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# EFFECT OF NITROGEN LEVELS ON NUTRIENT CONTAINS AND FORAGE YIELD OF PROMISING VARIETIES OF OAT (*Avena sativa* L. )

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## ABSTRACT

**A field experiment was conducted at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur during Rabi season of 2007-08. The experiment was laid out in Factorial Randomized Block Design with three replications. Different varieties of oat viz. UPO-2005-1 ($V_1$), NDO-1($V_2$), Kent (SC) ($V_3$) and OS-6 (SC) ($V_4$) and four levels of nitrogen viz. 0 kg/ha ($N_1$), 40 kg/ha ($N_2$), 80 kg/ha ($N_3$) and 120 kg/ha ($N_4$) are two factors were kept under different treatment combinations. The growth and yield attributes, like plant height, CGR, number of tillers, leaf stem ratio and fresh and dry forage yield were superior under UPO-2005-1($V_1$) variety of oat and 120 kg/ha ($N_4$) as compared to oat varieties and different nitrogen levels. Among different varieties of oat, Kent (SC) variety recorded significantly higher Nitrogen content (%), Nitrogen uptake, crude protein content (%) and crude protein yield. Among different doses of Nitrogen, application of Nitrogen @ 120 kg/ha recorded significantly Nitrogen content (%), Nitrogen uptake, crude protein content (%) and crude protein yield, which was statistically at par with Nitrogen application @ 80 kg N/ha ($N_3$). Among interaction effect, variety Kent (SC) + Nitrogen @ 120 kg/ha treatment recorded highest Nitrogen content (%), Nitrogen uptake, crude protein content (%) and crude protein yield. Plot where Kent (SC) variety grown, recorded significantly higher N status in soil over other treatments. Highest N status in soil was noted when Nitrogen was applied @ 120 kg/ha followed by 80 Nitrogen/ha. Among interaction effect, combination of variety Kent (SC) + Nitrogen @ 120 kg/ha recorded highest N status in soil. Among interaction effect of varieties and nitrogen levels, $V_3N_4$ ((Kent (SC) + Nitrogen @ 120 kg/ha) recorded highest number of tiller/m row length, Green fodder yield (417.33 q/ha) and dry fodder yield (94.38 q/ha) followed by $V_1N_4$ (UPO-2005-1 + Nitrogen @ 120 kg/ha) and $V_3N_3$ ((Kent (SC) + Nitrogen @ 80 kg/ha). The lowest number of tiller/m row length, Green fodder yield (190.03 q/ha) and dry fodder yield (43.46 q/ha) were recorded under $V_2N_1$ (NDO-1 + Nitrogen @ 0 kg/ ha).**

***Key Words :*** *Nitrogen levels, nutrient contains, forage yield and varieties of oat*

Oat (*Avena sativa* L.) is one of the most winter forage crop. It containing 10-12 per cent protein and 30-35 per cent fibre, rich in fat, vitamin B1, phosphorus and iron (1). Agriculture and Animal husbandry is complementary enterprises and it plays a vital role in Indian economy Animal husbandry output constitutes about 30 per cent of the country's agriculture output (2). Winter forage oat is good for milch and draft cattle and important annual forage crop in areas having limited irrigation facilities due to quick regrowth habit and high tonnage. Therefore, there is a need to boost the production of green and dry fodder yield with good nutritive quality and better palatability. So far no studies have been taken upto explore the production potential of oat under the agro-climatic condition of Chhattisgarh plains. Many high yielding varieties of oat have been developed which needs to be tested after the harvest of rice for enhancing the cropping intensity of Chhattisgarh besides providing good quality forage to the animals for good live stack management. Nitrogen is one of the essential plant nutrients and is the most limiting nutrient in Indian soil. The key function of nitrogen is to increase the vegetative growth and boost up the regrowth after cutting in forage production. The major portion of nitrogen taken by the plant is used in synthesizing protein. It is essential for formulation of efficient nitrogen doses to achieve production of green and dry fodder yield with good nutritive quality and better palatability for livestock production management.

## MATERIALS AND METHODS

A field experiment was conducted at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur during Rabi season of 2007-08. The soil of the experimental field was clayey in texture locally known

as known as Matasi (Inceptisol) with pH 7.6. Fertility status of soil was categories as low nitrogen (208.52 kg/ha) and medium phosphorus (13.20 kg/ha) and high in potassium (314.50 kg/ha), EC (0.13 ds/m at 25°C), organic corban 0.36%, permanent wilting point (17.5 %), water holding capacity (39.48 %) and bulk density (1.4 Mg $m^{-3}$). The experiment was laid out in Factorial Randomized Block Design with three replications. Different varieties of oat (viz. UPO-2005-1($V_1$), NDO-1 ($V_2$), Kent (SC) ($V_3$) and OS-6 (SC) ($V_4$) and four levels of nitrogen viz. 0 kg/ha (N1), 40 kg/ha ($N_2$), 80 kg/ha ($N_3$) and 120 kg/ha (N4) are two factors were kept under different treatment combinations. The treatments were allotted to different plots by using random methods. Raipur, the capital of Chhattisgarh state comes under dry sub humid to semi dry agro-climatic zone, receiving an average rainfall of 1150 mm rainfall annually out of which about 88% is received during the rainy season (June to September) and the rest 12% during winter season (October to February). The maximum temperature goes as high as 45°C during summer months and minimum as low as 6°C during winter months. Relative humidity is high from June to October and shows a declining trend thereafter with an absolute minimum during peak winter (January). The temperature ranged between 15.4 to 29.8 °C during the sowing week, which favored germination and plant establishment. The temperature (18-21 °C) was quite favorable during vegetative growth of crop (3). The highest relative humidity varying between 85.8–92 per cent was also favorable for vegetative growth of the crop.The crop growth period received only 19.2 mm total rainfall. The maximum mean temperature for different months varied from 24.4-31.2 °C. The relative humidity was varying from 74-93 percent .Thus; weather ingredients were favorable during crop growth period. The open pan evaporation value ranged from 2.1 mm to 4.4 mm/day. The maximum sunshine hours was 9.5 hour/day in third standard metrological week of January and minimum 2.3 hours/day in first week of February. Observation on plant height, LAI, fresh weight of plant, dry matter accumulation (g/splant), dry weight of plant, L: S ratio, N content in plant and Crude Protein content were recorded at different growth stages. Yield and yield attributing character were statistically analyzed. Sorghum– Berseem- Sorghum cropping sequence was followed in the experimental field since last two year. It is obvious that Sorghum was taken as main crop in Kharif season followed by Berseem in rabi. The recommended levels of fertilizers along with their agronomic practices were in general adopted on the crop during the past two years for forage crop production. Oat seeds @ 90 kg/ha were sown apart from 25 cm row distance. In all the treatments, to maintain uniform plant population gap filling was done at 10 days after sowing. The required quantity of fertilizer was carried out as per the treatments. Urea and single super phosphate were used as the source of N and P respectively. Full dose of phosphorus was applied as basal and nitrogen was applied through urea as per levels of particular treatments in two split first 50 per cent at 25 DAS. Hand weeding was done manuals at 20 and 45 DAS, to avoid the weed growth in the field. After sowing, immediately light irrigation were applied through border strip method. Subsequent irrigation was given at an interval of 20 days for proper growth and development of the crop. After cutting light irrigation was applied essentially.

**Crop Growth Rate (g/day/plant) :** The CGR was calculated with the help of following formula:

$$\text{CGR (g/day/plant)} = \frac{W_2 - W_1}{t_2 - t_1}$$

Where,

$W_2$ and $W_1$ = Difference in oven dry biomass at the time interval

$t_2 - t_1$ = Time interval in day

**Leaf Area Index :** The leaf area index (LAI) of each stage was calculated by following formula:

$$\text{LAI} = \frac{\text{Toal leaf area of the crop}}{\text{Total ground area the crop}}$$

**Crude Protein content (%) :** Crude protein content of oat at harvest stage was obtained by multiplying the respective N concentration with 6.25 factor.

$$\text{Crude protein content (\%)} = \frac{\text{N content (\%) x 6.25}}{100}$$

**Nitrogen uptake :** N uptake by oat at harvest stage was computed from their respective elemental concentrations.

**Table-1 :** Plant height of oat as influenced by various treatments.

| Treatment | 20 DAS | | | | | 40 DAS | | | | | 60 DAS | | | | | At Harvest | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean |
| $V_1$ | 24.47 | 23.57 | 23.5 | 25.9 | 24.1 | 51 | 66.67 | 71 | 75 | 65.92 | 60 | 90 | 98.9 | 99 | 89.55 | 74.3 | 105.13 | 108.67 | 110.9 | 103 |
| $V_2$ | 19.8 | 23.13 | 23.1 | 24.5 | 22.6 | 46 | 62.2 | 66 | 68 | 60.55 | 58 | 87 | 88.4 | 90 | 80.82 | 73.8 | 92.67 | 104.4 | 106.1 | 94.25 |
| $V_3$ | 23.33 | 26.53 | 27.9 | 26.7 | 26.1 | 56 | 66.53 | 73 | 75 | 67.48 | 68 | 93 | 103 | 105 | 94.67 | 75.8 | 112.73 | 115.33 | 118.5 | 105.6 |
| $V_4$ | 21.27 | 23.73 | 23.9 | 24.8 | 23.4 | 54 | 64 | 66 | 69 | 61.43 | 60 | 83 | 93.8 | 97 | 83.28 | 75.5 | 96.67 | 105.33 | 109.5 | 96.75 |
| Mean | 22.22 | 24.12 | 24.6 | 25.5 | | 52 | 64.85 | 69 | 72 | | 64 | 91 | 97.2 | 99 | | 74.9 | 101.8 | 108.43 | 111.3 | |
| | Vari | Nitro | Inter | | vari | nitro | inter | | | Vari | Nitro | Inter | | | Vari | Nitro | Inter | | | |
| SEm± | 0.69 | 0.69 | 1.39 | | 1.4 | 1.42 | 2.85 | | | 1.70 | 1.70 | 3.40 | | | 1.21 | 1.21 | 2.43 | | | |
| CD (5%) | NS | NS | NS | | 4.1 | 4.12 | 8.25 | | | 4.91 | 4.91 | 9.83 | | | 3.51 | 3.51 | 7.03 | | | |

**Table-2 :** Fresh weight (g/plant) of oat as influenced by various treatments.

| Treatments | 20 DAS | | | | | 40 DAS | | | | | 60 DAS | | | | | At Harvest | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean |
| $V_1$ | 0.6 | 0.95 | 1.4 | 1.48 | 1.1 | 1.22 | 1.9 | 2.75 | 2.96 | 2.21 | 4.2 | 5.13 | 6.98 | 7.25 | 5.89 | 8.34 | 9.3 | 11.69 | 11.96 | 10.32 |
| $V_2$ | 0.47 | 0.88 | 1.3 | 1.4 | 1.0 | 0.95 | 1.77 | 2.6 | 2.82 | 2.04 | 3.9 | 4.85 | 6.41 | 6.62 | 5.46 | 7.97 | 9 | 10.98 | 10.98 | 9.72 |
| $V_3$ | 0.65 | 0.97 | 1.4 | 1.52 | 1.14 | 1.32 | 1.96 | 2.82 | 3.05 | 2.29 | 4.3 | 5.22 | 7.16 | 7.42 | 6.01 | 8.47 | 9.4 | 11.81 | 12.24 | 10.47 |
| $V_4$ | 0.5 | 0.92 | 1.4 | 1.45 | 1.02 | 1.02 | 1.78 | 2.71 | 2.91 | 2.05 | 4.1 | 4.98 | 6.55 | 6.92 | 5.64 | 8.02 | 9.1 | 11.02 | 11.42 | 9.89 |
| Mean | 0.56 | 0.94 | 1.4 | 1.46 | | 1.13 | 1.8 | 2.82 | 2.93 | | 4.1 | 5.05 | 6.78 | 7.05 | | 8.2 | 9.2 | 11.38 | 11.65 | |
| | Vari | Nitro | Inter | | vari | nitro | inter | | | Vari | Nitro | Inter | | | Vari | Nitro | Inter | | | |
| SEm± | 0.02 | 0.02 | 0.01 | | 0.05 | 0.05 | 0.03 | | | 0.10 | 0.10 | 0.07 | | | 0.05 | 0.05 | 0.03 | | | |
| CD (5%) | 0.07 | 0.07 | 0.05 | | 0.15 | 0.15 | 0.10 | | | 0.30 | 0.30 | 0.20 | | | 0.14 | 0.14 | 0.09 | | | |

**Table-3 :** Dry weight (g/plant) of oat as influenced by various treatments.

| Treatments | 20 DAS | | | | | 40 DAS | | | | | 60 DAS | | | | | At Harvest | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean | $N_1$ | $N_2$ | $N_3$ | $N_4$ | Mean |
| $V_1$ | 0.1 | 0.16 | 0.22 | 0.28 | 0.2 | 0.16 | 0.25 | 0.34 | 0.42 | 0.29 | 1.27 | 1.6 | 2.2 | 2.29 | 2.53 | 2.8 | 3.59 | 3.64 | 3.2 | 0.1 |
| $V_2$ | 0.07 | 0.13 | 0.17 | 0.22 | 0.1 | 0.11 | 0.2 | 0.28 | 0.3 | 0.18 | 1.23 | 1.5 | 2.1 | 2.16 | 2.41 | 2.7 | 3.51 | 3.54 | 3 | 0.07 |
| $V_3$ | 0.07 | 0.18 | 0.25 | 0.29 | 0.2 | 0.12 | 0.28 | 0.38 | 0.44 | 0.3 | 1.31 | 1.7 | 2.2 | 2.32 | 2.57 | 2.8 | 3.65 | 3.69 | 3.2 | 0.07 |
| $V_4$ | 0.06 | 0.14 | 0.18 | 0.25 | 0.1 | 0.1 | 0.22 | 0.31 | 0.32 | 0.19 | 1.25 | 1.6 | 2.1 | 2.18 | 2.43 | 2.8 | 3.52 | 3.58 | 3.1 | 0.06 |
| Mean | 0.08 | 0.15 | 0.22 | 0.25 | | 0.12 | 0.24 | 0.33 | 0.38 | | 1.27 | 1.6 | 2.2 | 2.24 | 2.49 | 2.8 | 3.57 | 3.61 | | 0.08 |
| | Vari | Nitro | Inter | | vari | nitro | inter | | | Vari | Nitro | Inter | | | Vari | Nitro | Inter | | | |
| SEm± | 0.02 | 0.02 | 0.01 | | 0.03 | 0.03 | 0.02 | | | 0.03 | 0.03 | 0.02 | | | 0.01 | 0.01 | 0.01 | | | |
| CD (5%) | 0.06 | 0.06 | 0.04 | | 0.09 | 0.09 | 0.06 | | | 0.09 | 0.09 | 0.06 | | | 0.04 | 0.04 | 0.03 | | | |

**Table-4 :** N uptake (kg/ha), Crude protein content (%), N status (kg/ha) in soil after harvest of oat as influe influenced by various treatments.

| Treatments | N content (%) | | | | | Crude protein content (%) | | | | | N uptake (kg/ha) | | | | | N status (kg/ha) in soil after harvest of oat | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N1 | N2 | N3 | N4 | Mean | N1 | N2 | N3 | N4 | Mean | N1 | N2 | N3 | N4 | Mean | N1 | N2 | N3 | N4 | Mean |
| $V_1$ | 0.1 | 0.16 | 0.22 | 0.28 | 0.2 | 0.16 | 0.25 | 0.34 | 0.42 | 0.29 | 1.27 | 1.6 | 2.2 | 2.29 | 2.53 | 2.8 | 3.59 | 3.64 | 3.2 | 0.1 |
| $V_2$ | 0.07 | 0.13 | 0.17 | 0.22 | 0.1 | 0.11 | 0.2 | 0.28 | 0.3 | 0.18 | 1.23 | 1.5 | 2.1 | 2.16 | 2.41 | 2.7 | 3.51 | 3.54 | 3 | 0.07 |
| $V_3$ | 0.07 | 0.18 | 0.25 | 0.29 | 0.2 | 0.12 | 0.28 | 0.38 | 0.44 | 0.3 | 1.31 | 1.7 | 2.2 | 2.32 | 2.57 | 2.8 | 3.65 | 3.69 | 3.2 | 0.07 |
| $V_4$ | 0.06 | 0.14 | 0.18 | 0.25 | 0.1 | 0.1 | 0.22 | 0.31 | 0.32 | 0.19 | 1.25 | 1.6 | 2.1 | 2.18 | 2.43 | 2.8 | 3.52 | 3.58 | 3.1 | 0.06 |
| Mean | 0.08 | 0.15 | 0.22 | 0.25 | | 0.12 | 0.24 | 0.33 | 0.38 | | 1.27 | 1.6 | 2.2 | 2.24 | 2.49 | 2.8 | 3.57 | 3.61 | | 0.08 |
| | Vari | Nitro | Inter | | vari | nitro | inter | | | Vari | Nitro | Inter | | | Vari | Nitro | Inter | | | |
| SEm± | 0.02 | 0.02 | 0.01 | | 0.03 | 0.03 | 0.02 | | | 0.03 | 0.03 | 0.02 | | | 0.01 | 0.01 | 0.01 | | | |
| CD (5%) | 0.06 | 0.06 | 0.04 | | 0.09 | 0.09 | 0.06 | | | 0.09 | 0.09 | 0.06 | | | 0.04 | 0.04 | 0.03 | | | |

$$\text{Nitrogen uptake (kg/ha)} = \frac{\text{Concentration (\%)} \times \text{Dry matter yield (q/ha)}}{100}$$

**Crude protein yield :** Crude protein yield of oat at harvest stage was computed from their respective crude protein contents.

$$\text{Crude protein yield (q/ha)} = \frac{\text{Crude protein (\%)} \times \text{Dry matter yield (q/ha)}}{100}$$

The preceding crops were fertilized with recommended NPK doses and the residual effect of previous crop was practically uniform to the crop growth during the present investigation.

## RESULTS AND DISCUSSION

### Plant height (cm)

The data showing the effect of different treatment on plant height (cm) are presented in table-2. Plant height at 20 DAS there was non-significant effect between varieties, nitrogen levels and interactions. At 40, 60 DAS and at harvest, oat plants produce significantly taller plant with variety Kent (SC) ($V_3$) than OS-6 (SC) ($V_4$) variety however, it was at par with UPO-2005-1 variety ($V_1$). Lowest plant height was observed in variety NDO-1($V_2$). Amongst different doses of N applied, application of Nitrogen @ 120 kg N/ha recorded significantly taller plant over other doses; however, it was at par with Nitrogen applied @ 80 kg N/ha ($N_3$). The lowest plant height was recorded from control plot ($N_1$). At 60 DAS and harvest stage interaction effect was found significant difference. Treatment $V_3N_4$ (Kent (SC) + Nitrogen @ 120 kg/ha) recorded significantly tallest plant followed by treatment $V_1N_3$ and $V_4N_3$, however it was on par with treatment $V_3N_3$ (Kent (SC) + Nitrogen @ 80 kg/ha). The lowest plant height was recorded by variety NDO-1 without nitrogen application. The increased in plant height might be attributed due to the genetic makeup of plant and regular availability of nitrogen which helped in acceleration of various metabolic process ultimately producing taller plant with more foliage (4) also observed that forage cereal responded well to nitrogenous fertilizer as the nitrogen has the quickest and most pronounced effect on the vegetative growth. Similar results were also reported by (5, 6).

### Fresh weight (g/plant) and Dry matter accumulation (g/plant)

The data on fresh weight and Dry matter accumulation were recorded at 20, 40, 60 DAS and at harvest are presented in table 2. Result revealed that fresh weight and Dry matter accumulation (g/plant) significantly differed at all the stages of observation. At 20, 40, 60 DAS and at harvest, oat plants give significantly higher fresh weight and Dry matter accumulation with variety Kent (SC) ($V_3$) followed by NDO-1($V_2$) and OS-6 (SC) ($V_4$) variety, but it was at par with UPO-2005-1 variety ($V_1$). The mean value from the table revealed that fresh weight and Dry matter accumulation increased significantly with each increment of nitrogen level at 20, 40, 60 DAS and at harvest. It was observed that fresh weight and Dry matter accumulation per plant increased significantly with application of 120 kg N/ha (N4) over other doses at all stages of observation, however it was at par with Nitrogen applied @ 80 kg N/ha ($N_3$). Obviously lowest fresh weight and Dry matter accumulation of plant recorded from by application of nitrogen @ 0 kg N/ha ($N_1$). Highly significantly fresh weight and Dry matter accumulation were found at 60 DAS and at harvest under V3N4 (Kent (SC) + Nitrogen @ 120 kg/ha) over rest of treatment and lowest fresh weight & Dry matter accumulation under $V_2N_1$ (.NDO-1+ Nitrogen @ 0 kg/ha). Fresh weight and Dry matter accumulation were increased with each increment of nitrogen level over control plot; the reason for this positive response of nitrogen level might be due to its impact on forage yield contributory characters and moisture retention, better nutrient availability for plant growth. The result of (7) are also in confirmation with that of present investigation, he reported that fresh weight increased with increasing levels of nitrogen from 0 to 180 kg N/ha. (8) also reported that the balanced fertilization significantly improved over all growth of the crop in terms of fresh weight and dry matter accumulation per unit area (m) by virtue of its impact on morphological and photosynthetic components of growth.

### Crop growth rate (g/plant/day) and Leaf area index

It is quite clear from the table-2 that variety Kent (SC)

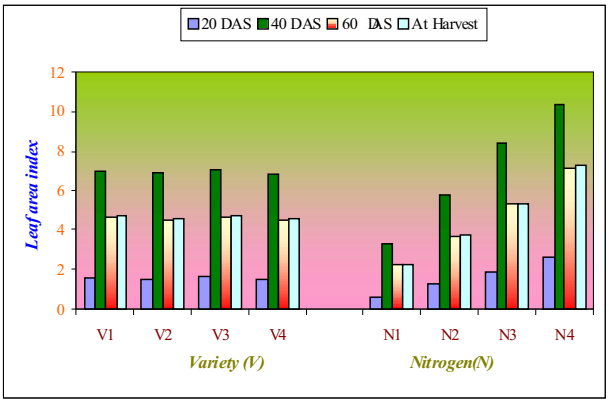


**Fig.-1 :** Leaf area Index as influenced by various treatments

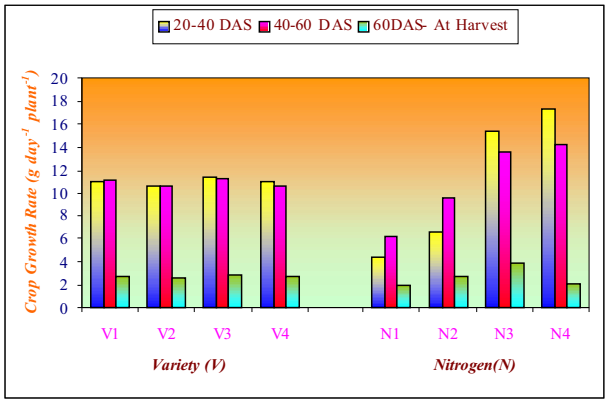


**Fig. 2:** Crop growth rate (g/plant/day) as influenced by various treatments

($V_3$) recorded higher value of CGR and Leaf area index followed by NDO-1($V_2$) and OS-6 (SC) ($V_4$) variety, but it was at par with value at CGR and Leaf area index recorded with UPO-2005-1 variety ($V_1$). The mean value from table-2 revealed that CGR and Leaf area index during 20 to 40 DAS and 40 to 60 DAS, significantly influenced by various level of nitrogen application. Application of Nitrogen @ 120 kg/ha recorded highest value of CGR and Leaf area index where as lowest value of CGR and Leaf area index were recorded under 0 kg N/ha ($N_1$). Among interaction, $V_3N_4$ (Kent (SC) + Nitrogen @ 120 kg/ha) recorded significantly higher value of CGR and Leaf area index over other treatment combination during 20-40 DAS and 40 to 60 DAS. Lowest values of CGR and Leaf area index were recorded with $V_2N_1$ (NDO-1+ Nitrogen @ 0 kg/ha). At 60 DAS to harvest, CGR & Leaf area index recorded lowest compared to 20 to 40 DAS and 40 to 60 DAS. The possible reason is that the dry matter accumulation was greater due to increasing doses of nitrogen resulting in higher crop growth rate value & Leaf area index. This result is in agreement with the findings of (9, 10) reported that the application of $N_{100}$ + P60 kg/ha were produced taller plant (125.5 cm), crop growth rate (17.94 and 15.1 g m-2 day-1) and leaf area index (5.10) which was at par with $N_{75}$ + $P_{40}$ kg/ha + Azotobacter inoculation.

**Nitrogen content (%) and Crude protein content (%)**

A perusal of mean value from table indicated that among varieties of oat, variety Kent (SC) (V3) recorded significantly higher N content and Crude protein content over variety UPO-2005-1 ($V_1$), where as lowest N content and Crude protein content (%) was recorded in NDO-1($V_2$) variety. Application of nitrogen @ 120 kg/ha ($N_4$) recorded significantly higher N content over other doses, however statistically it was on par with application of Nitrogen @ 80 kg/ha ($N_3$). The lowest N content & Crude protein content (%) were recorded in control plot (0 kg/ha ($N_1$)). Among interaction effect of varieties and nitrogen levels, $V_3N_4$ ((Kent (SC) + Nitrogen @ 120 kg/ha) recorded highest N content and Crude protein content followed by $V_1N_4$ (UPO-2005-1 + Nitrogen @ 120 kg/ha) and $V_3N_3$ ((Kent (SC) + Nitrogen @ 80 kg/ha). The lowest N content and Crude protein content (%) were recorded under V2N1 (NDO-1+ Nitrogen @ 0 kg/ha). Application of 120 kg Nitrogen/ha recorded higher N content and Crude protein content might be due to the higher uptake of Nitrogen from soil. (11) concluded that UPO-212 was suitable variety of oat for cultivation rather than Kent and JHO-851. Oat (UPO-212) should be fertilized with 120 kg N/ha for getting higher and superior quality of forage.

**Nitrogen uptake (kg/ha) and Crude protein yield (q/ha)**

Among all varieties of oat, variety Kent (SC) ($V_3$) recorded significantly higher N uptake and Crude protein yield (q/ha) over rest of varieties; however it was at par with variety UPO-2005-1 ($V_1$). Lowest N content and Crude protein yield (q/ha) were recorded in NDO-1 ($V_2$) variety. The response of nitrogen application was linear upto 120 kg/ha. Significantly highest N uptake and Crude protein yield (11.53 q/ha)

were recorded when Nitrogen was applied @120 kg/ha over other treatments, however it was at par when Nitrogen was applied @ 80 kg/ha ($N_3$). All Nitrogen level recorded significantly higher N uptake& Crude protein yield (q/ha) were over control. Interaction effect was also found significant. Treatment V3 (Kent (SC) with application of $N_4$ (+ Nitrogen @ 120 kg/ha) recorded significant highest nitrogen uptake and Crude protein yield were followed by $V_1N_4$ (UPO-2005-1 + Nitrogen @ 120 kg/ha). Combine effect of $V_2N_1$ (NDO-1+ Nitrogen @ 0 kg/ha) showed the lowest N uptake & Crude protein yield. (12) also reported that the Increase in crude protein yield might be attributed due to increase photosynthetic and meristmetic activities of plant due to presence of adequate available N to growing plants (13). Similar result were also reported by (14) who observed in two oat cultivars, JHO-851 and JHO-822 that the higher crude protein yields of oat were obtained with nitrogen level of 150 kg/ha.

**Nitrogen status in soil (kg/ha)**

Nitrogen status in soil was significantly higher in plot where oat variety Kent (SC) ($V_3$) was grown, however it was on par in plot where variety UPO-2005-1 ($V_1$) was grown. Whereas lowest Nitrogen status was recorded in the plot where namely NDO-1($V_2$) variety was grown. The response of nitrogen was linear with respect to Nitrogen status in the soil. Significantly highest value was recorded in plot where Nitrogen was applied @ 120 kg/ha followed by 80kg and 40 kg N/ha. The nitrogen status in the soil was significantly influenced by interaction of varieties and nitrogen levels. V3N4 combination of treatment (Kent (SC) + Nitrogen @ 120 kg/ha) recorded highest N status in the soil after harvest followed by $V_1N_4$ (UPO-2005-1 + Nitrogen @ 120 kg/ha). Lowest nitrogen status in soil was showed in $V_2N_1$ (NDO-1+ Nitrogen @ 0 kg/ha) combination. Each increment of Nitrogen level increased residual N content in soil after harvest of the crop. This might be due to residual effect of fertilizer. Nikitishen et al. (1987) reported that all N treatments increased yield and N uptake as a direct and residual effect.

**Tillers/m row length and Green fodder yield (q/ha)**

The effect of various treatments on tillers/m row length and Green fodder yield (q/ha) in fodder oat are presented in table. It is evident from the table that tillers/m row length and Green fodder yield in forage oat were significantly affected by various treatments. Perusal of mean value from table indicated that amongst varieties, variety Kent (SC) ($V_3$) recorded significantly higher number of tiller/m row length and Green fodder yield which was at par with the value of variety UPO-2005-1 ($V_1$). Lowest number of tiller/m row length was recorded in NDO-1($V_2$) variety. Application of Nitrogen @ 120 kg/ha (N4) recorded significantly higher number of tiller/m row length and Green fodder yield followed by application of nitrogen @ 80 kg/ha ($N_3$) which was statistically on par. The lowest number of tiller/m row length and Green fodder yield recorded under control plot (0 kg N/ha). Among interaction effect of varieties and nitrogen levels, $V_3N_4$ ((Kent (SC) + Nitrogen @ 120 kg/ha) recorded highest number of tiller/m row length and Green fodder yield (417.33 q/ha), followed by $V_1N_4$ (UPO-2005-1 + Nitrogen @ 120 kg/ha) and $V_3N_3$ ((Kent (SC) + Nitrogen @ 80 kg ha). The lowest number of tiller/m row length and Green fodder yield (190.03 q/ha) were recorded under $V_2N_1$ (NDO-1+ Nitrogen @ 0 kg/ha). Tillers/m row length and Green fodder yield were increased with increased levels of nitrogen; this might be due to higher uptake of Nitrogen by plant. (16) opined that number of tillers/m row length of oat crop increased significantly with each increment of 40 kg N from 0-120 kg N/ha over the preceding one. Green forage yield one of the possible reason for favourable influence of increasing dose of nitrogen on yield attributes might be due to increased plant height and leafs thickness compared to no nitrogen. Chlorophyll effect might have resulted in higher green forage yield due to nitrogen fertilization. (16) also reported that forage yield and quality yield were better with higher nitrogen levels.

**Dry matter yield (q/ha) and Leaf : stem ratio**

Among different varieties of oat, variety Kent (SC) ($V_3$) recorded significantly higher dry matter yield and Leaf: stem ratio of oat as compared to other varieties. However it was on par with the value of variety UPO-2005-1 ($V_1$). The lowest dry matter yield and Leaf: stem ratio were associated with variety NDO-1($V_2$). Application of different levels of nitrogen significantly affected the dry matter yield and Leaf: stem ratio of oat and the response of application of different levels of nitrogen was linear. Among different levels of nitrogen,

application of Nitrogen @ 120 kg/ha ($N_4$) recorded significantly higher DMY and Leaf: stem ratio of oat which was at par with DMY recorded by application of Nitrogen @ 80 kg/ha ($N_3$). Interaction effect of varieties and nitrogen levels significantly affected the dry matter yield and Leaf: stem ratio of oat, combine effect of $V_3N_4$ ((Kent (SC) + Nitrogen @ 120 kg/ha) produced significantly higher dry matter yield& Leaf: stem ratio over other treatment combination followed by $V_1N_4$ (UPO-2005-1 + Nitrogen @ 120 kg/ha). The lowest dry matter yield and Leaf: stem ratio were recorded under $V_2N_1$ (NDO-1+ Nitrogen @ 0 kg/ha) treatment. This might be due to improved nutrients availability, physico-chemical and biological properties of soil, promoted accumulation of carbohydrate resulting in higher green fodder yield and dry matter content in plant, ultimately leading to higher dry matter yield and Leaf : stem ratio of oat. also reported that the application of 120 kg nitrogen/ha gave significantly higher green forage (569.99 q/ha) and dry matter yield (117.34 q/ha) than all other nitrogen levels. Found that var. SK 0-7 recorded maximum leaf: stem ratio with two cuts (single cut autumn crop followed by double (autumn+ spring) cut crop and spring harvested crop).

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## REFERENCES

1. Mehra, K.L. (1978). Oats. *ICAR,* New Delhi.
2. Anonymous, (2007). Hand book of Agriculture. *ICAR,* New Delhi. pp. 1128.
3. Chatterjee, B.N. and Das, P.K. (1989). Forage crop production principle and practices. *Oxford and IBH Publishing Co. Pvt. Ltd.,* New Delhi.
4. Tiwari, B.P. and Koshta, L.P. (1980). Effect of rate and time of N-application on growth and other characteristics of two multicut fodder sorghum varieties. *JNKVV Research Journal, 14 (3-4) :* 87-91.
5. Poonia, T.C.; Mali, A.L. and Singh, P. (1999). Growth and yield attributes of sorghum influenced by nitrogen and plant density. *Annals of Agricultural Bio. Research. 4 (1) :* 21-23.
6. Anda, A. (1987). Some radiation, heat and water balance component of maize fodder as a function of different nitrogen levels. *Novenytermels. 36 (3):* 161-170.
7. Juza, J. (1994). Effect of split application of different rates of nitrogen on yield of fodder maize ears. *Sbornik Jihosceska Universita Zemedelska Fakulta, Radda.11(2):* 15-23.
8. Choubey, R.N.; Prasad, S.V.S. and Roy, A.K. 2001. Study on variability, associations and path analysis in forage oat. *Range Management and Agroforestry. 22 (2):* 188-192.
9. Prasad, T.V.R., Krishnamurthy, K. and Shrivashankar, K. (1990). Canopy and growth difference in maize genotypes in relation to plant densities and nitrogen levels. *Mysore J. Agril. Science. 24(4):* 437-444.
10. Karwarsra, R.S., Kumar, Y., Kumar, V. and Kumar, A. 2007. Integrated nutrient and cutting management in Oats (*Avena sativa* L.). *Forage Research. 33 (4):* 63-64.
11. Verma, S.K. and Singh, M.M. (2007). Performance of oat varieties at varying nitrogen levels. *Forage Research. 32 (4):* 269-270.
12. Pathan, S.H., Bhilare, R.L., Nawale, K.B. and Jadhav, V.T. (2007). Response of multicut Oats varieties to nitrogen levels. *Forage Research. 32 (4):* 269-270.
13. Sharma, K.K.; Sharma, S. and Neog, B.S. (2004). Integrated nutrient management in Oats (*Avena sativa* L.). *Forage Research. 29 (4):* 195-197.
14. Agrawal, R.K.; Varma, S.C. and Singh, K.K. (2000). Influence of nitrogen and moisture regimes on growth and yield of oat cultivars. *Range Management and Agroforestry. 21 (2):* 206-212.
15. Nikitishen, V.I., Shcherbakov, A.P. and Logoshin, V.I. (1987). Efficacy of nitrogen fertilizers applied systematically crop rotations on typical chernozem soils. *Agrokhemiya. 6:* 3-7.
16. Rana, R.S.; Rana, S.S.; Naveen K. and Prasad, R. (2002). Influence of nitrogen application and cutting management on the productivity and economics of summer oat in dry temperate region of Himachal Pradesh. *Himachal Journal of Agricultural Research 28 (1/2):* 1-5.