Forage Res., **42** (4) : pp. 263-266 (2017) **http://forageresearch.in**

NUTRIENT UPTAKE AND QUALITY OF OATS (*AVENA SATIVA* L.) AS INFLUENCED BY DIFFERENT AGRONOMIC PRACTICES

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(Received : 15 February 2017; Accepted : 28 March 2017)

SUMMARY

In view of the increasing demand for fodder, there is urgent need to maximize fodder production within the existing cropping systems. With this objective a field experiment was carried out in temperate environment during *rabi* seasons of 2009-10 and 2010-11 on silty clay loam soil to determine the impact of different sowing dates, fertility levels and cutting managements on growth, yield and quality of fodder oat. The treatments comprised of three sowing dates *viz*. 20 September., 30 September and 10 October; three fertility levels *viz.*, 150:70:40, 125:60:30 and 100:50:20 kg N:P_2O_5:K_2O kg/ha and two cutting management viz., single cut at 50% flowering and double cut on 15 December and 50% flowering stage. Late sowing resulted in poor crop growth and reduced green fodder yield to the tune of 42%. Green fodder yield (36.2 t/ha) and nutrient uptake were higher with the application of 150:70:40 N:P_2O_5:K_2O kg/ha. Double cutting practice produced more green fodder yield to the tune of 15.6 % over single cut crop.

Key words : Fertility levels, Sowing dates, Green fodder, Nutrient uptake, Oat, quality

India ranks first among the major livestock holding countries having about 15% livestock population of the world, however, milk production of our country is about 17%. Total livestock population of India is 512 million (2012-13). The present availability of green fodder is about 400 million tonnes projecting a deficit of 63.50% and that of dry fodder is around 466 million tonnes against the requirement of 609 million tonnes. Fodder and feed are the major inputs in animal production especially in milch animals, which accounts for about 60 to 70 % of total cost of milk production. The milk production can be easily increased by adequate supply of nutritious feed and fodder. Therefore, there is urgent need to maximise the tonnage and quality of fodder within the existing farming systems. Being highly nutritious, palatable and energy rich with good regeneration ability oat has become a promising forage crop for livestock production. Multi cut nature of the crop ensures continuous supply of fodder. Kashmir valley posses temperate type of climate, with snowfall and harsh conditions in the winter. Behaviour of crop under this condition is entirely different from rest of country, which can be modified through different agronomic manipulations to derive maximum benefits. Sowing time has great impact on fodder yield (Alam *et al*., 2005).

Oat (Avena sativa L.) is an important fodder crop and is fast growing and high yielding crop thus requires a large quantity of fertilizers N for enhancing production of quality of herbage (Singh and Dubey, 2007). It is an exhaustive crop considering its nutrient demand and puts heavy nutritional load on soil. Among the major nutrients, nitrogen plays a pivotal role in quantitative as well as qualitative improvement in productivity of fodders. It is an important constituent of protein and chlorophyll which imparts dark green colour to the plants and promotes early vegetative growth. It improves the quality by increasing the protein content of fodder crops and governs to a considerable utilization of potassium, phosphorus and other nutrients. In agronomic techniques fertilizer management is the most important aspect. Oats is exhaustive in nature, it is therefore essential that soil fertility is maintained to sustain higher yields. To improve supply of fodder over a period best cutting management needs to be evaluated. In view of these an experiment was undertaken to study the

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response of fodder oat to different sowing dates, fertility levels and cutting managements.

MATERIALS AND METHODS

The experiment was conducted during *rabi* seasons of 2009-10 and 2010-11 at Shalimar campus of Sher-e-Kashmir university of agricultural sciences and technology, Kashmir situated between 34°.05¢ N latitude and 74°.89¢ E longitude at an altitude of 1587 meters above mean sea level..The soil was silty clay loam with neutral *p*H (6.8), high organic carbon (0.91), low available nitrogen (262.89 kg/ ha), medium available phosphorus (21.03 kg/ ha) and potassium (165.25 kg/ ha). The precipitation was 383.70 and 428.10 mm during the cropping season of 2009-10 and 2010-11, respectively. The experiment was laid out in factorial randomized block design, having 18 treatment combinations with three replications. The treatments comprised of three sowing dates *viz*. 20 September., 30 September and 10 October; three fertility levels *viz.*, 150:70:40, 125:60:30 and 100:50:20 kg $N:P_2O_5:K_2O$ / ha and two cutting management viz., single cut at 50% flowering and double cut on 15 December and 50% flowering stage. The oat variety used was 'Sabzar' a selection from UPO-212. Light pre sowing irrigation was given during both the years of experimentation. Half dose of nitrogen and full dose of phosphorous and potassium was applied to each plot as per treatment through urea, Di-ammonium phosphate, and muriate of potash, respectively as basal. Remaining half dose of nitrogen was applied in two equal splits i.e. 30 days after sowing and first week of March, each after weeding. The green fodder yield from net plots, leaving border and penultimate rows, was recorded immediately after the harvesting. Representative Plant samples from 25 cm row length in penultimate rows were oven dried at 60-65^{0}c to a constant weight to determine dry matter content. The dried samples were finely powdered and digested. Crude protein was computed form N content in the plants multiplied by 6.65. Crude fiber and Ash content were determined by method described by A.O.A.C. (1995).

RESULTS AND DISCUSSIONS

Crop growth and yield

Growth parameters of fodder oat were significantly influenced by sowing dates, fertility and cutting management. Early sown crop recorded higher dry matter yield up to 120 days after sowing (Fig 1), which could be attributed to congenial weather for better germination, growth and development of the crop. Sowing on 10 October recorded significant increase in plant height and dry matter towards maturity, followed by 30 September sowing (Table 1 & Fig 1). This was attributed to better regeneration of growth after winter and longer growth period. Increase in the fertility level brought subsequent improvement in growth parameters. Application of higher dose of fertilizer 150:70:40 $N:P_2O_5:K_2O$ kg/ha resulted in higher values for plant growth and dry matter accumulation (Table 1 & Fig 2).This might be due to improvement in soil fertility with respect primary essential nutrients . These results are in line with those of Singh *et al.* (2005). Single cut crop recorded significantly higher plant height compared to double cut crop. This could be attributed to slow growth process (Fig. 3) after first cut during winter in the later treatment.

TABLE 1
Crop growth and quality of fodder oats as influenced by different dates of sowing, fertilizer and cutting management

Treatment	Plant height (cm)	Crude protein (%)	Crude fiber (%)	Ash (%)
Sowing dates				
20 September	78.89	8.49	22.71	8.94
30 September	107.63	8.56	22.55	9.29
10 October	109.62	8.81	22.00	9.23
S. Em±	1.91	0.06	0.17	0.06
C. D. (P=0.05)	5.52	0.17	0.50	0.18
Fertility levels ($N : P_2O_5 : K_2O$ kg/ ha)				
F_1 (150+70+40)	105.66	8.90	22.31	9.58
F_2 (125+60+30)	99.63	8.59	22.40	9.31
F_3 (100+50+20)	90.82	8.37	22.55	9.95
S. Em±	1.91	0.06	0.17	0.06
C. D. (P=0.05)	5.52	0.17	NS	0.18
Cutting levels				
Single cut	110.86	8.46	23.02	9.61
Double cut	86.54	8.77	21.82	9.04
S. Em±	1.51	0.05	0.14	0.05
C. D. (P=0.05)	4.50	0.13	0.39	0.15

Green fodder yield showed discernible variation under different sowing dates, fertility and cutting management (Fig 4).There was marked reduction in yield to the tune of 42% in late sown crop. Delayed sowing exposes crop to unfavourable

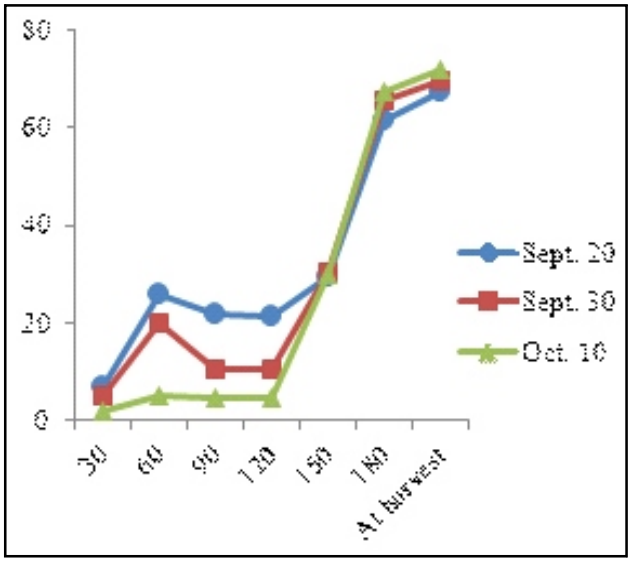

Fig. 1. Periodic dry matter accumulation in fodder oat under different dates of sowing.

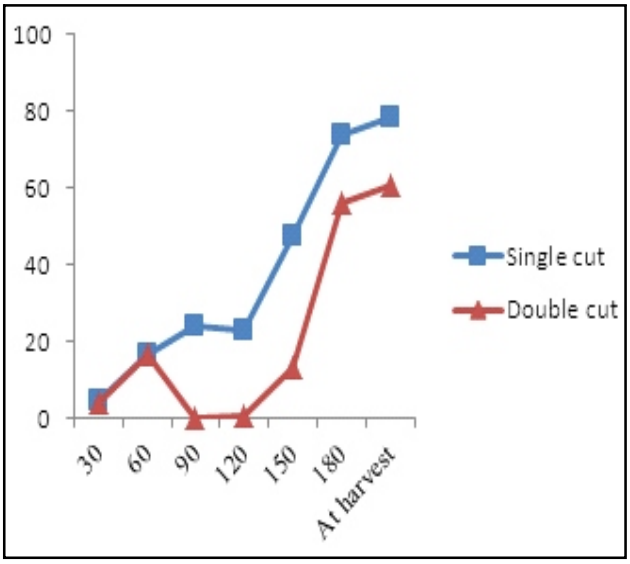

Fig. 3. Periodic dry matter accumulation in fodder oat under different cutting practices.

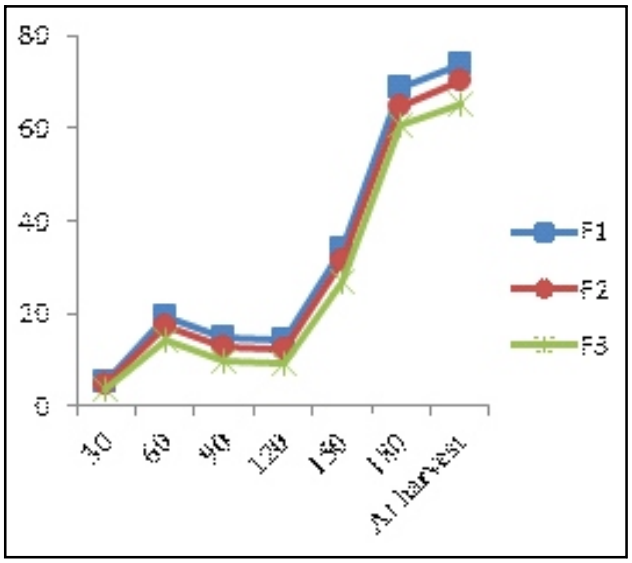

Fig. 2. Periodic dry matter accumulation in fodder oat under different fertility levels.

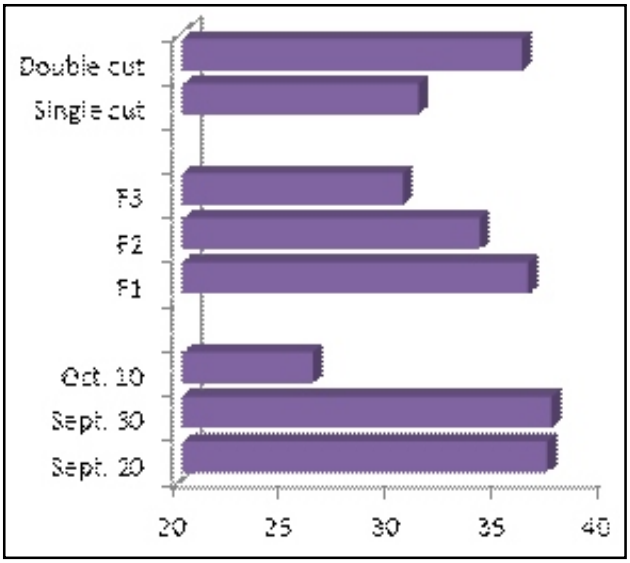

Fig. 4. Green fodder yield under different dates of sowing, fertility levels and cutting practices.

environment and drastically decrease yield (Mubarak and Singh, 2011). Green fodder yield increased with the increase in fertility from lower to higher level. Application of 150:70:40 N:P_2O_5:K_2O kg/ha produced more green fodder yield (36.2 t/ha) over rest treatments. This might be due to better growth of crop with enhanced availability of primary essential nutrients *viz.* N, P and K. Higher dose of nitrogen used in conjugation with phosphorus and potassium increases green fodder yield (Velayudham *et al.,* 2011) Increase in green fodder yield with higher fertility level 150:70:40 N:P_2O_5:K_2O /ha was to the tune of 19 % over lower fertility level 100:50:20 kg N:P_2O_5:K_2O /ha. Double cutting practice recorded higher green fodder yield (35.9 t/ha) compared to single cutting management. This may be attributed to the fact that the double cutting practice in addition to the supply of fodder at 50% flowering stage, provided additional fodder in December cut. The magnitude of increase in green fodder yield was 15.6 % over single cut crop.

Nutrient uptake

Nutrient uptake with respect to NPK was significantly higher in 30 September sown crop (Table 2). This may be attributed to the increased fodder and dry matter yield with this treatment. Application of 150:70:40 N:P_2O_5:K_2O /ha had a marked effect on nutrient uptake, which was 29%,51% and 38 % higher over lower fertilizer dose 100:50:20 N:P_2O_5:K_2O kg/ha with respect to N, P and K. Better crop growth, higher crop yield and improvement in nutrient contents due to increased availability of nutrients could be the reason. Similar results were also observed by Sharma (2009). Double cut crop removed more N and P in comparison to single cut. Cutting treatments remained at par for Potassium uptake.

TABLE 2

Nutrient uptake of fodder oats as influenced by different dates of sowing, fertilizer and cutting management

Treatments	Nutrient uptake (kg/ha)		
	N	P	K
Sowing dates			
20 September	164.1	16.6	84.6
30 September	170.9	18.8	89.6
10 October	118.4	16.2	76.5
S. Em±	2.66	0.7	1.75
C. D. (P=0.05)	7.72	2.20	5.03
Fertility levels			
(N : P_2O_5 : K_2O kg/ha)			
F_1 (150+70+40)	170.4	20.7	95.1
F_2 (125+60+30)	155.0	17.1	87.9
F_3 (100+50+20)	132.5	13.7	69.2
S. Em±	2.70	0.69	1.89
C. D. (P=0.05)	7.84	1.99	5.67
Cutting levels			-
Single cut	105.2	14.2	75.87
Double cut	142.6	16.2	73.93
S. Em±	2.95	0.63	1.23
C. D. (P=0.05)	7.95	1.84	NS

Quality parameters

Among the sowing dates 10 October sown crop recorded higher crude protein content, lower crude fiber and ash content (Table 1). Since protein content is inversely proportional to fiber content, so was decrease in fiber content in 10th October sown crop compared to other treatments. Lower ash content might be due to higher moisture content and lower dry matter yield in this treatment. Increase in fertility level improved crude protein and ash content. This could be attributed to vigorous and luxuriant vegetative growth with higher nitrogen content in the plant tissues. These results confirm the findings of Namgyal (2009). Crude fiber content remained non significant among all the treatments. Higher fertility level registered significant improvement in the ash content over lower fertility levels. These results are in conformity with those of Bhilare and Joshi (2007). Double cut management practice recorded significantly higher crude protein content than single cut crop. However, crude fiber and ash content was significantly higher in single cut.

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