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Green fodder yield and quality of fodder oats (*Avena sativa*) as influenced by dates of sowing and nitrogen levels in Southern transition zone of Karnataka

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Abstract
A field experiment was conducted at college of Agriculture, Hassan during *Kharif*-2018 on influence of varied dates of sowing and nitrogen fertilization on growth, yield and quality of fodder oats in southern transition zone of Karnataka. The soil of the experimental site was red sandy loam and the was laid out in randomized complete block design with factorial concept replicated thrice which includes five dates of sowing and two nitrogen levels. It was revealed that early sown crop on first fortnight of June recorded significantly higher dry matter accumulation (97.73 0.5m^{-1} row length), green fodder yield (28.88 t ha^{-1}) and dry fodder yield (5.79 t ha^{-1}) production as compared to other dates of sowing. However significantly higher value of quality parameters viz., crude protein (6.39%), crude protein yield (3.70 q ha^{-1}), total ash (9.47%) and ether extract (2.97%) in same treatment compared to other treatments. Among the different nitrogen levels, application of 125 kg N ha^{-1} recorded significantly higher dry matter accumulation (97.73 0.5m^{-1} row length), green fodder yield (28.88 t ha-1) and dry fodder yield (5.79 t ha-1) production as compared to other dates of sowing. However significantly higher value of quality parameters viz., crude protein (5.20), crude protein yield (2.62 q ha^{-1}), total ash (8.05) and ether extract (2.42%) was recorded in 125 kg N ha^{-1} application as compared to 100 kg N ha^{-1}.

Keywords: fodder oats, dates of sowing, different nitrogen levels

Introduction
In India, the livestock is an integral component of agriculture economy, which contributes about 4.11% to total GDP and possess 15% of world's livestock population of 512.05 million constituting 37.3% cattle, 21.2% buffaloes, 12.7% sheep and 26.4% goats (DAHD & F 2017-18). The success of animal husbandry and dairy farming largely depends on regular supply of good quality fodder in sufficient quantities. Unfortunately, there is acute shortage of green as well as dry fodder in tune of 35.6 and 11.0 per cent, respectively (IGFRI Vision 2050) due to less acreage of green fodder crops (4.9 per cent) and more emphasis on food grain production (Kumar *et al*., 2018) that drastically affects the productivity of animals in comparison with other countries. Among the different *rabi* 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 was produced in 102.12 MH areas with an annual production of 223 MT. in the world and in India; cultivated fodder is limited to 4.9% of the total cropped area (Kour *et. al*., 2012). The total area under cultivated fodders is 8.6 MH 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 influence of dates of sowing and nitrogen applications on yield, quality parameters, uptake of nutrients and economics of fodder oats in southern transition zone of Karnataka.

Materials 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) of College of Agriculture, Hassan, University of Agricultural sciences, Bengaluru. The experimental site is geographically located in the Southern Transitional Zone (Zone-7) of Karnataka and situated between 12° 13' to 13° 33' N Latitude and 75° 33' to 76° 38' E longitude 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. At the time of sowing 50% 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 a constant weight was obtained. This plant material was ground using Willy grinder to a uniform mesh size. The standard methods were used for crude fibre and carbohydrates estimation. Plant samples from each treatment were collected at harvest and oven dried, powdered and used for analysis of quality parameters

Results and Discussion

Yield attributes

Effect of dates of sowing and nitrogen level on yield parameters of fodder oats are presented in Table No.1.

The results showed that sowing during first fortnight of June recorded significantly higher higher dry matter accumulation (97.73 0.5m^{-1} row length), green fodder yield (28.88 t ha^{-1}) and dry fodder yield (5.79 t ha^{-1}) production as compared to other dates of sowing. Among the different levels of Nitrogen, application of 125 kg N ha^{-1} recorded significantly higher dry matter accumulation (97.73 0.5m^{-1} row length), green fodder yield (28.88 t ha^{-1}) and dry fodder yield (5.79 t ha^{-1}) production as compared 100 kg N ha^{-1}. The interaction effect was found to be significant.

The green fodder yield and dry fodder yield of fodder oats differed significantly with respect to dates of sowing and nitrogen levels. 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}) followed by second fortnight of June sowing (26.19 t ha^{-1} and 5.39 t ha^{-1} green and dry fodder yield, respectively). The lower green fodder yield (16.52 t ha^{-1}) and dry fodder yield (3.52 t ha^{-1}) was recorded during first fortnight of August. The increase in green fodder yield 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 parameters registered when the fodder oats 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 was also noticed by Lokesh *et al.* (2013) [21] and Kalhapure and Shete (2013).

Significantly, lower green fodder yield and dry fodder yield of fodder oats was observed with the delayed dates of sowing which might be due to reduced photosynthetic activity as a result of unfavourable weather conditions prevailing during the different stages of crops which adversely affect the growth performance of the fodder oats. Yusufali *et al*. (2007), Alam *et al*. (2005) [3] and Kavak (2004) noticed the similar findings.

Application of 125 kg nitrogen per hectare recorded significantly higher green and dry fodder yield (23.57 and 4.86 t ha^{-1}, respectively) as compared to application of 100 kg nitrogen per ha (21.72 and 4.53 t ha^{-1}, respectively). None of the interactions between seed rates and nitrogen levels was found significant.

Application of nitrogen at 125 kg per ha significantly increased green fodder biomass production. This might be due to improved growth and yield parameter. Singh *et al*. (1998) [35] revealed that nitrogen had beneficial effects on cell division and elongation, nucleotide formation and co-enzymes 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. This is in conformity with findings of Mannikar *et al*. (1974) [22], Mitra *et al*. (2003), Kajale *et al*. (2001), Dudhat *et al*. (2004) and Rana *et al*. (2009) [30].

Quality parameters

Effect of dates of sowing and nitrogen level on yield parameters of fodder oats are presented in Table No.2.

Significantly, higher value of quality parameters viz., crude protein (6.39%), crude protein yield (3.70 q ha^{-1}), total ash (9.47%) and ether extract (2.97%) was recorded in first fortnight of June as compared to other treatments. However significantly higher value of quality parameters viz., crude protein (5.20), crude protein yield (2.62 q ha^{-1}), total ash (8.05) and ether extract (2.42%) was recorded in 125 kg N ha^{-1} application as compared to 100 kg N ha^{-1}. The interaction effect was found to be significant.

Increased crude protein content and total ash content when the crop was sown at first fortnight of June was due to higher dry matter accumulation. The higher dry matter accumulation because of favourable climatic conditions prevailed during crop growth period helped in better uptake of nutrients from the soil and lead to more nutrient accumulation which resulted in higher crude protein content, crude fibre yield and total ash content in the fodder oats. However, when sowing was delayed the rainfall distribution and temperature was not found to be optimum, as a result the moisture availability in soil decreases, which in turn decreased the nutrient uptake capacity of crops leading to nutrient accumulation. Because of this condition, the palatability of green fodder decreases and increases the crude fibre content and crude fibre yield. It is found that soil moisture had direct relationship with crude fibre content and crude fibre yield. Jakhar *et al.* (2003), Waheed *et al*. (2012), Tiwana *et al*. (2003) and Bhilare and Joshi, (2007), also obtained the similar results.

Table 1: Green fodder yield, dry fodder yield and dry matter accumulation of fodder oats as influenced by dates of sowing and nitrogen levels

Treatments	Green fodder yield (t ha^{-1})	dry fodder yield (t ha^{-1})	Dry matter accumulation (g 0.5 m^{-1} row length)
Dates of sowing (D)			
D_1: First fortnight of June	28.88	5.79	97.73
D_2: Second fortnight of June	26.19	5.39	87.11
D_3: First fortnight of July	22.66	4.64	80.81
D_4: Second fortnight of July	18.97	4.14	70.38
D_5: First fortnight of August	16.52	3.52	60.37
S.Em±	0.64	0.12	2.12
CD (P=0.05)	1.95	0.31	6.36
Nitrogen levels (N)			
N_1: 100 kg ha^{-1}	21.72	4.53	76.25
N_2: 125 kg ha^{-1}	23.57	4.86	81.78
S.Em±	0.44	0.06	1.25
CD (P=0.05)	1.22	0.20	3.76
Interaction (D × N)			
D_1N_1	27.60	5.64	94.70
D_1N_2	30.17	5.95	100.76
D_2N_1	25.94	5.25	88.43
D_2N_2	26.45	5.54	85.80
D_3N_1	20.15	4.40	80.47
D_3N_2	25.18	4.89	81.17
D_4N_1	18.83	4.07	62.78
D_4N_2	19.11	4.22	77.98
D_5N_1	16.08	3.29	60.22
D_5N_2	16.98	3.75	60.53
S.Em±	0.91	0.15	3.01
CD (P=0.05)	NS	NS	NS

NS – Non-significant
DAS – Days after sowing

Table 2: Crude protein, crude protein yield, ash content and ether extract of fodder oats as influenced by dates of sowing and nitrogen levels

Treatments	Crude protein (%)	Crude protein yield (%)	Total ash (%)	Ether extract (%)
Dates of sowing (D)				
D_1: First fortnight of June	6.39	3.70	9.47	2.98
D_2: Second fortnight of June	5.78	3.02	8.81	2.69
D_3: First fortnight of July	5.07	2.37	7.64	2.32
D_4: Second fortnight of July	4.19	1.73	6.37	1.94
D_5: First fortnight of August	3.65	1.28	5.56	1.66
S.Em±	0.11	0.07	0.19	0.06
CD (P=0.05)	0.34	0.23	0.59	0.18
Nitrogen levels (N)				
N_1: 100 kg ha^{-1}	4.83	2.22	7.09	2.21
N_2: 125 kg ha^{-1}	5.20	2.62	8.05	2.42
S.Em±	0.07	0.04	0.12	0.04
CD (P=0.05)	0.21	0.14	0.37	0.11
Interaction (D × N)				
D_1N_1	6.11	3.45	9.93	2.83
D_1N_2	6.67	3.97	9.02	3.12
D_2N_1	5.74	2.81	9.15	2.66
D_2N_2	5.84	3.24	8.47	2.71
D_3N_1	4.59	2.02	8.71	2.06
D_3N_2	5.56	2.72	6.58	2.58
D_4N_1	4.17	1.70	6.61	1.93
D_4N_2	4.22	1.78	6.15	1.95
D_5N_1	3.56	1.17	5.87	1.59
D_5N_2	3.75	1.41	5.25	1.74
S.Em±	0.16	0.11	0.28	0.08
CD (P=0.05)	NS	NS	NS	NS

NS – Non-significant,
DAS – Days after sowing

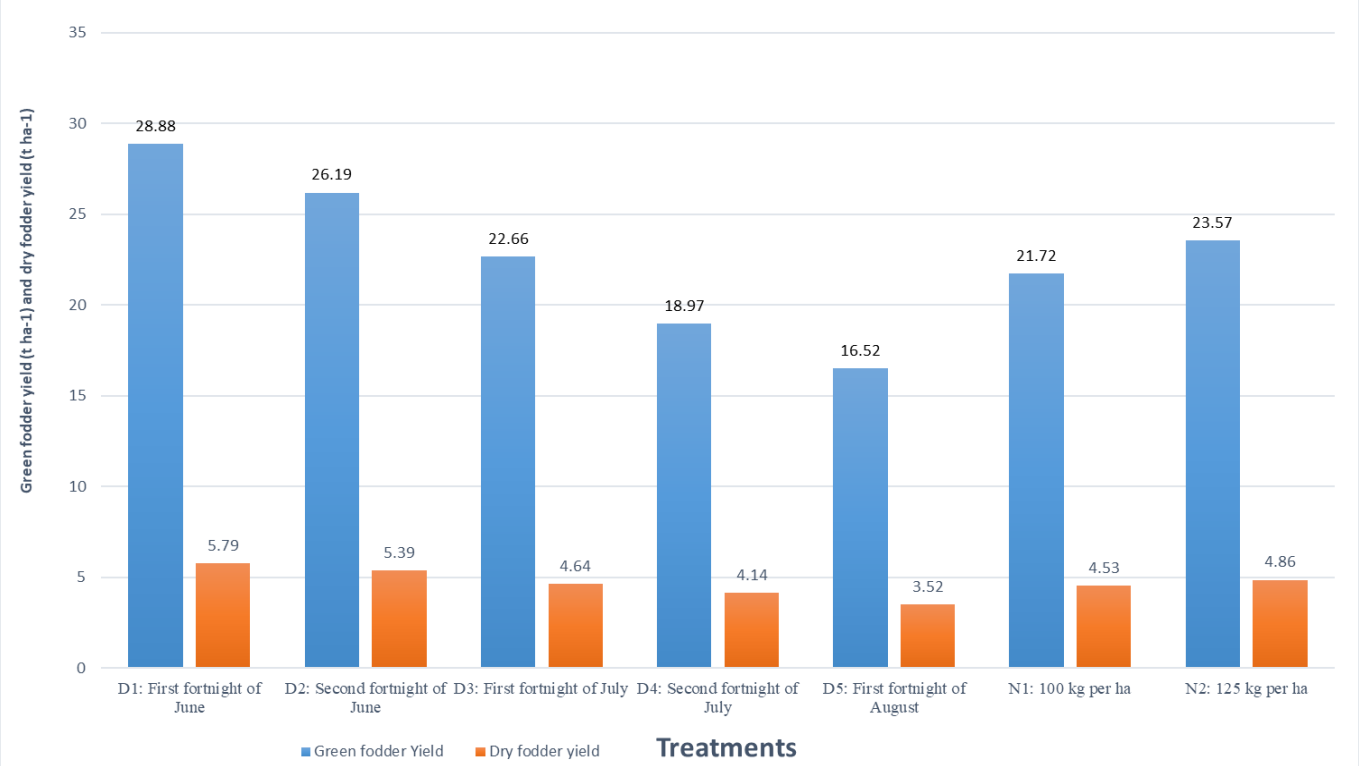

Fig 1: Green fodder yield (t ha^{-1}) and dry fodder yield (t ha^{-1}) of oats as influenced by dates of sowing and nitrogen levels

T_1: D_1N_2 (First fortnight of June with 125 kg N ha^{-1}) T_1: D_1N_1 (First fortnight of June with 100 kg N ha^{-1})

Plate 1: Best treatment of fodder oats as influenced by dates of sowing and nitrogen levels

Conclusion

In southern transitional zone of Karnataka fist fortnight of June is the best time for growing of fodder oats, which gives higher yield. Delayed sowing results in lower yield parameters.

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