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INFLUENCE OF DATES OF SOWING, CULTIVARS AND DIFFERENT FERTILITY LEVELS ON ECONOMICS OF FODDER OAT (*AVENA SATIVA* L.) UNDER TEMPERATE CONDITIONS OF KASHMIR VALLEY

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SUMMARY

A study was conducted at Research Farm of Division of Agronomy, Shalimar campus of SKUAST-Kashmir during **rabi** 2009-10 and 2010-11 to study the influence of dates of sowing, varieties and fertility levels on the economics of forage oat. The soil of the experimental field was silty clay loam, low in available nitrogen, medium in available phosphorus and potassium with neutral pH. The experiment was laid out in split plot design, having two dates of sowing (D_1) 5 October and D_2 (5 November), three varieties V_1 (Sabzar), V_2 (SKO-20) and V_3 (SKO-108) and four fertility levels F_1 (50+25+15 kg/ha, N, P_2O_5, K_2O), F_2 (100+50+25 kg/ha N, P_2O_5, K_2O), F_3 (150+175+35 kg/ha N, P_2O_5, K_2O), F_4 (200+100+45 kg/ha, N, P_2O_5, K_2O). Treatments included combination of two dates of sowing and three varieties assigned to main plots and four fertility levels assigned to sub-plots with three replications. The results revealed that early date of sowing D_1 (5 October) recorded highest net profit and benefit cost ratio of Rs. 80,312.66/ha and 3.38 for SKO-108 variety (V_3) and F_4 (200+100+45 kg/ha N, P_2O_5, K_2O) fertility level ($D_1V_3F_4$) treatment combination and lowest corresponding values with treatment combination 5 November. Date of sowing, variety Sabzar (V_1) and F_1 (50+25+15 kg/ha, N, P_2O_5, K_2O) fertility level ($D_2V_1F_1$) were Rs. 11,107.83/ha and 0.56 and F_1 (50+25+15 kg/ha, N, P_2O_5, K_2O) and fertility level ($D_2V_1F_1$) were Rs. 11,107.83/ha and 0.56.

Key words : Sowing dates, cultivars, fertility levels, relative economics

INTRODUCTION

Oat (*Avena sativa* L.) is important winter forage and cereal crop in north-western regions of India due to congenial climate for this crop in these regions owing to its excellent growth habit, quick regrowth after cutting and high nutritive value for both milch and draught livestock, its popularity as fodder crop is increasing. As oat crop is generally sown in the month of November, the effect of early and delayed sowing on green fodder yield and other quality parameters need to be studied under temperate valley conditions of Kashmir to identify the ideal sowing time to exploit the full production potential of this crop. To increase the fodder yield under restricted growth conditions of temperate Kashmir, there is need to identify higher yielding genotypes which may compensate the much arising green fodder demand during winter/spring months. Since oat is responsive to nitrogen fertilization, the cost of fertilizer being very high necessitates to find the ways and means to minimise the fertilizer requirement of a crop without reduction in yield for higher economic returns.

MATERIALS AND METHODS

A field experiment was conducted at Research Farm of Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar campus during **rabi** seasons of 2009-10 and 2010-11. The experiment was laid out in split plot design and replicated thrice. The treatment combinations comprised two dates of sowing D_1 (5 October) and D_2 (5 November), three varieties V_1 (Sabzar), V_2 (SKO-20) and V_3 (SKO-108) and four fertility levels F_1 (50+25+15 kg/ha, N, P_2O_5, K_2O), F_2 (100+50+25 kg/ha N, P_2O_5, K_2O), F_3 (150+75+35 kg/ha N, P_2O_5, K_2O), F4 (200+100+45 kg/ha, N, P_2O_5, K_2O). The soil of the experimental field was silty clay loam, low in available nitrogen, medium in available phosphorus and potassium with neutral pH. Half dose of nitrogen and full dose of phosphorus and potassium was applied at the time of sowing and the remaining half was applied in two equal splits-one each at tillering and before heading stage. The crop was harvested for green fodder at 50 per cent flowering stage. Relative

economics of all treatment combinations was worked out on the basis of green fodder yield of oat. The cost of input and output was estimated as per prevailing market rates at the time of experimentation. The benefit : cost ratio (returns per rupee invested) was determined as :

$$\text{Benefit cost ratio} = \frac{\text{Net return}}{\text{Total cost of cultivation}}$$

RESULTS AND DISCUSSION

Interaction Effect on Green Fodder Yield

Interaction effect (Table 1) as influenced by date of sowing and fertility levels revealed that at same date of sowing increasing levels of fertility at early sowing date (D_1) significantly increased fodder yield up to F_4(200+100+45 kg ha^{-1} N, P_2O_5, K_2O) fertility level whereas at late sowing D_2 significant response of fertility levels was recorded up to F_3 (150+75+35 kg ha^{-1} N, P_2O_5, K_2O) level as difference between F_3 (150+75+35 kg ha^{-1} N, P_2O_5, K_2O) and F_4 (200+100+45 kg ha^{-1} N, P_2O_5, K_2O) was not significant in 2009-10. Similar trend was recorded during 2010-11.

At same level of fertility difference between dates of sowing was not significant at F_1 (50+25+15 kg ha^{-1}, N, P_2O_5, K_2O) and F_3 (150+75+35 kg/ha N, P_2O_5, K_2O) level of fertility in 2009-10. Whereas in 2010-11, at all fertility levels difference between sowing dates was significant with regard to green fodder yield.

Interaction effect (Table 2) as influenced by varieties of oat and fertility levels revealed that at the same level of variety increasing levels of fertility increased green fodder yield up to F_3 (150+75+35 kg ha^{-1} N, P_2O_5, K_2O). Fertility level F_4 (200+100+45 kg ha^{-1} N, P_2O_5, K_2O) was at par with F_3 (150+75+35 kg ha^{-1} N, P_2O_5, K_2O) with regard to variety Sabzar and SKO-108. Whereas, increasing levels of fertility with respect to variety SKO-20 F_4 (200+100+45 kg ha^{-1} N, P_2O_5, K_2O) recorded significant yield over other fertility levels in both the years.

At same level of fertility level, SKO-108 recorded significantly highest green fodder yield over SKO-20 and Sabzar at all fertility levels in both the years. Highest green fodder yield 492.6 q/ha was recorded with

TABLE 1
Green fodder (q ha^{-1}) as influenced by the interaction of dates of sowing and fertility levels at flowering stage

Treatments	Fertility levels (N, P_2O_5, K_2O)							
	2009-10				2010-11			
	F_1 50+25+15	F_2 100+50+25	F_3 150+75+35	F_4 200+100+45	F_1 50+25+15	F_2 100+50+25	F_3 150+75+35	F_4 200+100+45
5th October (D_1)	240.88	345.16	384.66	431.27	263.10	327.79	381.08	425.35
5th November (D_2)	233.63	285.71	378.73	394.84	182.59	241.77	292.73	330.12
	S. Em±	C. D. (P=0.05)			S. Em±	C. D. (P=0.05)		
Dates at the same level of fertility	9.62	28.21			15.37	45.50		
Fertility at the same level of dates	9.10	26.11			13.55	40.25		

TABLE 2
Green fodder yield (q/ha) as influenced by interaction of varieties and fertility levels at flowering stage

Treatments	Fertility levels (N, P_2O_5, K_2O)							
	2009-10				2010-11			
	F_1 50+25+15	F_2 100+50+25	F_3 150+75+35	F_4 200+100+45	F_1 50+25+15	F_2 100+50+25	F_3 150+75+35	F_4 200+100+45
Sabzar (V_1)	187.05	213.74	332.00	308.77	199.47	254.08	300.17	339.52
SKO-20 (V_2)	248.49	330.89	350.56	438.24	209.32	275.38	329.38	371.65
SKO-108 (V_3)	276.22	401.68	462.51	492.64	259.74	324.89	381.17	422.02
	S. Em±	C. D. (P=0.05)			S. Em±	C. D. (P=0.05)		
Varieties at the same level of fertility	9.62	28.21			12.00	35.28		
Fertility at the same level of variety	11.15	31.98			14.15	41.47		

treatment F_4 (200+100+45 kg ha^{-1} N, P_2O_5, K_2O) and V_3 in 2009-10. Corresponding value for the year 2010-11 was 422.0 q/ha.Kakol *et al.* (2003), Albrecht *et al.* (2006) and Joshi *et al.* (2010) reported similar findings.

Dates of sowing x fertility levels

Data in Table 1 revealed that at same date of sowing increasing levels of fertility at early date of sowing significantly increased green fodder yield up to F_4 (200+100+45 kg ha^{-1} N, P_2O_5, K_2O) highest fertility level, whereas at late sowing significant response of fertility levels was recorded up to F_3 (150+75+35 kg ha^{-1} N, P_2O_5, K_2O) level as difference between F_3 (150+75+35 kg/ha N, P_2O_5, K_2O) and F_4 (200+100+45 kg ha^{-1} N, P_2O_5, K_2O) was not significant in 2009-10. Similar trend was recorded during 2010-11. This may be due to higher plant height, more number of tillers, higher leaves tiller^{-1}, higher LAI, RGR, dry matter accumulation with early date of sowing and in response to increasing levels of fertility. At lower levels of fertility, dates of sowing did not exhibit any significant difference.

Varieties x fertility levels

Interaction effect (Table 2) revealed that at same level of variety increasing levels of fertility increased green fodder yield up to F_3 (150+75+35 kg/ha N, P_2O_5, K_2O). Fertility level F_4 (200+100+45 kg/ha N, P_2O_5, K_2O) was at par with F_3 (150+75+35 kg/ha N, P_2O_5, K_2O) with regard to variety Sabzar and SKO-108, whereas increasing levels of fertility with respect to variety SKO-20 (V_2) F_4 (200+100+45 kg/ha N, P_2O_5, K_2O) recorded significant yield over other fertility levels in both the years. This may be attributed to lesser number of tillers, lower values of LAI, lower dry matter accumulation and genetic character of varieties.

SKO-108 (V_3) recorded significantly highest green fodder over SKO-20 and Sabzar at all fertility levels in both the years. This is due to superiority of SKO-108 in yield attributes like tillers, leaves tiller^{-1}, dry matter accumulation, RGR. Moreover, it may be attributed to genetic potential of this variety which resulted in highest green fodder yield at all fertility levels in both the years.

Relative Economics

Economics in terms of net returns and benefit : cost ratio with respect to green fodder yield of oat (*Avena sativa* L.) was worked out on pooled basis for various treatment combinations. It is evident from the data (Table 3) that net returns and benefit : cost ratio increased consistently up to F_4 level of fertility i. e. (200+100+45 kg/ha N, P_2O_5, K_2O) for all treatment combinations except $D_2V_3F_4$ (5 November date of sowing, SKO-108 and 200+100+45 kg/ha N, P_2O_5, K_2O). Highest net profit and benefit : cost ratio of Rs. 80,312.66/ha and 3.38 were recorded for 5 October date of sowing (D_1) for SKO-108 variety (V_3) and F_4 (200+100+45 kg/ha N, P_2O_5, K_2O).

Fertility level ($D_1V_3F_4$) treatment combination and lowest corresponding values were with treatment combination 5 November. Date of sowing, variety Sabzar (V_1) and F_1 (50+25+15 kg/ha, N, P_2O_5, K_2O) fertility level ($D_2V_1F_1$) were Rs. 11,107.83/ha and 0.56.

In general, earlier date of sowing 5 October recorded comparatively higher net returns and benefit cost ratio compared to delayed sowing 5 November. SKO-108 obtained higher values of net returns and benefit : cost compared to SKO-20 and Sabzar.

Pooled economics in terms of net returns and benefit : cost ratio with respect to green fodder yield of oat (*Avena sativa* L.) was worked out for various treatment combinations. Data in Table 1 reveal that net returns and benefit : cost ratio increased consistently up to F_4 (200+100+45 kg P_2O_5 and K_2O) level of fertility for all treatment combinations except $D_2V_3F_4$ (5th November date of sowing, SKO-108 and F_4 200+100+45 kg/ha N, P_2O_5, K_2O). Highest net profit and benefit cost ratio of Rs. 80,312.66/ha and 3.38 were recorded for 5 October date of sowing (D_1) for SKO-108 (V_3) variety and fertility level F_4 200+100+45 kg/ha N, P_2O_5, K_2O ($D_1V_3F_4$) treatment combination and lowest corresponding values. With treatment combination 5 November, date of sowing (D_2), variety Sabzar (V_1) and 50+25+15 kg/ha N, P_2O_5, K_2O fertility level ($D_2V_1F_1$) which were Rs. 11,107.83/ha and 0.56. The significant highest green fodder yield recorded by early date of sowing 5 October (D_1) during both the years, variety SKO-108 (V_3) recorded significantly highest green fodder yield during both the years, fertility level F_4 (200+100+45 kg/ha N, P_2O_5, K_2O) may have resulted in highest net returns and benefit : cost ratio. Same trend was reported by Sharma *et al.* (2001), Sharma and Bhunia (2001), Sharma and Verma (2005) and Sarkar and Mahasin (2007).

TABLE 3
Relative economics of oats (Rs./ha) as influenced by various treatments (pooled)

Treatment	Green fodder yield (q/ha)	Total cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B : C ratio
$D_1V_1F_1$	233.02	19594.50	46604.00	27009.50	1.37
$D_1V_1F_2$	279.04	20818.00	55809.33	34991.33	1.68
$D_1V_1F_3$	333.73	22262.50	66746.33	44483.83	1.99
$D_1V_1F_4$	356.25	23707.00	71250.00	47543.00	2.00
$D_1V_2F_1$	228.76	19594.50	45752.00	26157.50	1.33
$D_1V_2F_2$	317.66	20818.00	63532.66	42714.66	2.05
$D_1V_2F_3$	358.72	22262.50	71745.00	49482.50	2.22
$D_1V_2F_4$	408.58	23707.00	81716.66	58009.66	2.44
$D_1V_3F_1$	294.19	19594.50	58838.33	39243.83	2.00
$D_1V_3F_2$	412.73	20818.00	82547.33	61729.33	2.96
$D_1V_3F_3$	458.16	22262.50	91223.00	68970.50	3.09
$D_1V_3F_4$	520.09	23707.00	104019.66	80312.66	3.38
$D_2V_1F_1$	153.51	19594.50	30702.33	11107.83	0.56
$D_2V_1F_2$	188.77	20818.00	37755.00	16937.00	0.81
$D_2V_1F_3$	298.45	22262.50	59690.33	37427.83	1.68
$D_2V_1F_4$	291.55	23707.00	58310.33	34603.33	1.45
$D_2V_2F_1$	229.05	19594.50	45811.00	26216.50	1.33
$D_2V_2F_2$	288.61	20818.00	57722.33	36904.33	1.77
$D_2V_2F_3$	321.22	22262.50	64244.66	41982.16	1.88
$D_2V_2F_4$	401.32	23707.00	80264.33	56557.33	2.38
$D_2V_3F_1$	241.78	19594.50	48356.33	28761.83	1.46
$D_2V_3F_2$	313.84	20818.00	62768.66	41950.66	2.01
$D_2V_3F_3$	387.52	22262.50	77505.00	55242.50	2.48
$D_2V_3F_4$	394.57	23707.00	78915.33	55208.33	2.32

D_1 = 5 October D_2 = 5 November V_1 = Sabzaar V_2 = SKO-20 V_3 = SKO-108

	N	P_2O_5	K_2O		N	P_2O_5	K_2O		N	P_2O_5	K_2O		N	P_2O_5	K_2O
F_1 =	50	25	15	F_2 =	100	50	25	F_3 =	150	75	35	F_4 =	200	100	45

Rate N : Rs. 12.13/kg P : Rs. 24.52/kg K : Rs. 9.16/kg Cost of green fodder : Rs.2/kg

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