Range Mgmt. & Agroforestry 35 (1) : 51-55, 2014
ISSN 0971-2070

Influence of dates of sowing, cultivars and different fertility levels on fodder oat (*Avena sativa* L.) under temperate conditions of Kashmir valley (India)

N. A. Dar*, K. N. Singh, Latief Ahmad, J. A. Sofi, M. Elyass Bhat and R. Kotru
Division of Agronomy, Sher-e- Kashmir University of Agricultural Sciences and Technology
Shalimar, Srinagar (J&K)-190025, India
*Corresponding author e-mail: naseerahdar@gmail.com
Received: 9th July, 2013 Accepted: 15th June, 2014

Abstract
A study was conducted at Kashmir valley during Rabi 2009-10 and 2010-11 to study the influence of dates of sowing, varieties and fertility levels on the yield and quality of forage oat. In split plot design, treatments included the 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 (5th October) recorded significantly higher values in growth attributes like plant height, tillers per metre row green fodder yield. The crude protein and crude fibre content was significantly higher with delayed sowing (5th November). Among varieties, Sabzar registered higher plant height than SKO-20 and SKO-108. SKO-108 showed significant superiority in tillers per metre row and green fodder yield. SKO-108 recorded highest green fodder yield during both years of investigation. Growth yield and quality parameters were significantly influenced with increasing levels of fertility being maximum with F_4 (200+100+45 kg ha^{-1}, N, P_2O_5, and K_2O).

Keywords: Cultivars, Fertility levels, Green fodder yield, Oats, Quality, Sowing dates

Introduction

Oat (*Avena sativa* L.) is an important winter cereal forage crop in north-western regions of India due to congenial climate leading to excellent growth, quick regrowth and high nutritive value for both milch as well as draught livestock. 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 for exploiting the full production potential. 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 felt green fodder demand during winter / spring months. Oat being responsive to nitrogen fertilization and considering the high cost of fertilizer, we need to minimise the fertilizer requirement of a crop without reduction in yield.

Materials and Methods

A field experiment was conducted at Research Farm of Division of Agronomy, Sher-e-Kashmir University of Agriculture Sciences & Technology of Kashmir, Shalimar campus during *Rabi* seasons of 2009-10, 2010-11. The experiment was laid out in split plot design and replicated thrice. The treatment combinations comprised of two dates of sowing, D_1 (5th October) and D_2 (5th 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^{-1}, N, P_2O_5, K_2O), F_2 (100+50+25 kg ha^{-1} N, P_2O_5, K_2O), F_3 (150+75+35 kg ha^{-1} N, P_2O_5, K_2O), F_4 (200+100+45 kg ha^{-1}, N, P_2O_5, K_2O). The soil of the experimental field was silty clay loam medium in available nitrogen (405 kg/ha), medium in available phosphorus (28 Kg/ha) and potassium (250 kg/ ha) with neutral pH (7.0). 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, at tillering and before heading stage (200 DAS). The crop was harvested for green fodder at 50 per cent flowering stage. A fresh sample taken from each treatment at pre-heading/ harvest stage was oven dried at 60-65°C to a constant weight, ground and subsequently used for quality analysis.

Results and Discussion

Plant height: Plant height was significantly higher with early sowing (5th October) harvested on 24th April than (5th November) sowing harvested on 5th May (Table 1). This may be attributed to longer growth period and better weather conditions under early date of sowing. Similar findings were reported by Bali *et al*. (1998). Sabzar (V_1) recorded highest plant height of 121.45 cm at harvest, which may be attributed to its higher plant height for its quick germination and early vegetative phase than SKO-

108 (V_3) which is a late maturing variety and has a dwarf character. Graded fertility levels from F_1 (50+25+15 kg ha-1, N, P_2O_5, K_2O) to F_4 (200+100+45 kg ha-1, N, P_2O_5, K_2O) significantly increased plant height. Maximum plant height (113.8 cm) was recorded with highest fertility level F_4 at harvest which was significantly higher than F_1 and recorded consistently an increasing trend till harvest. This may be due to the reason that nitrogen being a key element in oat fertility management and essential constituent of plant tissue; induced rapid cell division and elongation and may have favoured plant height. (Sood and Sharma, 1996; Bali *et al*., 1998; Hasan and Shah, 2000).

Tiller per metre row: Early date of sowing (5th October) recorded higher number of tillers per metre row than delayed sowing (5th November) (Table 1). The delayed sowing significantly reduced tillers per metre row length which may be attributed to delayed germination and slow growth due to low temperature. This is in conformity with the findings of Bali *et al*. (1998). Significantly highest number of tillers per metre row was recorded with SKO-108 (V_3). The higher number of tillers per metre row may be ascribed to better vegetative vigour, broad leaf area in SKO-108 (V_3), than Sabzar (V_1) and SKO-20 (V_2). These findings are in line with that of Sood and Sharma (1996).

Fertility effect was marked in both the years on tillers per metre row. Significantly higher number of tillers was recorded with fertility level F_4 than F_3, F_2 and F_1. Balanced fertilization especially higher nitrogen content created condition for better vegetative growth which was responsible for more tillering in oat crop. Moreover the abundant supply of N may have increased protoplasmic constituents and accelerated the process of cell division and elongation resulting in luxuriant vegetative growth and more number of tillers. Application of phosphorus supplies energy for growth and other increase in number of tillers per metre row. Results are in conformity with findings of Bali *et al*. (1998); Hasan and Shah (2000).

Dry matter accumulation: Dry matter accumulation exhibited significant increase from 150 DAS till harvest (Table 1). A distinct increase in dry matter accumulation was observed consistently at all stages. Early sowing date, 5th October (D_1) produced significantly more dry matter at all growth stages as compared to 5th November (D_2) sowing (Table 1).The dry matter accumulation at harvest was 68.55 ha^{-1} which was 25.63 percent higher over late sown crop at harvest. Significant variation among varieties was observed in dry matter accumulation at all growth intervals barring 150 DAS. A consistent increase was registered till harvest. SKO-108 (V_3) recorded higher dry matter accumulation than Sabzar (V_1) and SKO-20 (V_2) at all growth stages except at 150 DAS where Sabzar was at par with SKO-108. At harvest, the magnitude of increase in dry matter accumulation was 29.62 per cent and 13.63 per cent in SKO-108 over Sabzar and SKO-20.

Application of various graded fertility levels of N, P_2O_5, K_2O had a significant effect on dry matter accumulation (Table 1). With increasing levels of fertility from F_1 to F_4, dry matter accumulation also increased significantly. Maximum dry matter accumulation (73.11 q ha^{-1}) was recorded with F_4 at harvest. The magnitude of increase was 19.49, 21.88, and 31.63 per cent over F_3, F_2 and F_1 respectively.

Green fodder yield: Early sowing (5th October) recorded significantly higher yield than delayed sowing (5th November) (Table 2). The higher green fodder yield in case of early sowing date may be ascribed to its superiority over delayed sowing in respect of various yield attributes such as plant height, number of tillers per metre row which all were enhanced due to higher temperature at early growth stage. Variety SKO-108 (V_3) recorded significantly highest green fodder yield (377.61q ha^{-1}) over other varieties. The superiority of SKO-108 (V_3) may be due to its more vigour, broad leaf, thick stem and longer growth duration. Similar trend was noticed by Sood and Sharma (1996); Choubey *et al*. (2001); Patel (2003); May William *et al*. (2004); Pathan *et al*. (2007); Joshi and Sheoran (2010).

Dry fodder yield: Early sowing (5th October) significantly recorded higher dry fodder yield (73.18 q ha^{-1}) than delayed (5th November) sowing (66.61 q ha^{-1}) (Table 2). Variety SKO-108 recorded significantly higher yield than SKO-20 and Sabzar whereas SKO-20 was significantly higher than Sabzar. The magnitude of superiority recorded by SKO-108 over SKO-20 and Sabzar was 10.61 and 20.64 per cent respectively. Variety SKO-20 showed a superiority of 11.22 over Sabzar. Highest dry fodder yield of (72.3 q ha^{-1}) was recorded with highest fertility dose of F_4. The graded levels of fertility from F_1 to F_4 significantly increased dry fodder yield. The increase in dry fodder yield was significantly higher in F_2 in 2009-10 than F_1. The magnitude of superiority exhibited by F_2 over F_1 was 2.61 per cent. The magnitude of superiority exhibited by F_4 over F_3, F_2 and F_1 was 1.99, 4.39 and 6.90 per cent respectively.

Table 1. Pooled data of growth parameters of Oats as influenced by dates of sowing, varieties and fertility levels

Treatments	Plant height			Tiller per meter row			Dry matter accumulation	
Dates of sowing	**50DAS**	**150DAS**	**At harvest**	**50DAS**	**150DAS**	**At harvest**	**150**	**At harvest**
5th Oct (D_1)	36.30	42.05	111.97	44.26	54.70	96.02	26.72	68.55
5th Nov (D_2)	13.65	37.50	92.53	23.86	48.37	87.14	21.24	50.98
SEm±CD	1.05	0.52	0.91	0.97	0.43	0.97	0.43	0.87
(P≤0.05)	3.15	1.65	2.87	2.92	1.38	3.11	1.36	2.77
Varieties								
Sabzar (V_1)	30.58	45.18	121.45	31.9	46.93	80.66	23.10	49.15
SKO-20 (V_2)	24.98	49.41	111.37	35.01	53.37	110.79	24.54	60.32
SKO-108 (V_3)	19.23	25.65	73.93	38.02	54.31	83.28	24.30	69.84
SEm±	1.32	0.64	1.11	1.1	0.53	1.20	0.53	1.07
CD (P≤0.05)	4.16	2.035	3.51	3.17	1.69	3.80	1.67	3.4
Fertility levels (Kg/ha)								
N P_2O_5 K_2O								
50 25 15(F_1)	15.95	29.60	88.44	28.73	41.16	80.65	19.71	49.98
100 50 25 (F_2)	24.20	41.91	100.31	32.21	54.74	90.70	22.28	57.11
150 75 35(F_3)	27.10	42.74	106.41	35.17	50.91	88.34	25.32	58.86
200 100 45(F_4)	32.47	46.08	113.85	40.13	59.33	106.63	28.62	73.11
SEm±	0.66	0.85	0.79	0.71	0.29	0.59	0.23	0.54
CD (P≤0.05)	1.91	2.44	2.30	1.98	0.85	1.75	0.66	1.57

Table 2. Pooled data of quality and yield of Oats as influenced by dates of sowing, varieties and fertility levels

Treatments	Crude protein content (%)		Crude fibre (%)		Ash content		Green fodder yield (q/ha)	Dry fodder yield (q/ha)
Dates of sowing	**Pre-heading**	**At harvest**	**Pre-heading**	**At harvest**	**Pre-heading**	**At harvest**		
5th Oct (D_1)	8.61	7.56	32.78	33.68	8.17	8.86	349.91	73.18
5th Nov (D_2)	10.21	11.62	33.39	34.31	8.25	8.93	292.51	66.61
SEm±CD	0.29	0.31	0.125	0.012	0.095	0.05	5.15	0.48
(P≤0.05)	0.045	0.42	0.40	0.20	NS	NS	16.22	1.52
Varieties								
Sabzar (V_1)	8.85	9.31	32.49	33.51	7.70	8.42	266.78	61.92
SKO-20 (V_2)	10.51	9.00	32.98	33.72	8.09	8.91	319.24	69.75
SKO-108 (V_3)	8.86	10.44	33.78	34.58	8.84	9.35	377.61	78.03
SEm±	0.18	0.16	0.15	0.017	0.11	0.06	6.30	1.36
CD (P≤0.05)	0.58	0.52	0.49	0.25	0.36	0.21	19.88	1.86
Fertility levels (Kg/ha)								
N P_2O_5 K_2O								
50 25 15(F_1)	7.87	8.80	33.19	34.25	8.58	9.02	230.04	67.31
100 50 25 (F_2)	9.74	9.98	33.04	33.82	8.16	8.83	300.10	69.12
150 75 35(F_3)	10.57	10.01	33.32	34.23	8.13	8.86	359.30	70.86
200 100 45(F_4)	9.45	9.56	32.80	33.23	7.98	8.88	395.39	72.30
SEm±	0.11	0.095	0.19	0.065	0.09	0.07	4.37	0.46
CD (P≤0.05)	0.32	0.29	NS	0.20	0.29	NS	12.54	1.32

Crude protein content: Crude protein Content per cent was significantly higher with delayed sowing (5th November) at pre-heading stage (Table 2). Similar trend was recorded at harvest stage in both the years. Higher crude protein content with 5th November (D_2) sowing might be due to the reason that fewer yields gives more crude protein and higher yield gives less crude protein due to dilution effect. Various cultivars showed a significantly marked difference in crude protein content (%) in both the years at pre-heading and at harvesting stage except at pre-heading and harvesting stage where difference between SKO - 108 and Sabzar was not significant. The

variation in crude protein content might be due to the difference in genetic constitution of various varieties.

Highest value of 10.51 per cent crude protein content at pre-heading stage which was significantly higher than Sabzar (V_1) and SKO-108 (V_3) was recorded by SKO-20 (V_2), which may be due it being an early maturing variety. These results are in conformity with Collins *et al*. (1990); Bali *et al*. (1998); Albrecht *et al*. (2006); Pathan *et al*. (2007). Increase in fertility levels from F_1, F_2 to F_3 recorded significant improvement in crude protein content. Maximum crude protein content (10.57) was recorded with highest fertility level of F_4 at pre-heading state. At harvest stage, crude protein increased significantly up to F_3 level of fertility and significantly decreased with increasing level of fertility from F_3 to F_4. This might be attributed to the dilution effect at highest N level.

The increase in crude protein content with successive increase in NPK was due to role of N in protein synthesis and role of P in synthesis of RNA and also role of K in activation of enzymes involved in protein synthesis. Similar results have been reported by Singh and Singh (1995); Singh *et al*. (1997); Bali *et al*. (1998); Shah and Hasan (1999); Hasan and Shah (2000); Kakol *et al*. (2003); Sarkar and Mahasin (2007); Pathan *et al*. (2007).

Crude fibre: Crude fibre showed a marked variation due to delayed sowing (5th November) at both pre-heading and harvesting stage of growth than early sowing (5th October). Maximum crude fibre content (34.58) was recorded by SKO-108 (V_3) at harvest (Table 2). SKO-108 being a late maturing variety recorded highest crude fibre content at harvest because the crude fibre content increases with increases in maturity. The results are in conformity with Kakol *et al*. (2003). Increasing levels of fertility had no effect on crude fibre content at pre-heading stage. However, at harvesting stage F_1 was significantly superior to other fertility levels except F_3. This is attributed to the fact that with the advancement in maturity increasing fertility levels and high nitrogen do not improve crude fibre content per cent.

Ash: Dates of sowing had no effect in ash content in pre-heading and at harvesting stage (Table 2). Among the varieties, SKO-108 (V_3) gave significantly higher ash content at pre-heading and harvest over SKO-20 (V_2) and Sabzar (V_1). This may be attributed to the fact that SKO-108 recorded higher biomass and dry matter which improved mineral matter. Increasing fertility levels had no significant influence on ash content at harvest. Dadheech *et al*. (2005) also reported similar results.

References

Albrecht, Kenneth, A. Francisco and E. Govea-Contreras. 2006. Forage production and nutritive value of oat in autumn and early summer. *Crop Sci.* 46: 2382-2386.

Bali, A. S., M. H. Shah., B. Hassan., A. S. Bali and K. N. Singh. 1998. Influence of various nitrogen, phosphorus and seed rates on herbage yield and quality of newly released oat genotype SK-0-7 (Sabzar) in temperate Kashmir. *Forage Res.* 24(2): 67-70.

Choubey, R. N., S. V. S Prasad and A. K. Roy. 2001. Study on variability, associations and path analysis in forage oat. *Range Mgmt. & Agroforestry* 22(1): 188-192.

Collins, M., M. A. Brinkman and A. A. Salman. 1990. Forage yield and quality of oat cultivars with increasing rates of nitrogen fertilization. *Agronomy J.* 82(4): 724-728.

Dadheech, R. C., A. K Verma and H. K. Sumeriya. 2005. Influence of legume mixture and nutrient levels on yield and quality of fodder oat (*Avena sativa* L.). *Forage Res.* 30(4): 179-183.

Hasan, B. and Shah Waseem. 2000. Biomass grain production and quality of oats (*Avena sativa* L.) under different cutting regimes and nitrogen levels. *Cereal Res. Commun.* 28(1-2): 203-210.

Joshi, U. N. and R. S. Sheoran. 2010. Agronomic evaluation of oat varieties for growth, forage yield and quality with varying levels of nitrogen under semi-arid conditions. *Forage Res.* 36(1): 32-33

Kakol, N. B., S. C. Alagubdagi and S.V. Hosamani. 2003. Effect of seed rate and nitrogen levels on forage yield and quality of oat (*Avena sativa* L.). *Indian J. Anim. Nutr.* 20(2): 149-154.

May William, E., M. Mohr Ramona, G. P. Lafond, M. Johnston Adrian and F. C. Stevenson. 2004. Early seeding dates improve oat yield and quality in the eastern prairies. *Can. J. Plant Sci.* 84: 431-42.

Patel, J. R. 2003. Effect of sowing dates on fodder yield of different crops during winter season. *Journal of Maharashtra Agriculture University* 28(2): 181-182.

Pathan, S. H., R. L. Bhilare, K. B. Nawale and V. T. Jadhav. 2007. Response of multicut oat varieties to nitrogen levels. *Forage Res.* 32(4): 269-270.

Sarkar, R. K. and D. M. Mahasin. 2007. Productivity, quality and profitability of oat (*Avena sativa*) based intercropping system under graded fertility levels. *Indian J. Agric. Sci.* 77(12): 862-865.

Shah, Waseem and B. Hasan. 1999. Grain and fodder yield of oats (*Avena sativa*) as influenced by nitrogen levels and cutting schedules. *Forage Res.* 24(4): 185-190.

Singh, A. and R. Singh 1995. Nutrient uptake and biomass production by oat varieties as influenced by moisture regimes and nitrogen application. *Ann. Agric. Res.* 16(3): 394-395.

Singh, K. N., A. S. Bali, B. Hasan, M. H. Shah, A. S. Bali and H. U. Khan. 1997. Effect of seed rate and nitrogen on biomass production and quality of oat (*Avena sativa*). *Indian J. Agron.* 42(2): 310-312.

Sood, B. R. and V. K. Sharma.1996. Comparative performance of barley and oat for fodder at varying levels of nitrogen under rainfed condition. *Forage Res.* 21(4): 174-176.