Growth, Yield and Quality Parameters of Fodder Oats (*Avena sativa* L.) under Varied Dates of Sowing and Nitrogen Application

G. V. SUMANTH KUMAR, R. JAYARAMAIAH, PRAKASH KOLER AND S. T. BHAIRAPPANAVAR
Department of Agronomy, College of Agriculture, UAS, GKVK, Bengaluru - 560 065
e-Mail : jayaram.uas@gmail.com

ABSTRACT

A field experiment was conducted at College of Agriculture, Hassan during *kharif* 2018 to study the growth, yield and quality parameters of fodder oats (*Avena sativa* L.) under varied dates of sowing and nitrogen application. The experiment was conducted on red sandy loam soil and the experiment was laid out in a factorial RCBD with 10 treatment combinations, which consisted of five different dates of sowing and two nitrogen levels replicated thrice. The results revealed that sowing during first fortnight of June recorded significantly higher plant height (133.42 cm), number of tillers (93.80) 0.5 m^{-1} row length, leaf to stem ratio (0.76), leaf area (3,766 cm^2 0.5 m^{-1} row length), dry matter accumulation (97.73 g 0.5 m^{-1} row length) and SPAD readings (29.83), green fodder yield (28.88 t ha^{-1}), dry fodder yield (5.79 t ha^{-1}) crude protein (6.39%), B:C ratio (2.32) as compared to other dates of sowing. Application of 125 kg N ha^{-1} recorded significantly higher leaf to stem ratio (0.57), SPAD readings (25.46), leaf area (3,151 cm^2 0.5 m^{-1} row length) green fodder yield (23.57 t ha^{-1}), uptake of nitrogen, phosphorous and potassium (96.80 kg ha^{-1}, 16.86 kg ha^{-1} and 82.11 kg ha^{-1}, respectively) gross returns (Rs.47156/- ha^{-1}) and net returns (Rs.22279/- ha^{-1}) as compared to 100 kg N ha^{-1}.

Keywords : Fodder oats, Dates of sowing, Nitrogen levels

IN Agriculture the significance of fodder crops needs no emphasis because livestock needs nutritious and regular fodder availability to meet the demand of milk, meat, butter and other by-products as per human demands (Devi *et al.*, 2014). Among the different fodder crops, oats (*Avena sativa* L.) is one of the most important *rabi* fodder crop. Oats requires the cool and moist weather for germination, tillering, booting and heading stage. It is grown over an area of 102.12 million ha with an annual production of 223 million t. in the world and in India, cultivation of oat is limited to 4.9 per cent of the total cropped area (Kour *et al.*, 2012). The total area under cultivated fodders is 8.6 million ha on individual crop basis. The crop occupies maximum area in Uttar Pradesh (34 %), followed by Punjab (20 %), Bihar (16 %), Haryana (9 %) and Madhya Pradesh (6 %). Oats rank fifth in terms of world cereal production. It is extensively grown as forage crop and gaining importance in many regions of the world. It is the most important winter cereal fodder, which is highly palatable, rich source of energy, protein, vitamin B_1, phosphorus, iron and other minerals.

Nitrogen fertilizer is a key element in fertility management of oats. Several quality parameters of oats particularly in the late milk to early dough stage have been addressed in the literature but the effect of N fertilizer rate on forage yield, quality of oats cultivars, have received little attention. It is generally agreed that oats should be harvested prior to maturity for fodder purpose because forage yield does not increase much after the milky stage and forage quality declines after heading. In Southern Transition Zone of Karnataka, optimum condition for growing of oats is prevailing during *kharif* season as compared to *rabi* season. Hence, this study was undertaken to know the effect of different dates of sowing and nitrogen levels on growth, yield and quality of fodder oats in *kharif* season.

MATERIAL AND METHODS

Fodder oats was sown in five dates of sowing *viz.,* first fortnight of June (D_1), second fortnight of June (D_2), first fortnight of July (D_3), second fortnight of July (D_4) and first fortnight of August (D_5) at College of Agriculture, Hassan, University of Agricultural

Sciences, Bangalore. The experimental site is geographically located in the Southern Transition Zone (Zone 7) of Karnataka and situated between 12°13' to 13°33' N latitude 75°33' to 76°38' E longitude and at an altitude of 827 m above mean sea level. The crop was sown with different dates of sowing during *kharif* 2018 in plots consisting of 12 rows with 25 cm spacing between the rows. The experiment was conducted in randomized block design (RBD) in factorial arrangements with ten treatments and three replications. At all date of sowing, two nitrogen treatments [100 kg N h^{-1} (N_1) and 125 kg N ha^{-1} (N_2)] were given. Nitrogen was supplied through urea in split doses as per the treatments, 50 per cent of N was applied as basal and the remaining half was applied after 20 DAS. Whole plant samples were collected at three different growth stages *i.e.,* 15, 30 and at harvest to determine growth and quality components. Yield was determined at harvest stage of the crop. Fresh plant leaf samples were collected after every harvest, sun dried and the completely dried in hot air oven until the constant weight was obtained. This plant material was ground using Willy grinder to a uniform mesh size. The standard methods were adopted for crude protein and carbohydrates estimation.

Fodder oats was harvested at flowering stage. The green fodder was harvested at every 55 days of each sowing. The fodder weight was recorded in each plot by harvesting separately as per treatments and the values were converted on hectare basis and expressed in tons per hectare.

Treatments	Date of sowing	Date of harvesting
First fortnight of June	15.06.2018	10.08.2018
Second fortnight of June	30.06.2018	25.08.2018
First fortnight of July	15.07.2018	10.09.2018
Second fortnight of July	30.07.2018	25.09.2018
First fortnight of August	15.08.2018	10.10.2018

Plant sample from each treatment was collected at harvest and oven dried, powdered and used for analysis of quality parameters such as crude fiber (%) and ash content (%). Nutrient uptake of nitrogen, phosphorus and potassium were analyzed. Gross returns (Rs.ha^{-1}), net returns (Rs.ha^{-1}) and benefit cost ratio were worked out by using the following formulae.

Gross returns = green fodder yield x market price

Net returns = Gross returns – total cost of cultivation

$$\text{B: C ratio} = \frac{\text{Gross returns}}{\text{Cost of cultivation}}$$

All the data pertaining to the present investigation were statistically analyzed as per the method described by Panse and Sukhatme (1967). The level of significance used in 'F' and 't' was p = 0.05.

Results and Discussion

Effect of dates of sowing and nitrogen level on growth, yield, quality, uptake, economics, pH, electrical conductivity and organic carbon of fodder oats are presented in Table No.1, 2, 3 and 4.

The results revealed that sowing during first fortnight of June recorded significantly higher plant height (133.42 cm), number of tillers (93.80 0.5 m^{-1} row length), green fodder yield (28.88 t ha^{-1}), dry fodder yield (5.79 t ha^{-1}), ash content (9.47 %), N uptake (121.50 kg ha^{-1}), P uptake (21.39 kg ha^{-1}), K uptake (105.48 kg ha^{-1}), gross returns (Rs.57770/- ha^{-1}), net returns (Rs.31223/- ha^{-1}) and B:C (2.32) as compared to other dates of sowing. Application of 125 kg N ha^{-1} recorded significantly higher plant height (111.23 cm), number of tillers (81.87 0.5 ha^{-1} row length), green fodder yield (23.57 t ha^{-1}), total nitrogen, phosphorus and potassium uptake (96.80 kg ha^{-1}, 16.86 kg ha^{-1} and 82.11 kg ha^{-1}, respectively), gross returns (Rs.47156/- ha^{-1}), net returns (Rs.22279/- ha^{-1}) and benefit : cost (1.95) as compared 100 kg N ha^{-1}.

Significantly, higher plant height and number of tillers were noticed with fodder oats sown during first fortnight of June might be attributed to better growth response of fodder oats because of longer day length and favourable climatic conditions prevailed during crop growth period. The fodder oats sown after first fortnight of June experienced higher temperature and low rainfall condition during different stages of the crop

TABLE 1

Effect of dates of sowing and nitrogen levels on growth parameters of fodder oats

Treatments	Plant height (cm)	No. of tillers ($0.5m^{-1}$ row length)	Leaf to stem ratio	Leaf area (cm^2)	SPAD readings
Dates of sowing (D)					
D_1: First fortnight of June	133.42	93.80	0.76	3766	29.83
D_2: Second fortnight of June	117.38	85.28	0.62	3319	27.17
D_3: First fortnight of July	101.30	80.31	0.53	3259	23.31
D_4: Second fortnight of July	95.83	68.38	0.49	2529	21.05
D5: First fortnight of August	89.50	59.71	1.36	1931	17.41
S.Em±	3.52	1.68	0.01	147.7	1.56
CD (P=0.05)	10.55	5.03	0.04	442.5	4.68
Nitrogen levels (N)					
N_1: 100 kg $ha^{-1)}$	103.74	75.833	0.53	2771	22.5
N_2: 125 kg $ha^{-1)}$	111.23	81.87	0.57	3151	25.46
S.Em±	2.22	1.01	0.01	93.47	0.98
CD (P=0.05)	6.67	3.05	0.02	279.86	2.96
Interaction (D x N)					
D_1N_1	128.85	89.52	0.75	3420	27.65
D_1N_2	138.00	98.09	0.78	4111	32.01
D_2N_1	107.97	83.77	0.57	3127	26.82
D_2N_2	126.80	86.80	0.69	3512	27.54
D_3N_1	98.37	79.47	0.52	3094	20.38
D_3N_2	104.24	81.17	0.54	3424	26.25
D_4N_1	94.60	64.45	0.48	2397	18.82
D_4N_2	97.07	72.31	0.51	2661	23.29
D_5N_1	88.95	58.55	0.36	1815	16.60
D_5N_2	90.06	60.87	0.37	2047	18.23
S.Em±	4.98	2.38	0.02	209.01	2.21
CD (P=0.05)	NS	NS	NS	NS	NS

growth, which adversely affected the growth performance of fodder oats. The results are in line with findings Jehangir *et al.* (2013) and Kour *et al.* (2012) in wheat and Mumtaz *et al.* (2015) in wheat. Nitrogen application at 125 kg per ha increased growth parameters like plant height and number of tillers which might be due to increased level of nitrogen which caused corresponding increase in plant height at all growth stages of crop. Nitrogen attributed for synthesis of food materials resulted in greater cell division and cell elongation, which inturn increased plant height with increasing nitrogen application. Interaction effect was found to be non-significant. These findings are in agreement with the results of Midha *et al.* (2015). Nitrogen is required in larger quantities and its availability and internal concentration affect the partitioning of biomass between roots and shoots. The amount and timing of N application can also alter plant morphology, nutrient availability and net photosynthesis. N supplementation is required to maximize seedling

TABLE 2

Effect of dates of sowing and nitrogen levels on growth, yield and quality parameters of fodder oats

Treatments	Dry matter accumulation (g)	Green fodder yield (t ha^{-1})	Dry fodder yield (t ha^{-1})	Crude protein (%)	Total carbohydrates (%)
Dates of sowing (D)					
D_1: First fortnight of June	97.73	28.88	5.79	6.39	8.65
D_2: Second fortnight of June	87.11	26.19	5.39	5.78	10.09
D_3: First fortnight of July	80.81	22.66	4.64	5.07	11.85
D_4: Second fortnight of July	70.38	18.97	4.14	4.19	13.21
D_5: First fortnight of August	60.37	16.52	3.52	3.65	15.12
S.Em±	2.12	0.64	0.12	0.11	0.28
CD (P=0.05)	6.36	1.95	0.31	0.34	0.84
Nitrogen levels (N)					
N_1 : 100 kg ha$^{-1)}$	76.25	21.72	4.53	4.83	12.32
N_2 : 125 kg ha$^{-1)}$	81.78	23.57	4.86	5.20	11.24
S.Em±	1.25	0.44	0.06	0.07	0.17
CD (P=0.05)	3.76	1.22	0.20	0.21	0.54
Interaction (D x N)					
D_1N_1	97.70	27.60	5.64	6.11	15.69
D_1N_2	100.76	30.17	5.95	6.67	14.55
D_2N_1	88.43	25.94	5.25	5.74	13.75
D_2N_2	85.80	26.45	5.54	5.84	12.67
D_3N_1	80.47	20.15	4.40	4.59	13.09
D_3N_2	81.17	25.18	4.89	5.56	10.62
D_4N_1	62.78	18.83	4.07	4.17	10.27
D_4N_2	77.98	19.11	4.22	4.22	9.92
D_5N_1	60.22	16.08	3.29	3.56	8.83
D_5N_2	60.53	16.98	3.75	3.75	8.47
S.Em±	3.01	0.91	0.15	0.16	0.40
CD (P=0.05)	NS	NS	NS	NS	NS

biomass during initial nursery stages of growth, even for some legume species. However, high N availability and its concomitant affect root and shoot biomass production. The growth-promoting effect of N (up to the optimum level) increases cytokin in production, which subsequently affects cell wall elasticity, number of meristematic cells and cell growth. In addition, N fertilization also increases seedling height and root collar. The present study demonstrated that N supplementation can increase growth parameters to a certain extent but has a negative effect at higher levels. Researchers have reported both positive and negative effects of fertilizer application on subsequent seedling growth and survival (Razak *et al*., 2017).

Fodder oats sown during first fortnight of June recorded significantly higher green fodder yield (28.88 t ha^{-1}) and dry fodder yield (5.79 t ha^{-1}). The increase in green fodder yield with in first fortnight of June was due to better growth attributing parameters *viz.,* plant height, number of tillers, leaf area, leaf to stem ratio and dry matter accumulation. The better growth attributing

TABLE 3

Effect of dates of sowing and nitrogen levels on uptake of nutrients and economics of fodder oats

Treatments	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	Gross returns (ha^{-1})	Net returns (Rs.ha^{-1})	B:C
Dates of sowing (D)						
D_1: First fortnight of June	121.50	21.39	105.48	57770	31,223	2.32
D_2: Second fortnight of June	109.50	19.64	94.33	52390	27,510	2.10
D_3: First fortnight of July	92.00	16.18	74.50	45715	20,450	1.94
D_4: Second fortnight of July	81.00	12.98	65.35	37940	13,060	1.52
D_5: First fortnight of August	63.50	11.33	57.88	33560	9,513	1.33
S.Em±	2.14	0.37	1.86	-	-	-
CD (P=0.05)	6.43	1.11	5.57	-	-	-
Nitrogen levels (N)						
N_1 : 100 kg ha$^{-1)}$	90.20	15.74	76.90	43794	18,423	1.74
N_2 : 125 kg ha$^{-1)}$	96.80	16.86	82.11	47156	22,279	1.95
S.Em±	1.35	0.23	1.17	-	-	-
CD (P=0.05)	4.06	0.70	3.52	-	-	-
Interaction (D x N)						
D_1N_1	120.00	20.72	97.40	55200	29916	2.15
D_1N_2	123.00	22.06	113.57	60340	32530	2.50
D_2N_1	104.00	19.30	93.34	51880	26263	2.03
D_2N_2	115.00	19.99	95.33	52900	28757	2.19
D_3N_1	85.00	14.60	72.56	41071	14683	1.80
D_3N_2	99.00	17.76	76.44	50360	26217	2.09
D_4N_1	80.00	12.90	64.93	37660	12043	1.47
D_4N_2	82.00	13.07	65.78	38220	14077	1.58
D_5N_1	62.00	11.22	56.31	33160	9209	1.26
D_5N_2	65.00	11.44	59.45	33960	9816	1.41
S.Em±	3.04	0.53	2.63	-	-	-
CD (P=0.05)	NS	NS	NS	-	-	-

parameters registered when the fodder oats was sown during first fortnight of June due to favorable environment conditions such as rainfall distribution, temperature and relative humidity prevailed during crop growth period. The similar findings were also noticed by Lokesh *et al*. (2013) and Kalhapure and Shete (2013). Application of nitrogen at 125 kg ha^{-1} significantly increased green fodder biomass production (23.57 t ha^{-1}) and dry fodder yield (4.86 t ha^{-1}) as compared to 100 kg N ha^{-1}. This may be due to improved growth and yield parameters. Nitrogen had beneficial effects on cell division and elongation, nucleotide formation and co-enzymes production resulted in increased activity of meristematic tissues and photosynthetic area and hence increased production resulting in the accumulation of photosynthates, which resulted in higher yield. Interaction effect was found to be non-significant.

The growth, yield, quality and availability of N, P and K differed significantly at different stages of crop growth. Significantly higher leaf to stem ratio (0.76),

TABLE 4

Effect of dates of sowing and N levels on pH, electrical conductivity and organic carbon in soils after harvest of fodder oats

Treatments	pH	Electrical conductivity (dS m^{-1})	Organic carbon (%)
D_1: First fortnight of June	7.62	0.19	0.56
D_2: Second fortnight of June	7.61	0.16	0.55
D_3: First fortnight of July	7.61	0.16	0.53
D_4: Second fortnight of July	7.59	0.15	0.52
D_5: First fortnight of August	7.51	0.15	0.50
S.Em±	0.07	0.02	0.01
CD (P=0.05)	NS	NS	NS
Nitrogen levels (N)			
N_1: 100 kg ha^{-1}	7.55	0.17	0.54
N_2: 125 kg ha^{-1}	7.63	0.15	0.55
S.Em±	0.04	0.01	0.01
CD (P=0.05)	NS	NS	NS
Interaction (D × N)			
D_1N_1	7.60	0.18	0.56
D_1N_2	7.66	0.21	0.56
D_2N_1	7.61	0.16	0.55
D_2N_2	7.61	0.17	0.56
D_3N_1	7.62	0.17	0.53
D_3N_2	7.62	0.12	0.54
D_4N_1	7.57	0.16	0.55
D_4N_2	7.63	0.14	0.56
D_5N_1	7.37	0.18	0.55
D_5N_2	7.67	0.12	0.55
S.Em±	0.12	0.03	0.01
CD (P=0.05)	NS	NS	NS

dry matter accumulation (97.73 units), leaf area (3766 cm^2 0.5m^{-1} row length), SPAD readings (29.83), green fodder yield (28.88 t ha^{-1}), dry fodder yield (5.79 t ha^{-1}), crude protein (6.39 %) and total carbohydrates (8.65) were recorded in first fortnight of June followed by second fortnight of June compared to other dates of sowing and interaction effect were non-significant. In two levels of nitrogen application, significantly higher leaf to stem ratio (0.57), dry matter accumulation (81.78 g), leaf area (3151 cm^2 0.5m^{-1} row length), SPAD readings (25.46), green fodder yield (23.57 t ha^{-1}), dry fodder yield (4.86 t ha^{-1}), crude protein (5.20 %) and total carbohydrates (11.24 %) were recorded in 125 kg N ha^{-1} compared to100 kg N ha^{-1} and interaction effects were non-significant.

Significantly, higher leaf to stem ratio, leaf area, dry matter accumulation and SPAD readings were noticed with fodder oats sown during first fortnight of June might be attributed to better response of fodder oats because of favourable climatic conditions prevailed during crop growth period. The fodder oats sown after first fortnight of June experienced higher temperature and low rainfall condition during different stages of the crop growth, which adversely affected the growth performance of fodder oats. The results are in line with findings Jehangir *et al*. (2013), Kour *et al*. (2012) and Mumtaz *et al*. (2015) in wheat. Nitrogen application at 125 kg ha^{-1} increased growth parameters like leaf to stem ratio, leaf area, dry matter accumulation and SPAD readings which might be due to increased level of nitrogen caused corresponding increase in plant height at all growth stages of crop, because nitrogen attributed for synthesis of food materials resulting in greater cell division and cell elongation. Therefore, elongation in plants increases with increasing nitrogen application. Interaction effect was found to be non-significant. These results are in agreement with the findings of Midha *et al*. (2015).

Increased crude protein content, when the crop was sown at first fortnight of June was due to higher dry matter accumulation. The higher crude protein content because of favourable climatic conditions prevailed during crop growth period which helped in better uptake of nutrients from the soil and lead to more nutrient accumulation and resulted in higher crude protein content in the fodder oats. When nitrogen was applied at 125 kg per ha, there was significant increase in crude protein. This might be due to the fact that nitrogen plays a key role in plant metabolism as a constituent of amino acids (DNA and RNA), it is responsible for transfer of genetic transformation and helps in regulating cellular metabolism of amino acids and protein that form structural units and biological catalyst of phosphorylated compounds which are involved in transformation of energy. It is a major structural constituent of cell wall thus increasing fodder quality by improving the protein content. These findings are in close conformity with Harikesh *et al*. (2017) and Iqbal *et al*. (2013).

Total carbohydrates content decreased significantly with increased nitrogen levels. It has been documented that application of nitrogen, causes increased meristematic activity and in this condition more mineral salts are absorbed and the respiration process becomes rapid which leads to the conversion of most of the carbohydrates into fats. These results are in conformity with findings of Aravind Neelar (2011) and Smitha Patel (2014).

Significantly higher uptake of nutrients was observed during first fortnight of June as compared to other dates of sowing this might be due to better nutrient uptake during early dates of sowing which resulted in better growth and growth attributing parameters which is superiorly influenced by favorable environmental conditions prevailed during crop growth period. Among various climatic factors, well distribution of rainfall helped in better uptake of nitrogen, phosphorus and potassium due to better availability of moisture content in the soil, which increased the available concentration of nitrogen, phosphorus and potassium in the labile pool of the soil, which in turn helped for better uptake of these nutrients by the crop plants. These results are in agreement with the findings of Murthy *et al*. (2012), Kour *et al*. (2012) and Lokesh *et al*. (2013). The increase in nitrogen application significantly influenced N, P and K uptake. Application of 125 kg N ha^{-1} resulted in significantly higher uptake of N (96.80 kg ha^{-1}), P (16.86 kg ha^{-1}) and K (82.11 kg ha^{-1}) over 100 kg N ha^{-1}. Highest N, P and K uptake may be attributed to the beneficial effect of nitrogen sufficiency in the soil solution and higher dry matter yields leading to improved uptake to a sufficiency level. Interaction effect was found to be non-significant. These findings corroborated the results of Joshi and Singh (2015), Jat *et al.* (2015) and Verma *et al*. (2016).

Gross returns (Rs.57770/- ha^{-1}), net returns (Rs.31223/- ha^{-1}) and B:C ratio (2.32) were found to be higher when the fodder oats sown during the first fortnight of June followed by second fortnight of June sowing (52390/- ha^{-1}, Rs.27510/- ha^{-1} and 2.10, respectively). The higher gross returns, net returns and B:C ratio was due to higher green fodder yield obtained with the first fortnight of June sowing was due to better growth of crop supported with favorable climatic conditions. However, the lower gross returns (Rs.33560/- ha^{-1}), net returns (Rs.9513/- ha^{-1}) and B:C (1.33) was noticed with the fodder oats sown during first fortnight of August which was due to lower green fodder yield, attributed to poor crop growth and development. These results are in conformity with the findings of Devi *et al*. (2014), Smitha Patel (2014) and Tomar *et al*. (2014) in fodder sorghum.

Higher gross returns (Rs.47156/- ha^{-1}), net income (Rs.22279/- ha^{-1}) and benefit cost ratio (1.95) was obtained with the application of 125 kg N ha^{-1} compared to application of 100 kg N ha^{-1}. This might be due to higher green fodder yield obtained with the 125 kg N ha^{-1} due to better growth of crop supported with favourable climatic conditions and lower gross returns (Rs.43794/- ha^{-1}), net returns (Rs.18423/- ha^{-1}) and B: C (1.74) obtained with the application of N 100 kg ha^{-1} due to lower green fodder yield attributed to poor crop growth and development. This is in conformity with the findings of Devi *et al*. (2014) and Joshi *et al*. (2015) in oats.

The available nitrogen, phosphorus and potassium were found to be significantly superior in the soil after the harvest of the crop sown during first fortnight of June as compared to other dates of sowing. This might be attributed to increased available nutrient status in the soils after harvest of crop sown during first fortnight of June due to better rainfall received during the early season of crop which resulted in increased moisture content in soil which inturn increased the solubility of nutrients in the soil and was available in soil for a longer period of time. The higher available nitrogen status of soil after harvest of the crop was observed with increased nitrogen levels, which was mainly due to build-up of nutrients in soil because of addition of nitrogenous fertilizer into the soil. These results are in agreement with Jat *et al*. (2015) in oats.

Soil pH

Among the different treatments, soil pH after harvest of the crop did not vary significantly due to different dates of sowing and nitrogen levels. However, it ranged from 7.37 to 7.66.

Electrical Conductivity

Among the different treatments, electrical conductivity after harvest of the crop did not vary significantly due to application of nitrogen and dates of sowing. However, it ranged from 0.18 to 0.21 deci Siemen per metre (dS m^{-1}).

Organic Carbon Content

Carbon content after harvest of the crop did not vary significantly due to different dates of sowing and nitrogen levels. However, it ranged between 0.50 to 0.56 per cent.

Sowing of fodder oats during the first fornight of June recorded significantly higher plant height (133.42 cm), number of tillers (93.80 0.5 m^{-1} row length), leaf to stem ratio (0.76), leaf area (3766 cm^2 0.5 m^{-1} row length) dry matter accumulation (97.73 g 0.5 m^{-1} row length), green fodder yield (28.88 t ha^{-1}), crude protein (6.39 %), B:C ration (2.32) as compared to other dates of sowing. Application of 125 kg N ha^{-1} recorded significantly higher number of tillers (81.87 0.5 m^{-1} row length), leaf area (3151 cm-2 0.5 m^{-1} row length), green fodder yield (23.57 t ha^{-1}), uptake of nitrogen, phosporus and pottasium (96.80, 16.86 and 82.11 kg ha^{-1}, respectively), gross returns (Rs.47.156 ha^{-1}) and net returns (Rs.22279 ha^{-1}) as compared to application of 100 kg N ha^{-1}.

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