crop in comparison to single cut crop at 50 per cent flowering due to higher cumulative dry fodder yield.

Economics

Crop sown on September 30 proved to be economical in terms of higher net returns and B:C ratio of Rs. 34463 and 1.98, respectively (Table 1). Net returns and benefit cost ratio increased with increase in fertility levels from

Table 1. Effect of sowing dates, fertility levels and cutting management on biomass production, crude protein yield and economics of oats

Treatment	Dry herbage yield (q ha^{-1})		Green herbage yield (q ha^{-1})			Crude protein yield (q ha^{-1})		Cost of cultivation (Rs ha^{-1})*	Net returns (Rs ha^{-1})*	B:C ratio
	2009-10	2010-11	2009-10	2010-11	Mean	2009-10	2010-11			
Sowing dates										
September, 20	104.79	97.39	379.47	359.40	369.43	8.90	8.21	17277	32546	1.87
September, 30	105.00	99.04	382.85	364.50	373.67	9.05	8.42	17277	34463	1.98
October, 10	83.99	79.25	269.63	253.90	261.76	7.44	7.00	17277	23681	1.36
SE(m)±	1.21	1.28	3.86	4.22		0.07	0.09	-	-	-
CD (p=0.05)	3.51	3.72	11.45	12.18		0.21	0.25	-	-	-
Fertility levels (N: P_2O_5: K_2O kg ha^{-1})										
150 : 70 : 40	103.71	99.68	370.54	354.58	362.56	9.26	8.84	17990	32856	1.82
125 : 60 : 30	97.06	93.90	344.43	333.71	339.07	8.42	7.98	17278	30615	1.77
100 : 50 : 20	93.01	82.06	316.88	289.50	303.19	7.84	6.82	16563	27219	1.64
SE(m)±	1.21	1.28	3.86	4.22	-	0.07	0.09	-	-	-
CD (p=0.05)	3.51	3.72	11.45	12.18	-	0.21	0.25	-	-	-
Cutting levels										
Single cut	95.40	89.27	320.32	301.44	310.88	8.10	7.25	16919	29355	1.72
Double cut	100.40	94.51	367.59	350.41	359.00	8.90	8.28	17634	31105	1.77
SE(m)±	0.99	1.05	3.24	3.45	-	0.06	0.07	-	-	-
CD (p=0.05)	2.86	3.03	9.34	9.94	-	0.17	0.20	-	-	-

* On the basis of mean of two years, ** Dry herbage @ Rs.500 q ha^{-1}

100+50+20 to 150+70+40 kg N:P_2O_5:K_2O ha^{-1}. The crop recorded net returns of Rs. 32856 and B:C of 1.82 with highest fertility level. Double cut treatment comprising of forage cut twice on December 15 and at 50 per cent flowering realised 6.0 per cent higher net returns over single cut crop. Similarly higher B:C ratio of 1.77 was registered with double cut crop.

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