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EFFECT OF VARIETIES AND SOWING WINDOWS ON PRODUCTIVITY AND NUTRIENT UPTAKE OF FODDER OAT

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ABSTRACT

A field experiment was conducted during *rabi*, 2024-25 on sandy clay loam soils of dryland farm, S.V. Agricultural College, Tirupati, with the objective to find out optimum time of sowing and yield parameters of fodder oat in Southern Agro-Climatic Zone of Andhra Pradesh. The experiment was laid in the randomized block design with factorial concept and replicated thrice.Treatments include three varieties *viz*., V_1: RO-11-1, V_2: OS-403 and V_3: OS-6 with five sowing windows *viz*., S_1: October I FN, S_2: October II FN, S_3: November I FN, S_4: November II FN and S_5: December I FN.The results showed that the significantly higher green (18104 kg ha^{-1}) and dry fodder yield (4735 kg ha^{-1}) and N, P and K uptake by the crop at harvest (142 kg ha^{-1}, 21.6 kg ha^{-1} and 138 kg ha^{-1} respectively) were obtained with RO-11-1 sown during November II FN. The available N, P_2O_5 and K_2O in the soil (208 kg ha^{-1}, 53.6 kg ha^{-1} and 223 kg ha^{-1} respectively) at harvest recorded higher with OS-403 sown during October I FN compared to all other treatments.

Keywords: Fodder oat, Nutrient uptake, Productivity, Sandy loam soils, Sowing windows

INTRODUCTION

Livestock is a vital component of Indian agriculture, contributing 25.6% to the agricultural GDP and supporting nearly 58% of the population through allied sectors like poultry and fisheries. Despite being the world's top milk producer and home to 57.3% of global buffalo and 14.7% of cattle populations (Anonymous, 2019), India faces a critical shortage of quality feed and fodder up to 40% for green fodder and 23% for dry fodder. Only 4.4% of agricultural land is dedicated to fodder cultivation, creating a significant gap between demand and supply.

Oat (*Avena sativa* L.), a nutrient-rich *rabi* fodder crop, has the potential to address this fodder deficit, particularly in the Southern regions of India where it is not traditionally grown andwidely cultivated in north-western India under irrigated and cool conditions. It is soft, palatable and highly nutritious rich in protein, fibre, essential amino acids like lysine and minerals. Oat is a dual-purpose crop used for food and fodder. Its quick growth, high biomass and suitability for green fodder, silage or hay make it a valuable choice.However, productivity is influenced by varietal performance and sowing time, with both early

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and late sowing reduce yields. To promote oat cultivation in non-traditional areas like southern India, awareness of improved production practices and climatic adaptability is essential.

Efficient nutrient uptake is a critical determinant of crop growth, yield and quality particularly in fodder crops like oat (*Avena sativa* L.), which are cultivated for their high biomass and nutritional value. Oat, being a fast-growing and nutrient-demanding crop, requires a balanced and timely supply of essential nutrients to achieve optimal fodder yield and quality. Among these, nitrogen (N), phosphorus (P) and potassium (K) are the most influential macronutrients affecting plant metabolism, chlorophyll synthesis, root development and dry matter accumulation. Monitoring nutrient uptake and soil nutrient status at harvest helps assess fertilization efficiency, variety performance and nutrient depletion. Since nutrient uptake is closely associated with environmental factors, it is essential to evaluate how different sowing times and varieties influence the absorption and utilization of nutrients in fodder oats. Moreover, understanding the changes in soil nutrient availability at harvest helps in developing location specific nutrient management strategies that ensure sustainable fodder production without exhausting soil reserves.

MATERIAL AND METHODS

The investigation was carried out during *rabi*, 2024-25 on sandy loam soils of dryland farm of S.V. Agricultural College, Tirupati, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The soil was neutral in reaction (6.8 pH),low in available nitrogen (220 kg ha^{-1}), medium in available phosphorus (34 kg ha^{-1}) and medium in available potassium (249 kg ha^{-1}) status. The field experiment was conducted with randomised block design with factorial concept consisting of fifteen treatments and replicated thrice. Treatments include three varieties *viz*., V_1: RO-11-1, V_2: OS-403 and V_3: OS-6 with five sowing windows *viz*., S_1: October I FN, S_2: October II FN, S_3: November I FN, S_4: November II FN and S_5: December I FN. The crop was sown at 30 x 10 cm spacing with a seed rate of 100kg ha^{-1}.Recommended dose of fertilizer was 80 – 40 – 30 N, P_2O_5 & K_2O kg ha^{-1}, entire dose of phosphorus and potassium fertilizers were applied as basal at the time of sowing whereas nitrogen was applied in split application, 50% of N was applied as basal and 50% was applied as top dressing at 30 DAS.Irrigation and weeding were done as and whenrequired.All the growth parameters *viz.,* plant height, leaf: stem ratio, leaf area index and dry matter production were recorded before harvesting of the crop.The crop was harvested for green fodder at 50% flowering stage, where the quality parameters like crude protein and crude fibre content at their peak stages.A fresh sample taken from each treatment at harvest stage was oven dried to a constant weight, ground and subsequently used for quality analysis.The data collected on various cropparameters were statistically evaluated usingthe randomised block design with factorial concept method.

Green fodder yield of forage oat from the net plot area was taken separately by leaving 5 cm stubbles from ground surface and expressed in kg ha^{-1}.After harvesting fodder oat from net plot area, heaps were left in the field for one week for sun drying. Then dry fodder yield of oat from net plot area wasweighed and total dry fodder yield wasexpressed in kg ha^{-1}.Nutrient uptake was estimated by taking the whole plant at harvesting stage, then dried and analysed for nutrient content. The nutrient uptake was calculated using the following formula:

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%) x Dry matter production (kg ha}^{-1})}{100}$$

Post-harvest soil nutrient status wasestimated by taking the soil samples at 0-15cm depth from each treatmentplot after harvestof the crop and analysed for chemicalproperties by using Alkaline potassiumpermanganate method for available nitrogen, Olsen's method for available phosphorousand Flame photometry for available potassium in the soil.

RESULTS AND DISCUSSION

Data pertaining to growth parameters, yield, N, P and K uptake by fodder oat and post-harvest soilnutrient status at harvest as influenced by varieties and sowing windows was discussed here under.

Growth parameters, green and dry fodder yield

Critical observation of the data, (Table 1) revealed that all the growth parameters of fodder oat at harvest *viz.,* plant height, leaf to stem ratio, leaf area index and dry matter production significantly recorded higher values by the variety RO-11-1 among the varieties evaluated. The lowest values of these growth parameters were registered with OS-403 variety which was comparable with that of OS-6. The differance in growth parameters among the varieties might be due to their genetic makeup and environment adaptability during the crop growth period. These findings are similar to Murali *et al*., (2021) and Koushal *et al*., (2024).

Among the sowing windows tried, significantly taller plants, higher leaf to stem ratio, higher leaf area index and higher dry matter production at harvest were noticed with fodder oat sown during November II FN, while all these parameters were at their lowest during October I FN (Table 1). This might be attributed to better growth response of fodder oat because of availability of optimum temperature (Max.Temp-29.9 °C, Min.Temp-17.7°C), relative humidity (67.6%) and suitable photoperiod (5.9 h day^{-1}) that prevailed during the crop growth period. Similar results were obtained by Kumar *et al*., (2021) and Megharaja *et al*., (2023).

The variety RO-11-1 registered higher green and dry fodder yield which was significantly higher than the variety OS-6, while OS-403 registered the lower green and dry fodder yield which was statistically similar to that of OS-6 (Table 1). Increase in green and dry fodder yield of RO-11-1 than other varieties could be attributed to its genetic potentiality resulting in better performance of growth and yield parameters. Further, the performance of RO-11-1 variety in producing higher values of plant height, leaf area and leaf to stem ratio has resulted in increased accumulation of photosynthates which were directly related to the production of bulk herbage. Similar results were obtained by Kashyap *et al.,* (2022), Samal *et al*., (2023), Jindal *et al*., (2024) and Satpal *et al*., (2024).

November II FN sown crop recorded significantly higher green and dry fodder yield over other sowings. The next best treatment was December I FN followed by November I FN and October II FN with significant disparity among them. The lowergreen and dry fodder yield was recorded during October I FN (Table 1). The higher green and dry fodder yields were recorded during November II FN might be due to congenial microclimate and macroclimate that might have led into luxuriant vegetative growth in the forms of plant height, leaf stem ratio, leaf area index and dry matter accumulation where these parameters

Table 1. Growth parameters, green and dry fodder yield of fodder oat at harvest as influenced by varieties and sowing windows

Treatments	Plant height (cm)	Leaf: stem ratio	Leaf area index	Dry matter production (kg ha^{-1})	Green fodder yield (kg ha^{-1})	Dry fodder yield (kg ha^{-1})
Varieties						
V_1: RO-11-1	102	0.64	1.43	2728	12538	3643
V_2: OS-403	94	0.53	1.27	2360	11467	2648
V_3: OS-6	95	0.58	1.31	2401	11558	2710
SEm±	1.4	0.014	0.027	42.7	176	87
CD (P=0.05)	4	0.04	0.08	124	510	254
Sowing windows						
S_1: October I FN	83	0.44	0.94	820	3335	829
S_2: October II FN	89	0.51	1.21	1484	5966	1502
S_3: November I FN	97	0.58	1.34	2972	14513	3581
S_4: November II FN	112	0.72	1.67	3807	18104	4735
S_5: December I FN	104	0.65	1.53	3398	17354	4354
SEm±	1.8	0.018	0.035	55.1	227	113
CD (P=0.05)	5	0.05	0.10	160	659	328
Varieties×Sowing windows						
SEm± 3.2	0.031	0.060	95.5	394	195	
CD (P=0.05)	NS	NS	NS	NS	NS	NS

ultimately lead to higher fodder yield compared to remaining sowing windows. These results were in conformity with the findings of Kumar *et al*., (2021),Murali *et al*., (2021), Megharaja *et al*., (2023) and Samal *et al*., (2024).

Nutrient uptake

Nutrient uptake of fodder oat varieties revealed that maximum nitrogen, phosphorus and potassium uptake was observed with RO-11-1 which was significantly higher than variety OS-6. Whereas, the uptake levels were at their minimum with OS-403, which was on par with OS-6 variety (Table 2 & Fig 1). The differences in the genetic makeup of varieties might have resulted into varied root geometry and concomitant nutrient mobilization potential through root exudates which leads to differences in nutrient content and finally uptake in oat. The present findings corroborate with that of Satpal *et al.,* (2018) and Samal *et al*.(2023).

Among the sowing windows tried, November II FN sown crop resulted in significantly higher nitrogen, phosphorus and potassium uptake, while the lowest values were registered during October I FN (Table 2). The increased nutrient uptake might be due to favourable weather conditions that prevailed

Table 2. Nutrient uptake (kg ha^{-1}) of fodder oat at harvest as influenced by varieties and sowing windows

Treatments	Nitrogen	Phosphorus	Potassium
Varieties			
V_1: RO-11-1	127	16.6	109
V_2: OS-403	98	14.3	80
V_3: OS-6	102	15.2	84
SEm±	2.8	0.30	2.4
CD (P=0.05)	8	0.9	7
Sowing windows			
S_1: October I FN	71	11.2	53
S_2: October II FN	92	12.5	67
S_3: November I FN	109	14.1	86
S_4: November II FN	142	21.6	138
S_5: December I FN	128	17.4	114
SEm±	3.6	0.38	3.2
CD (P=0.05)	10	1.1	9
Varieties × Sowing windows			
SEm±	6.3	0.66	5.5
CD (P=0.05)	NS	NS	NS

during crop period which enhanced dry matter accumulation. This in turn, improved nutrient absorption from the soil and led to greater nutrient accumulation in the plants. The results were in conformity with the findings of Kadam *et al*. (2020), Kumar *et al*., (2021) and Samal *et al*.(2023).

Post-harvesting soil nutrient status

The data presented on post-harvest soil available nutrient status of nitrogen, phosphorus and potassium revealed that significantly higher values registered with variety OS-403, which was comparable with OS-6, while the lower nutrient status of all the above nutrients was observed with variety RO-11-1 (Table 3 & Fig 2). The variations in varieties might be due to the variations in their uptakes. Varieties which recorded significantly higher biomass yield have the increased nutrient uptake which ultimately resulted in lower soil available nutrient status.

With regard to sowing windows, October I FN sown crop recorded significantly higher post-harvest soil available nutrients followed by October II FN, November I FN and December IFN with significant difference among them. The lower values were registered during November II FN (Table 3).The higher availability of available nutrients in the soil during October I FN might be due to micro and macro climate prevailed during the crop growth period. Similar results were collaborated with findings of Kadam *et al*. (2020) and Kumar *et al.* (2021).

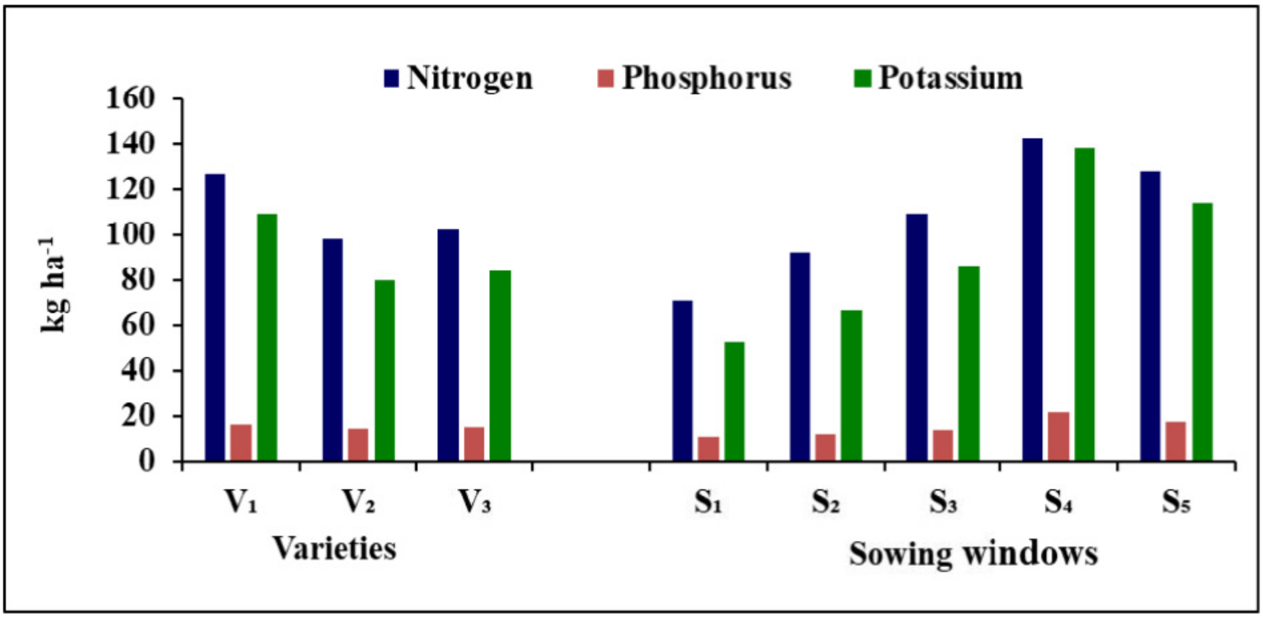

Fig. 1. Nutrient uptake (kg ha^{-1}) of fodder oat at harvest as influenced by varieties and sowing windows.

Table 3. Post-harvest soil available nutrient status (kg ha^{-1}) of fodder oat as influenced by varieties and sowing windows

Treatments	Available N	Available P_2O_5	Available K_2O
Varieties			
V_1: RO-11-1	153	42.5	169
V_2: OS-403	184	50.3	192
V_3: OS-6	176	48.5	186
SEm±	3.9	0.75	4.2
CD (P=0.05)	11	2.2	12
Sowing windows			
S_1: October I FN	208	53.6	223
S_2: October II FN	192	50.9	209
S_3: November I FN	173	47.1	187
S_4: November II FN	132	39.6	135
S_5: December I FN	152	44.4	158
SEm±	5.0	0.97	5.4
CD (P=0.05)	15	2.8	16
Varieties × Sowing windows			
SEm±	8.7	1.68	9.3
CD (P=0.05)	NS	NS	NS

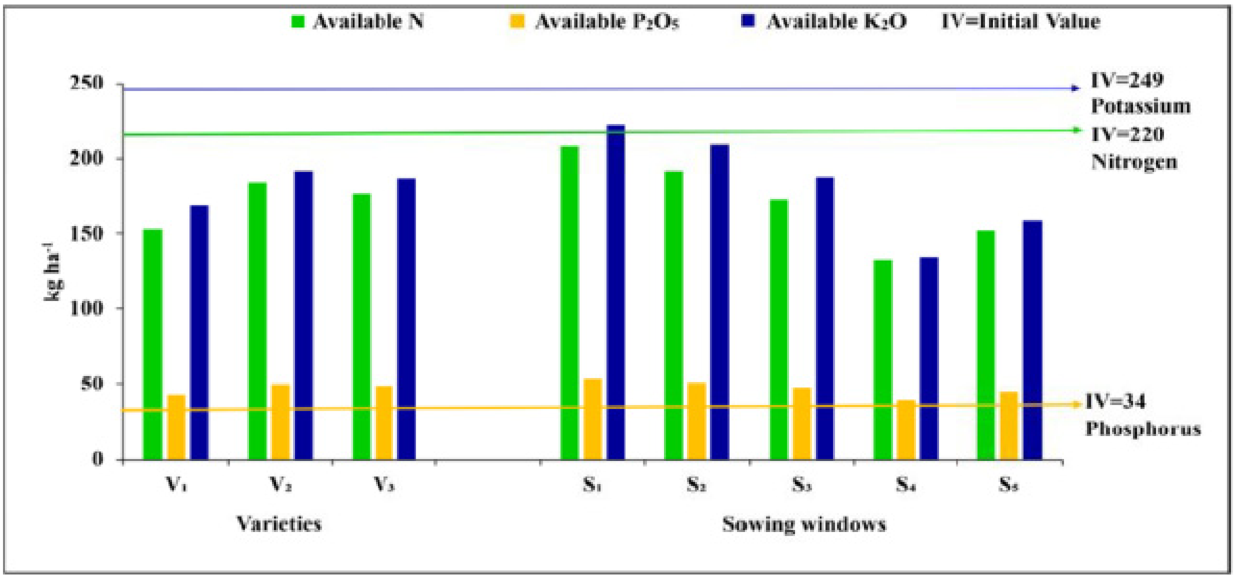

Fig. 2. Post-harvest soil available nutrient status (kg ha^{-1}) of fodder oat as influenced by varieties and sowing windows.

CONCLUSION

The variety RO-11-1 sown during November II FN was found to be most efficient to obtain better growth parameters, higher yield (green fodder (18104 kg ha^{-1}) and dry fodder yield (4735 kg ha^{-1})), higher nutrient uptake by the crop (N, P and K uptake (142 kg ha^{-1}, 21.6 kg ha^{-1} and 138 kg ha^{-1} respectively) and available N, P_2O_5 and K_2O in the soil (208 kg ha^{-1}, 53.6 kg ha^{-1} and 223 kg ha^{-1} respectively) at harvest recorded higher with OS-403 variety of fodder oat sown during October I FN in the Southern Agroclimatic Zone of Andhra Pradesh.

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