**Influence of sowing windows on growth and yield of fodder oat varieties** **in Southern Agro-Climatic Zone of Andhra Pradesh, India**

**ABSTRACT**

The present experiment was carried out at dryland farm of Sri Venkateswra Agricultural College, Tirupati, ANGRAU-India during *rabi*, 2024-25 on sandy loam soils. The experiment laid out in the randomized block design with factorial concept and replicated thrice. The results of the experiment showed that the variety RO-11-1 sown during November II FN exhibited superior performance in terms of all growth parameters such as plant height, leaf to stem ratio, leaf area index and dry matter production. Furthermore, this treatment produced significantly higher green and dry fodder yields (18104 kg ha-1 and 4735 kg ha-1 respectively) compared to all other treatments.

**Keywords:** Fodder oat, green fodder yield, growth parameters, sowing windows

**1.INTRODUCTION**

Livestock production forms the backbone of India’s Agricultural economy, contributing 25.6% to agricultural GDP and 4.11% to the national GDP (Anonymous, 2019). Nearly 58% of the population relies on agriculture and allied sectors such as livestock, poultry and fisheries, for their livelihood, making this sector essential for both income generation and nutritional security. Despite being the world’s leading milk producer and home to 57.3% global buffalo population and 14.7% cattle population, India faces a persistent deficit in feed and fodder availability. On an average, there is a 40 percent gap in the dry and green fodder supply; by 2025, this deficit might rise to 45 percent. The lack of adequate supply of high-quality feed is one of the major bottle necks responsible for low productivity of livestock. Country’s agricultural land utilized to produce fodder is 4.4% only. The gap between the supply and demand of feed and fodder needs to be reduced. Addressing this challenge, requires enhancing the production and productivity of forage crops, while ensuring soil health and ecological sustainability.

Oat (*Avena sativa* L.) a highly nutritious *rabi* fodder crop, has been traditionally cultivated in the Northern and North-Western states of India, favoured by the region’s suitable climate. Oat adapt well to cooler environment. It grows best in locations with winter temperatures between 15 and 25◦C with moist conditions. Its crude protein content is higher than maize and barley. In contrast to the other cereals, oats have higher concentration of necessary amino acids such as lysine, making it one among the preferred feed by livestock farmers. Due to its quick growth, palatability, high protein content and dual-purpose nature, oat is emerging as a promising fodder crop in non-traditional regions such as Southern India, where fodder shortages are acute. Higher yielding fodder crop varieties are necessary to meet the nutritional requirements of the animals.

However, the productivity and quality of fodder oat is strongly influenced by environmental conditions, particularly the time of sowing. Time of sowing, which is regulated by temperature and moisture, is a major yield contributing factor for oat production. Early or delayed sowing can adversely affect the yield. Since oat is typically sown in October and November, fodder yield tends to fluctuate significantly owing to temperature variations during the growing season. Given the limited research and adoption of oat cultivation in Southern Agro-Climatic Zone, especially under varying sowing windows, there is a need to evaluate its growth and productivity to formulate region-specific agronomic recommendations.

This study investigates the performance of different oat varieties under various sowing windows to determine which variety performs best under specific sowing conditions in Southern Agroclimatic Zone of Andhra Pradesh.

**2.MATERIALS AND METHODS**

The present investigation was done at dryland farm of S.V. Agricultural College, ANGRAU, Tirupati during *rabi*, 2024-25.The soil of the experimental field was sandy loam and it 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 (241kg ha-1) status. The experiment was laid out in randomized block design with factorial concept and replicated thrice. The treatments consisted of fifteen combinations comprising of three varieties viz., V1: RO-11-1, V2: OS-403 and V3: OS-6 and five sowing windows viz., S1: October I FN, S2: October II FN, S3: November I FN, S4: November II FN and S5: December I FN. The crop was sown at 30 x 10 cm spacing with a seed rate of 100 kg ha-1. Recommended dose of fertilizer was 80 – 40 – 30 N, P2O5 & K2O kg ha-1, entire 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. 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 crop parameters were statistically evaluated using the randomised block design with factorial concept method recommended by Panse and Sukhatme (1985).

**3.RESULTS AND DISCUSSION**

**3.1 GROWTH PARAMETERS**

 With respect to the varieties, the plant height of fodder oat increased steadily with progress in the age of the crop up to harvest. At all the stages of observation, taller plants were produced with RO-11-1 variety which was significantly higher than that of variety OS-6. The shortest plants were produced by OS-403, which was however comparable with that of variety OS-6 (Table 1). The difference in plant height among the varieties might be due to their genetic makeup and environment adaptability. These results are in line with findings of Singh *et al*. (2018), Samal *et al.* (2023) and Satpal *et al*. (2024). Leaf to stem ratio of fodder oat showed decreasing trend with advance in age of the crop up to harvest. The variety RO-11-1 recorded significantly higher leaf to stem ratio compared to OS-6, while OS-403 registered the lower leaf to stem ratio which was statistically similar to that of OS-6 (Table 1). The variety RO-11-1 has a superior leaf portion and less stem biomass, which have contributed to higher leaf to stem ratio. The lower leaf to stem ratio was observed with OS-403, due to lower in leafiness and stem diameter compared to RO-11-1. Similar findings were reported from the studies of Sheoran *et al*. (2017), Satpal *et al*. (2018) and Sarkar *et al*. (2022).

Leaf area index of fodder oat increased progressively with the advance in age of the crop up to harvest. At all the stages of observation, higher leaf area index was recorded with RO-11-1 variety which was significantly higher than that of variety OS-6. Significantly, the lower leaf area index was observed with OS-403 oat variety which was however comparable with that of OS-6 (Table 1). The higher leaf area index were observed with the variety RO-11-1 might be due to genetic ability in producing more number of leaves and total leaf area plant-1. The lower leaf area index was recorded with OS-403 which owed to lesser number of leaves and leaf area. The present findings were in conformity with those of Shah *et al*. (2015), Pant *et al*. (2022) and Koushal *et al*. (2024). Dry matter production of fodder oat increased progressively with the advance of crop age up to harvest. At all the stages of crop growth, RO-11-1 recorded the highest dry matter production which was significantly superior over the variety OS-6. The lowest dry matter production was obtained withOS-403, which was statistically on par with variety OS-6 (Table 1). Dry matter production is the prerequisite for higher yields, which is an indication of the biosynthetic process associated with the crop growth and development. Irrespective of the stages of crop growth, significantly higher dry matter production was observed with variety RO-11-1 due to increase in the assimilatory surface area of plant might have caused an increase in its biomass, which ultimately lead to the accumulation of a large quantity of photo assimilates and also the variation among the varieties may be due to their genetic constitution during crop growth period. These results are in harmony with the findings of Sarkar *et al*. (2022) and Koushal *et al*. (2024).

 Among the sowing window trials, significantly taller plants, higher leaf to stem ratio, higher leaf area index and higher dry matter production were noticed with fodder oats sown during November II FN. The next best treatment was December I FN followed by November I FN and October II FN with significant disparity among them. While all these parameters were at their lowest during October I FN (Table 1). The increase in plant height might be due to availability of optimum temperature, suitable photoperiod and relative humidity which helps in better growth of plants through enhanced cell division, thus aids in internodal elongation. The higher leaf to stem ratio was due to the presence of more number of functional leaves and increase in more leaf production than stem elongation under later dates of sowing caused improvement in leaf stem ratio. Increase in leaf area index might be due to congenial micro and macro climatic conditions during the growth stage of the crop, that leads to production of taller plants coupled with more leaves, leaf area and leaf area index which increased the photosynthates production that would ultimately result in good performance of the crop in terms of leaf area index. The higher dry matter production during November II FN might be due to suitable photoperiod, optimal relative humidity, significantly higher plant height and higher number of functional leaves, all of which contribute to enhanced dry matter accumulation during the crop growth period. Hence, all these factors attributed to better growth response of fodder oats because of availability of optimum temperature, relative humidity and suitable photoperiod that prevailed during the crop growth period, which helps in better growth of plants through enhanced cell division, thus helps in internodal elongation, that leads to production of taller plants coupled with more leaves, leaf area which increased the photosynthesis that would ultimately result in good performance of the crop in terms of growth parameters. Similar results were obtained by Kadam *et al.* (2020), Kumar *et al*. (2021), Naveena *et al*. (2021), Megharaja *et al*. (2023) and Digamber *et al*. (2024).

**3.2 GREEN AND DRY FODDER YIELD**

Higher green and dry fodder yields were recorded by variety RO-11-1, which was significantly higher than that of OS-6 and the lower green and dry fodder yields were recorded with OS-403 variety which was on par with OS-6 (Table 2). Increase in green and dry fodder yield of RO-11-1 than other varieties could be attributed to its genetic potentiality to utilize and translocate the photosynthates from source to sink 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. It was stated that higher yields of fodder in oat cultivars can be possibly attributed to their greater leaf area, responsible for more photosynthetic activities having high capacity to store assimilative products of photosynthesis.These results are supported by findings of Kashyap *et al.* (2022) Sarkar *et al*. (2022), Samal *et al*. (2023), Jindal *et al*. (2024) and Satpal *et al*. (2024).

Among the varied sowing windows, signiifcantly the higher green and dry fodder yields were observed with November II FN sown crop. This was followed by December I FN, November I FN and October II FN and all the sowing windows were significantly differed among them. Signifcantly lower fodder yields were recorded during October I FN sown crop (Table 2). The fodder oat needs cool crop growth period for producing higher yields. 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 ultimately lead to higher fodder yield compared to remaining sowing windows.Lower green and dry fodder yield was produced during October I FN, might be due to reduced photosynthetic activity as a result of unfavourable weather conditions that prevailed during the various stages of crops and negatively impacted the growth performance of the fodder oats.These results were in conformity with the findings of Murali *et al*. (2021), Kumar *et al*. (2021), Megharaja *et al*. (2023), Samal *et al*. (2023) and Samal *et al*. (2024).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | **Leaf : stem ratio** | **Leaf area index** | **Dry matter production****(kg ha-1)** |
|  | **30 DAS** | **45 DAS** | **At harvest** | **30 DAS** | **45 DAS** | **At harvest** | **30 DAS** | **45 DAS** | **At harvest** | **30** **DAS** | **45 DAS** | **At harvest** |
| **Varieties** |
| V1: RO-11-1 | 36.0 | 65.9 | 102 | 1.22 | 0.89 | 0.64 | 0.44 | 1.02 | 1.43 | 460 | 1324 | 2728 |
| V2: OS-403 | 29.7 | 59.1 | 94 | 1.08 | 0.75 | 0.53 | 0.36 | 0.87 | 1.27 | 402 | 1036 | 2360 |
| V3: OS-6 | 31.8 | 60.9 | 95 | 1.12 | 0.77 | 0.58 | 0.38 | 0.91 | 1.31 | 413 | 1108 | 2401 |
| SEm± | 0.82 | 1.13 | 1.4 | 0.027 | 0.022 | 0.014 | 0.011 | 0.021 | 0.027 | 6.8 | 35.3 | 42.7 |
| CD (P=0.05) | 2.4 | 3.3 | 4 | 0.08 | 0.06 | 0.04 | 0.03 | 0.06 | 0.08 | 20 | 102 | 124 |
| **Sowing windows** |
| S1: October I FN | 23.6 | 50.7 | 83 | 0.89 | 0.61 | 0.44 | 0.27 | 0.73 | 0.94 | 260 | 531 | 820 |
| S2: October II FN | 27.6 | 56.8 | 89 | 1.02 | 0.73 | 0.51 | 0.33 | 0.85 | 1.21 | 330 | 782 | 1484 |
| S3: November I FN | 32.1 | 61.7 | 97 | 1.14 | 0.81 | 0.58 | 0.39 | 0.95 | 1.34 | 423 | 1121 | 2972 |
| S4: November II FN | 42.5 | 73.7 | 112 | 1.36 | 0.97 | 0.72 | 0.52 | 1.13 | 1.67 | 587 | 1807 | 3807 |
| S5: December I FN | 36.6 | 67.1 | 104 | 1.28 | 0.88 | 0.65 | 0.46 | 1.03 | 1.53 | 525 | 1540 | 3398 |
| SEm± | 1.06 | 1.46 | 1.8 | 0.034 | 0.028 | 0.018 | 0.014 | 0.028 | 0.035 | 8.8 | 45.6 | 55.1 |
| CD (P=0.05) | 3.1 | 4.3 | 5 | 0.10 | 0.08 | 0.05 | 0.04 | 0.08 | 0.10 | 25 | 132 | 160 |
| **Varieties × Sowing windows** |
| SEm± | 1.83 | 2.53 | 3.2 | 0.059 | 0.048 | 0.031 | 0.024 | 0.048 | 0.060 | 15.4 | 79.0 | 95.5 |
| CD (P=0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

**Table 1:** Growth parameters of fodder oat as influenced by varieties and sowing windows

**Table 2:** Green and dry fodder yield of fodder oat as influenced by varieties and sowing windows

|  |  |  |
| --- | --- | --- |
| **Treatments** | **Green fodder yield (kg ha-1)** | **Dry fodder yield (kg ha-1)** |
| **Varieties** |
| V1: RO-11-1 | 12538 | 3643 |
| V2: OS-403 | 11467 | 2648 |
| V3: OS-6 | 11558 | 2710 |
| SEm± | 176 | 87 |
| CD (P=0.05) | 510 | 254 |
| **Sowing windows** |
| S1: October I FN | 3335 | 829 |
| S2: October II FN | 5966 | 1502 |
| S3: November I FN | 14513 | 3581 |
| S4: November II FN | 18104 | 4735 |
| S5: December I FN | 17354 | 4354 |
| SEm± | 227 | 113 |
| CD (P=0.05) | 659 | 328 |
| **Varieties × Sowing windows** |
| SEm± | 394 | 195 |
| CD (P=0.05) | NS | NS  |

**CONCLUSION**

The research results indicated that fodder oat variety RO-11-1 sown during November II FN was found to be most efficient in obtaining better growth parameters and higher green and dry fodder yields. Hence, this could be the best variety and sowing window to sustain higher productivity and profitability in Southern Agroclimatic Zone of Andhra Pradesh.

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