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# STANDARDISATION OF NITROGEN FERTILISER DOSE AND SPACING IN FODDER OATS AT HIGH RANGES OF KERALA

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## SUMMARY

The study entitled "Standardisation of nitrogen fertiliser dose and spacing in fodder oats at high ranges of Kerala" was undertaken during *Rabi* 2021-22 at Wayanad Eastern Plateau with the objective to find out the optimum nitrogen dose and spacing level for fodder oat cultivation. The experiment was done in randomized block design with nine treatments replicated thrice. Treatments consisted of two factors *viz.,* row spacing (S) and nitrogen dose (N) at three levels each *viz.,* $s_1$ (15 cm), $s_2$ (25 cm), $s_3$ (35 cm) and $n_1$ (60 kg N/ha), $n_2$ (90 kg N/ha), $n_3$ (120 kg N/ha) respectively. The results of the study revealed that, $s_3n_3$ (35 cm, 120 kg N/ha) recorded the tallest plant and a greater number of tillers/hill. In case of GFY (green fodder yield) and DFY (dry fodder yield), $s_1n_3$ recorded the highest yield GFY and DFY. Nitrogen dose $n_3$(120 kg N/ha) recorded the highest chlorophyll content and crude protein content. Moreover, application of 120 kg/ha nitrogen at a spacing 15 cm had given the highest net income (Rs. 58645.92/ha) and BC ratio (1.87).

**Key words:** Chlorophyll, crude protein, fodder, minerals, palatability

Livestock is interwoven closely with Indian agricultural economy and possess 15 percent of worlds livestock population and contributes 4.11 percent to total GDP (DAHD&F, 2012). The livestock population is rising at a pace of 0.66 per cent per annum in India, but the scope for increasing area under fodder cultivation is limited. The fodder cultivation occupies about 4 per cent of the total cultivated land. Presently, India faces a shortage of 35.6 % green fodder and 11% dry fodder respectively (Pandey and Roy, 2011). Thus, it is important to employ the available limited area intelligently with at most capacity for fodder production.

In India, Oat (*Avena Sativa* L.) is one of the most dominant rabi fodder cereal crop. It is extremely delicious and nutritive with luxuriant growth. It is a great source of energy, protein, vitamin $B_1$, phosphorus, iron and other minerals. It is grown for grazing, fresh green forage, hay, silage and also for its grain. Comparing with wheat and barley, oat is enjoyed by all the animals considering its higher softness and palatability (Hameed *et al.,* 2014). A long cool season is necessary for its proper growth, thus can be grown successfully in the plains and hilly areas.

Row spacing is one of the key practices for fodder oat production because crop geometry affects both the growth and yield of forage since it is linked with nutrient availability and competition for resources (Irfan *et al.,* 2016). The rise or fall in row spacings and plant population follows a constant pattern in relation to the crop yield. In these opposing simultaneous effects of the two components there must be a locus where the highest yield is expected and that must be at the optimum row spacing. Nitrogen is the most crucial input for fodder cultivation since greatest vegetative growth is required within a short time span in fodder crops. Nitrogen executes a pivotal role in photosynthesis and is an integral component of protein. Under favourable environmental conditions fodder oat can respond well to application of nitrogen, there by producing more yield from unit area in unit time. However, excess nitrogen application to fodder oat under certain environmental conditions can result in accumulation of nitrate, which can be poisonous to the ruminants.

In Kerala, the high range zone faces scarcity for fodder during winter. Oat being a rabi crop will grow well in Wayanad district of Kerala during winter months. Since limited researches are available on fodder oat for Kerala high range zones, this study was planned to find effect of nitrogen fertiliser dose and spacing on fodder oat production in Kerala high range zones.

## MATERIALS AND METHODS

The experiment was undertaken in Instructional Farm attached to RARS, Ambalavayal, Wayanad, Kerala during 20$^{th}$ November 2021 to 4$^{th}$ February 2022. The soil was sandy clay loam in texture with strongly acidic in reaction, low in organic carbon, normal in electrical conductivity, medium in available nitrogen, high in available phosphorus and medium in available potassium. The experiment was carried out in RBD with nine treatments replicated thrice. Treatments consisted of two factors *viz.,* row spacing (S) and nitrogen doses (N) at three levels each *viz.*, $s_1$ (15 cm), $s_2$ (25 cm), $s_3$ (35 cm) and $n_1$ (60 kg N/ha), $n_2$ (90 kg N/ha), $n_3$ (120 kg N/ha), respectively. The fodder oat variety selected for the study was Kent. Line sowing of seeds at the rate of 100 kg/ha was done at a spacing 15 cm, 25 cm and 35 cm. FYM @ 15 t/ha was given uniformly in all the plots during final land preparation and thoroughly incorporated before planting. Full dose of P (40 kg/ha) and K (40 kg/ha) were incorporated as basal. N was given in 2 splits - 60 per cent as basal + 40 per cent at 40 days after sowing (DAS). As treatment constituted of nitrogen application in different levels and split, the needed quantity was calculated and given to corresponding plots in accordance with the experimental design. Irrigation was done once in 5 days to ensure sufficient moisture in the plots. Harvesting was done at 50% flowering. Only single cut was taken from the crop.

Height of 20 plants per plot was recorded from the base to the tip of the longest leaf of the sample plant. The mean heights were worked out and expressed in centimeters (cm). Tillers were counted from the sample plants in each plot and the mean was marked as number of tillers per hill at harvest. Crop was reaped just above the ground and then made into bundles in each plot. Fresh weight of the plants in the net plot was noted after the harvest and the total yield of green fodder was expressed in t/ha. The green fodder sample collected from each of the net plot was dried in sun and then dried in oven @ $65 \pm 5^0$C till a constant weight was attained. Dry matter content was calculated and the dry fodder yield was worked out in t/ha. Chlorophyll content of leaves was calculated using the formula suggested by Yoshida *et al.,* (1976). The crude protein content at harvest was calculated by multiplying nitrogen content of the plant sample in per cent (on dry weight basis) with the factor 6.25 (Simpson *et al.,* 1965). Net income was estimated by subtracting total cost of cultivation from returns. This value is the actual profit that is obtained by the farmer. B:C Ratio was estimated by dividing gross income by cost of cultivation.

## RESULTS AND DISCUSSION

The result revealed that growth characters like tiller count per hill, green fodder and dry fodder yield were significantly influenced by spacing but it failed to elicit any significant effect on height of plants. However, nitrogen levels and S x N interaction effect elicited significant effect on all the growth as well as yield parameters.

The result on height of plant clearly revealed that the highest dose of nitrogen application 120 kg N/ha had recorded the maximum plant height (102.53 cm). The higher nitrogen dose might have enhanced carbohydrate synthesis which in turn would have resulted in production of taller plants. According to Ahmad *et al.*, (2011) rising the dose of nitrogen application improved the height of plant compared to the application of lower levels of nitrogen. Among different treatment combinations, $s_3n_3$ (35 cm, 120 kg N/ha) had recorded the maximum plant height (111.92 cm) and was on par with $s_1n_3$ (15 cm, 120 kg N/ha). Wider spacing together with higher nitrogen availability would have resulted in higher plant height due to decreased competition and greater availability of nutrients. This result confirms the finding of Manjunath *et al.,* (2013) who recorded maximum height in fodder sorghum with rise in nitrogen levels at wider spacing.

Spacing, nitrogen levels and their interaction had significant effect on tiller count per hill. Wider row spacing ($s_3$) recorded the maximum number of tillers per hill (9.22). This might be because of the scarce competition for solar radiation, nutrients and soil moisture by plants grown under wider row spacing having a smaller number of plant population (Ayub *et al.,* 2013). Among nitrogen levels, maximum tiller production was recorded with $n_3$ (120 kg/ha). The results of an experiment done by Sharma and Verma (2004) confirmed the above finding and they also recorded that regardless of the varieties, 120 kg/ha nitrogen application accounted greater tiller count/m$^2$. Among treatment combinations, $s_3n_3$ (35 cm, 120 kg N/ha) had produced the maximum number of tillers per hill. Wider spacing together with higher nitrogen availability would have enhanced the tiller production. Similar increase in the tiller count in fodder oat was also reported by Dubey *et. al.,* (2013).

TABLE 1

Effect of row spacing, nitrogen levels and their interaction on yield and quality of fodder oat.

| Treatments | Green fodder yield (t/ha) | Dry fodder yield (t/ha) | Chlorophyll content (mg/g) | Crude protein (%) | Plant height (cm) | Number of tillers/hill |
|---|---|---|---|---|---|---|
| **Row spacing (S)-3** | | | | | | |
| $s_1$ (15 cm) | 26.58 | 5.32 | 3.02 | 12.31 | 86.61 | 8.28 |
| $s_2$ (25 cm) | 22.18 | 4.44 | 2.92 | 12.29 | 90.11 | 8.98 |
| $s_3$ (35 cm) | 22.12 | 4.42 | 3.09 | 12.00 | 88.31 | 9.22 |
| SEm (±) | 0.79 | 0.16 | 0.15 | 0.17 | 2.43 | 0.01 |
| CD (0.05) | 2.36 | 0.47 | NS | NS | NS | 0.01 |
| **Nitrogen levels (N)-3** | | | | | | |
| $n_1$ (60 kg/ha) | 18.61 | 3.72 | 2.56 | 11.79 | 77.41 | 8.68 |
| $n_2$ (90 kg/ha) | 24.57 | 4.92 | 2.92 | 12.27 | 85.09 | 8.82 |
| $n_3$ (120 kg/ha) | 27.69 | 5.54 | 3.54 | 12.54 | 102.53 | 8.99 |
| SEm (±) | 0.79 | 0.16 | 0.15 | 0.17 | 2.43 | 0.01 |
| CD (0.05) | 2.36 | 0.47 | 0.44 | 0.521 | 7.29 | 0.01 |
| **S x N interaction** | | | | | | |
| $s_1n_1$ | 23.49 | 4.69 | 2.29 | 12.13 | 72.33 | 8.08 |
| $s_1n_2$ | 26.09 | 5.22 | 3.15 | 12.25 | 80.83 | 8.28 |
| $s_1n_3$ | 30.14 | 6.03 | 3.61 | 12.54 | 106.67 | 8.48 |
| $s_2n_1$ | 13.79 | 2.76 | 3.03 | 12.10 | 88.60 | 8.78 |
| $s_2n_2$ | 25.66 | 5.13 | 2.54 | 12.27 | 92.00 | 8.98 |
| $s_2n_3$ | 27.09 | 5.42 | 3.16 | 12.52 | 89.73 | 9.18 |
| $s_3n_1$ | 18.55 | 3.71 | 2.35 | 11.15 | 71.28 | 9.18 |
| $s_3n_2$ | 21.96 | 4.39 | 3.07 | 12.29 | 82.46 | 9.19 |
| $s_3n_3$ | 25.85 | 5.17 | 3.84 | 12.56 | 111.19 | 9.29 |
| SEm (±) | 1.37 | 0.27 | 0.25 | 0.30 | 4.21 | 0.01 |
| CD (0.05) | 4.09 | 0.82 | NS | NS | 12.63 | 0.01 |

The study revealed that spacing, nitrogen levels and their treatment interaction had remarkable effect on GFY of fodder oat. Narrow row spacing $s_1$ (15 cm) had produced the maximum GFY (26.578 t/ha) and DFY (5.32 t/ha). This highest GFY and GFY in closer spacing might be due to the highest plant population in 15 cm spacing compared to that in 25 cm and 35 cm spacing. Within nitrogen levels, greatest GFY and DFY were obtained at maximum N dose $n_3$ (120 kg N/ha). Mahale *et al.,* (2003) reported a rise in green as well as dry forage yields with rise in N doses. According to Devi *et al.,* (2009) application of N resulted in an enhancement in cell wall protoplasm in turn contributed to an enhancement in cell size which altogether enhanced the growth and yield attributes. Within treatment combinations, $s_1n_3$ (15 cm, 120 kg N/ha) recorded the maximum GFY and DFY. This complies with the findings of Irfan *et. al.,* (2016) that 120 kg/ha nitrogen fertilizer had recorded the highest yield attributes at a closer row spacing.

Row spacing and S x N interaction did not have any significant influence on content of chlorophyll while nitrogen levels had significant influence on chlorophyll content. This confirms the findings of Kathirvelan and Kalaiselvan (2006) that chlorophyll content is a character of variety and thus not affected by the spacing. Chlorophyll content was recorded to be highest under nitrogen fertilization of 120 kg/ha than at lower nitrogen doses. This result also confirms with the findings of Skudra and Ruza (2017) that an elevation in content of chlorophyll at higher levels of nitrogen fertilization.

The data revealed that spacing and S x N interaction had no significant influence on the crude protein of fodder oat whereas nitrogen levels had significant impact on the crude protein. Significantly higher crude protein (12.542 %) was observed at $n_3$ (120 kg N/ha) and that was on par with $n_2$ (90 kg N/ha). Nitrogen is an integral part of various metabolites like amino acids and protein, thus increased nitrogen in plants could have resulted in increased protein synthesis. The above result agrees with the findings of Pradhan and Mishra (1994) that the crude protein of fodder oat increased greatly with successive rise in N doses.

The treatment combinations $s_1n_3$ (15 cm, 120 kg N/ha) produced the highest net income (Rs. 58646/ha) as well as B:C ratio (1.87) followed by $s_2n_3$ (25 cm, 120 kg N/ha). This is because of the obtained highest green fodder yield in $s_1n_3$ and $s_2n_3$ that in turn contributed to in higher net income as well as B:C ratio.

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