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Effect of Time of Sowing, Seed Rate, and Cultivar on Oat Green Fodder, Dry Matter and Crude Protein Yield

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ABSTRACT

A field experiment was conducted to find out suitable sowing time, optimum seed rate, and right cultivar of fodder oat for Telangana. The treatments consisted of 16 combinations with four times of sowing (first fortnight of October, second fortnight of October, first fortnight of November, and second fortnight of November), two seed rates (80 and 100 kg/ha), and two fodder oat cultivars (JHO 822 and Kent). The experiment was conducted in a split-plot design and replicated thrice in sandy loam soil. Two-year (2016-17 & 2017-18) pooled data analysis results revealed that green fodder yield, dry matter yield, and crude protein yields recorded were significantly ($p<0.05$) higher with the crop sown during the first fortnight of November followed by the second fortnight of October. Plant height and tiller number per meter row length also responded similarly. No significant difference was observed among the two seed rates for plant height, the number of tillers/meter row, green, and dry fodder yields except crude protein where 100 kg/ha seed rate recorded higher crude protein yield than 80 kg/ha seed rate. Cultivars significantly differed in plant height and crude protein yield only. All the interaction effects were found to be non-significant. The best sowing window for obtaining higher fodder yield and quality of oat in Telangana was found to be from the second fortnight of October to the first fortnight of November.

Key words: Cultivar, Fodder oat, Sowing time, Seed rate

INTRODUCTION

Oat (Avena sativa L.) is one of the best cereal fodder crops in North, Central, and Western parts of India in rabi season due to its ideal climate leading to good growth, quick regrowth, and high nutrition for both milch as well as draught livestock. Fodder shortage is common in Telangana State during winter because only a few fodder crops are available to grow in the winter season. One of the best suitable crops is oat which can grow quickly in cool weather and provide quality fodder in the winter months. Oat thrives well in areas where winter temperatures range between 15-25 ^{0}C and it requires a long winter season for their growth and development. Its fodder yield and quality are reduced due to hot and dry weather conditions though it can tolerate frost to some extent. Oat contains 10.0 to 11.5% crude protein in its dry fodder; and also consists, 55 to 63 % neutral detergent fibre, 30 to 32 % acid detergent fibre, 22.0 to 23.5 % cellulose, and 17 to 20 % hemicellulose when harvested at 50 % flowering stage of the crop (Kumar *et al.,* 2012). Oat is known for its multiple uses for livestock as green fodder, straw, hay, or silage. Oat grains provide good feed particularly, for horses, sheep, and poultry.

Shekara and Lohithaswa (2012)reported that October second fortnight sown fodder oats produced higher green forageyield and dry matter yield as well as crude protein yield followed by November first fortnight sown fodder oat. October 25th sown fodder oat has produced higher green fodder and dry matter yields compared to November 25th sown fodder oat, reported by Kadam *et al.* (2019). In many parts of Telangana, low temperatures prevail during the rabi season makes it fit for the production of fodder or grain oats. As oat crop is generally sown in the month of November in Telangana, the effect of early and delayed sowing on green fodder yield and other quality parameters needs to be studied to identify the ideal sowing time/sowing window for exploiting the full production potential. Optimum seed rate is also needed to be identified for getting optimum plant

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population for the production of higher fodder or seed yield. The seed rate of 120 kg/ha has produced higher green forage, dry matter, and crude protein yields. However, no significant difference found when compared this with the seed rate of 100 kg/ha (Shekara and Lohithaswa, 2012). To increase the fodder yield under restricted growth conditions of Telangana, there is a need to identify higher yielding genotypes which may compensate for the much-felt green fodder demand during winter months. With this background a field experiment was initiated in rabi 2016-17 inthe Experimental field of All India Coordinated Research Project on Forage Crops & Utilization Centerat Agricultural Research Institute, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad with the following objectives:

1. To identify a suitable time of sowing (sowing window) and establish a relationship with climatic factors on productivity in Telangana.
2. To identify an optimum seed rate for getting optimum plant population for production of higher fodder yield
3. To identify suitable variety for Telangana which produce higher fodder yield

MATERIALS AND METHODS

A field trial was conducted during rabi 2016-17 and repeated in rabi 2017-18.The experimental location is situated at 17°19' 18" N latitude, 78°24' 18" E longitude and at an altitude of 527m above mean sea level in the Southern Telangana Agroclimatic Zone in Telangana State India.The average annual rainfall of the area was 750 mm and maximum and minimum temperatures ranged between 24.6 to 34.10C and7.6 to 18.6 ^{0}C respectively during the crop growth period. Experimental site was well drained moderately deep sandy loam soil with pH of 7.8 and EC of 0.22 dS m-1. The experimental field was low in available N (152 kg ha-1), medium in phosphorus (26.0 kg ha-1) and high in potash (293.0 kgha-1). The experiment was conducted in a split-plot design with three replications. In the field layout four times of sowing were applied to four main plots (4 main blocks) and seed rates incombination with varieties were randomly allotted to sub plots within each main plot. Recommended dose of nitrogen, phosphorus, and potassium @ 100, 40, and 40 kg/ha was applied in the form of urea, single super phosphate (SSP), and muriate of potash (MOP) respectively. Full dose of SSP and MOP were applied to the experimental plots as basal dose and half of the total nitrogen applied as basal and remaining half was top dresses at 30 days after sowing. The crop was evaluated for plant height (cm), number of tillers/metercrop row, and green forage yield at 50% flowering stage. The crop was harvested plot-wise and fresh green forage yield was recorded in kg/plot, later it was converted into quintals per hectare. A fresh sample of 500 g taken from each treatmentwas sundried initiallyfollowed by oven driedat 60-65^{0}C to a constant weight and estimated dry matter yield, later dried plant samples were finely ground and subsequentlyused for quality analysis in the biochemistry laboratory. The collected data was statistically analysed by analysis of variance (ANOVA) for split plot design. Critical differences were worked out at five percent probability level in LSD, if treatments were significantly differedand if not; NS was denoted (Gomez and Gomez, 1984). Two years data was pooled and statisticallyanalysed using OPSTAT software for theinterpretations of results (Sheron *et al.,* 1998).

Details of the treatments:

Main plot Treatment (Times of sowing: 4)

1) T1: First fortnight of October; T2: Secondfortnight of October

2) T3: First fortnight of November; T4: Second fortnight of November

Sub plot Treatment (Seed rates:2)

1) S1:80 Kg/ha; 2) S2: 100 kg/ha

Sub plot Treatment (Cultivars: 2)

1) V1: JHO-822 ;2) V2: Kent

The total number of treatments was 4x2x2 = 16

RESULTS AND DISCUSSION

Times of sowing have a significant influence on plant height in fodder oat. Two-year pooled data (Table 1) revealed that November 1st fortnight sown fodder oats produced significantly taller plants when compared to October 1st fortnight and November 2nd fortnight sown fodder oats. But it was on par with October 2nd fortnight sown oats. Results of both rabi 2016 and 2017 also shown a similar trend. Similar findings were reported by Shekara and Lohithaswa (2012) and Kadam *et al.* (2019).

Table1. Effect of times of sowing, seed rate, and cultivar on plant height and tiller

Treatments	Plant Height (cm) at 50% flowering			No. of Tillers/m row at 50% flowering		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
Main plot: Times of sowing (4)						
T1: First fort night of October	72.0	60.2	71.9	141.3	140.5	140.0
T2: Second fortnight of October	76.9	71.8	76.0	159.0	158.0	158.6
T3: First fortnight of November	77.9	68.8	77.8	169.0	164.5	167.0
T4: Second fortnight of November	62.9	62.2	62.9	135.6	138.3	135.6
SEm+	1.9	1.0	1.9	5.0	4.5	4.9
CD (P<0.05)	6.8	3.5	6.8	15.8	13.1	14.8
Sub plot: Seed rates (2)						
S1: 80 Kg/ha	71.1	63.5	71.2	157.6	152.3	157.6
S2: 100 Kg/ha	73.3	66.5	73.2	165.8	154.4	165.8
SEm+	1.4	0.8	1.4	4.8	1.3	4.8
CD (P<0.05)	NS	NS	NS	NS	NS	NS
Sub plot: Varieties (2)						
V1: JHO-822	74.5	65.4	74.6	157.5	152.7	157.6
V2: Kent	70.0	62.1	70.2	166.0	154.0	161.2
SEm+	1.4	1.0	1.2	4.8	1.3	4.8
CD (P<0.05)	4.2	3.1	3.9	NS	NS	NS

Note: All the Interactions (T x S, T x V, S x V, and T x S x V) were found to be non-significant (NS)

Plant height was 71.2 cm at the seed rate of 80 kg/ha and 73.2 cm at the seed rate of 100 kg/ha, but these two seed rates didn't differ significantly in the pooled data (Table 1). This is in accordance with Droushiotis (1990). Pooled analysis showed that the cultivar JHO-822 produced significantly taller plants (74.6 cm) than Kent (70.2 cm).All the interaction effects (interaction between dates of sowing and seed rate, seed rates and cultivars, and dates, seed rates, and cultivars) were found non-significant in influencing the plant height.

The number of tillers per meter row length significantly differed with timesof sowing. Fodder oats sown in the first fortnight of November produced a higher number of tillers per meter (167.0), followed by the second fortnight of October sown oats (158.6). These two sowing dates were significantly higher than the first fortnight of October and the second fortnight of November sown, treatments in tiller number 140.0 and 135.6 respectively (Table 1). This higher tiller number may be due to conducive vegetative growth for oat.

November 1st fortnight and October 2nd fortnight sown fodder oats didn't differ significantly in tiller number per meter row length. Rabi 2016 and rabi 2017 results individually also followed a similar trend.Two seed rates and two cultivars didn't influence the number of tillers per meter row length significantly. Erega *et al.* (2020) had also reported the similar results. No interaction effect was found significant in affecting the tiller number.

The November 1st fortnight sown fodder oat has produced more green forage yield 525.5 q/ha than other 3 dates of sowing treatments. It was significantly higher than October 1st sown (430.2 q/ha) and November 2nd fortnight sown crop (373.8 q/ha). However, it was at par with the treatment October 2nd fortnight sown oats (478.4 q/ha). Shekara and Lohithaswa (2012) and Kadam *et al.* (2019) reported similarly, but Jehangir *et al.* (2013) reported that September 30th sown fodder oat produced significantly higher green fodder yield compared to October 10th sown crop at in Kashmir conditions; Sood *et al.* (1992) reported higher plant height, tillers per meter row, and green fodder yieldin early sown oat crop (5th October) under temperate conditions. Sharma *et al.* (2017) also reported October 15th sown fodder oats produced than that of October 30th sown and November 14th sown crop at Palampur, Himachal Pradesh (Jehangir *et al.,* 2013).Early sown (September 10th) berseem crop has produced significantly higher green forage yield than late sown crop (October 20th) at Amritsar reported by Singh *et al.* (2021). Kumar *et al.* (2021) also found that different dates of sowing differed significantly in producing green fodder yield in fodder oat.Fodder oat need cool winter season for good crop growth and to produce green fodder and dry matter yields. In temperate regions of India such as Kashmir & HP the fodder oat produced significantly higher yields in mid-September to mid-October sown crop where as in southern States such as Telangana and Karnataka fodder oats produced higher green forage and dry matter yields when sown during mid-October to mid-November. Green forage yield was not significantly influenced by the two seed rates in contrast to it (Shekara and Lohithaswa, 2012) reported and the similar trend was noticed also with the two cultivars used in the experiment. In contrast to it May *et al.* (2004) reported the significant difference between two cultivars they tested in combination with three sowing dates.

The times of sowing have a significant effect on dry matter yield also as November 1st fortnight sown fodder oat yielded more dry matter yield (123.7 q/ha) than other October 1st& 2nd fortnight sown and November 2nd fortnight sown fodder oat. Shekara and Lohithaswa (2012) have reported October 2nd fortnight sown fodder oat produced higher dry matter yield followed by November 2nd fortnight sown fodder oats. October 2nd fortnight sown annual ryegrass produced significantly higher dry matter yield than other treatments (Sidhu *et al.,* 2020). This may be due to congenial climate for better fresh growth that reflected in dry matter accumulation. Two seed rates did not influence dry matter yields. Similar results reported by Erega *et al.* (2020). However, Singh *et al.* (2018) has reported that seed rate 90 kg/ha of fodder oat produced higher dry matter yield than other seed rates viz., 60 and 120 kg/ha.Cultivars (JHO 822 and Kent) didn't significantly differ in producing dry matter yields. In contrast, Dar *et al.* (2014) and Sharma *et al.* (2017) reported that fodder oat cultivars differed significantly in producing dry matter yields.

Crude protein yields significantly differed with dates of sowing. The November 1st fortnight sown fodder oat produced highest crude protein yield which was followed by October 2nd fortnight sown crop. Similar results were also reported by Shekara and Lohithaswa (2012). In contrast to it Dar *et al.* (2014) reported that the crude protein and crude fiber content were significantly higher with delayed sowing (5th November).

Table 2. Effect of times of sowing, seed rate, and cultivar on green forage yield, dry matter yield, and crude protein yield

Treatments	Green Fodder Yield (q/ha) at 50% flowering			Dry Matter Yield (q/ha) at 50% flowering			Crude protein Yield (q/ha) at 50% flowering		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
Main plot: Times of sowing (4)									
T1: First fort night of October	453.2	383.5	430.2	120.4	90.5	100.6	9.1	7.8	8.8
T2: Second fortnight of October	552.1	423.4	478.4	123.6	102.5	112.5	9.8	9.2	9.5
T3: First fortnight of November	564.6	448.3	525.5	138.4	113.7	123.7	11.5	10.4	10.8
T4: Second fortnight of November	379.2	369.6	373.8	114.3	92.7	94.4	8.5	8.1	8.2
SEm+	15.2	13.7	13.9	4.8	4.3	4.6	0.2	0.3	0.05
CD (P<0.05)	55.8	47.2	47.8	15.5	13.2	14.4	0.7	1.0	0.20
Sub plot: Seed rates (2)									
S1: 80 Kg/ha	495.3	405.8	445.5	127.6	90.8	102.8	9.3	7.3	8.8
S2: 100 Kg/ha	504.2	415.8	464.7	133.6	93.9	108.9	10.3	7.9	9.4
SEm+	8.8	8.2	8.2	2.1	1.7	1.7	0.2	0.1	0.1
CD (P<0.05)	NS	NS	NS	NS	NS	NS	0.7	0.4	0.3
Sub plot: Varieties (2)									
V1: JHO-822	490.1	405.8	405.8	124.6	91.6	103.6	9.0	8.7	8.8
V2: Kent	509.4	415.8	455.2	131.6	93.2	110.1	10.1	9.5	9.9
SEm+	8.8	7.6	8.2	2.9	1.7	1.7	0.2	0.1	0.2
CD (P<0.05)	NS	NS	NS	NS	NS	NS	0.7	0.4	0.6

Note: All the Interactions (T x S, T x V, S x V, and T x S x V) were found to be non-significant (NS)

Seed rates and varieties have significantly influenced the crude protein yield in fodder oats (Table 2). But Shekara and Lohithaswa (2012) reported that seed rates did not influence significantly in crude protein yields in fodder oats. Dar *et al*. (2014) reported that cultivars significantly influenced crude protein yields in fodder oats.

CONCLUSION

November 1st fortnight sown fodder oat crop produced significantly higher green fodder yield, dry matter yield, and crude protein yields which was followed by second fortnight of October sown fodder oats. These two sowings were superior over the other two times of sowing (October 1st fortnight and November 2nd fortnight sown crop). Plant height and tiller number per meter row length also responded similarly. Hence the best sowing window for fodder oat in Telangana is from October 15th to November 15th. No significant difference was observed among two seed rates for plant height,

number of tillers/meter row, green and dry fodder yields except crude protein where 100 kg/ha seed rate recorded higher crude protein yield than 80 kg/ha seed rate. Cultivars significantly differed in plant height and crude protein yield only. All the interaction effects were found to be nonsignificant.

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