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# EFFECT OF VARIETIES AND NITROGEN LEVELS ON QUALITY, NUTRIENT CONTENT AND ITS UPTAKE BY FODDER OAT (*AVENA SATIVA* L.)

**KAVITA CHATURVEDI*, N. S. SOLANKI AND S. S. KADAM**

Department of Agronomy, Rajasthan College of Agriculture, Udaipur (Rajasthan)

**(e-mail : kavitachaturvedi294@gmail.com)*

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## SUMMARY

A field experiment was carried out during *rabi* 2017-18 at Instructional Farm, Rajasthan College of Agriculture, Udaipur with the objective to study the response of different fodder oat varieties to varying nitrogen levels. The experiment was conducted in factorial randomized block design. The treatments comprised of five varieties (Kent, JHO-851, JHO-822, JHO-99-2 and JHO-2000-4) and three nitrogen levels (80, 100 and 120 kg N/ha) with three replications. The soil of the experimental site was clay loam in texture with low in available nitrogen, medium in phosphorus and rich in potassium. The findings of the experiment indicated that variety JHO-99-2 recorded significantly higher crude protein, ash, ether extract and nitrogen free extract with low crude fibre content during both the cuttings. Similarly, application of 120 kg N/ha produced significantly higher crude protein, crude fibre, ash and ether extract content with less nitrogen free extract. The variety JHO-99-2 gave significantly higher NPK content and its uptake by fodder oat. NPK content and uptake by crop were increased significantly with increase in nitrogen levels and recorded maximum with the application of 120 kg N/ha at first and second cut.

**Key words :** Oat, varieties, nitrogen levels, quality, nitrogen uptake

Livestock is the essential component of agriculture in the developing countries like India since time immemorial and its contribution to the national economy through meat, milk, wool as well as farm yard manure is vast. India although posses about 15 per cent of world's livestock population, the productivity of our livestock is very low due to less availability of feed resources. Inclusion of cheaper green forage in animal feed is therefore important to curtail the expenses on purchase of concentrate feed. Unfortunately, there is acute shortage of green as well as dry fodder to tune of 35.6 and 11.0 per cent, respectively (IGFRI, 2013). To overcome this fodder deficit under the limited water supply where farmer cannot grow legumes like berseem or lucerne, oat can be a good choice. Oat (*Avena sativa* L.) is locally known as "*jai*' an important winter cereal forage crop because of its excellent growth, quick regrowth, multicut character and suitable for silage making. In cereal production, it ranks sixth in the world after wheat, maize, rice, barley and sorghum. The world area under oat is around 9.51 million hectare and production is 23.41 million metric tones (USDA, 2018). In India, it covers an area of about one million hectare with fodder productivity of 30-45 t/ha (FAO 2012). During recent years many improved varieties of oat have been evolved which contribute for quantitative and qualitative forage production. It is well known fact that no two varieties of any crop show identical performance in all the regions because of variation in their genetic makeup and eco-physiological responses to different habitats. Therefore, yield, quality parameters and nutrient content of any crop are varied due to different varieties. These varieties are highly responsive to fertilizers particularly higher dose of nitrogenous fertilizers that influence the quality and nutrient content in oat crop. Among the major nutrients; nitrogen plays a pivotal role in quantitative as well as qualitative improvement of oat fodder crop. It was reported that deficiency of nitrogen in fodder may cause severe disorders in animals and human being also (Midha *et al.*, 2015). Whereas, excess supply of nitrogen to oat under certain environmental conditions cause excessive nitrate accumulation in plant leaves, which may be toxic to the ruminants. These facts show the necessity of determining the adequate supply of nitrogen to the oat based on field experimentation for realizing the genetic yield potential and quality aspects of newly released varieties.

## MATERIALS AND METHODS

The experiment was conducted at the Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology Udaipur (Rajasthan) during *rabi* season of 2017-18. The site is situated at Southern part of Rajasthan at an altitude of 582.17 m above mean sea level, at 24°35' N latitude and 73°42' E longitude. The soil of the experimental site was clay loam in texture with low in available nitrogen, medium in phosphorus and rich in potassium. The treatments comprised of five varieties (Kent, JHO-851, JHO-822, JHO-99-2 and JHO-2000-4) and three nitrogen levels (80, 100 and 120 kg N/ha) tested in factorial randomized block design with three replications. Seeds were sown in line by drilling method at 20 cm row using recommended seed rate 100 kg/ha. Nitrogen was applied in the form of urea ½ as basal dose at the time of sowing, ¼ at 30 DAS and remaining ¼ after first cutting as per the treatment. Phosphorus fertilizer was given as common dose 40 kg/ha at the time of sowing through DAP. Irrigations and spraying of 2,4-D weedicide were carried as per recommendations. The samples of oat were taken from all the treatments and sun-dried and then kept in the oven at 70$^{o}$C. Oven dried samples were ground in a "Willey Mill" into powder form passing through 2 µ sieve and then fodder quality constituents were estimated on dry weight basis. These constituents along with methods used for analysis are as crude protein, crude fibre, mineral ash, ether extract and nitrogen free extract (A.O.A.C., 1995), nitrogen contnent (Nesseler's reagent colorimetric method by Lindner, 1994), Phosphorus content (Ammonium vanadomolybdate yellow colour method) and potassium content (Flame Photometeric method by Richards,1968). Crude protein content (%) of each plot was estimated by multiplying nitrogen content of each plot with 6.25. Uptake of N, P and K by fodder was estimated by following formula.

$$\text{Nutrient uptake by fodder (kg/ha)} = \frac{\text{(Nutrient content (\%)} \times \text{Dry fodder yield (kg/ha))}}{100}$$

## RESULTS AND DISCUSSION

### Quality parameters

The data in Table 1 showed that crude protein and crude fibre content differed significantly with different oat varieties. The highest crude protein content was recorded with JHO-99-2(12.5 and 8.4 per cent during first and second cut, respectively) whereas the minimum crude protein content was registered under JHO-851 (12.2 and 8.0 per cent during first and second cut, respectively). This might be due to genetic

TABLE 1

Crude protein, crude fibre, ether extract ash content and nitrogen free extract of fodder oat as influenced by varieties and nitrogen levels

| Treatment | Crude Protein (%) | | Crude Fibre (%) | | Ether Extract (%) | | Ash content (%) | | Nitrogen free extract (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1st cut | 2nd cut | 1st cut | 1st cut | 2nd cut | 2nd cut | 1st cut | 2nd cut | 1st cut | 2nd cut |
| **Varieties** | | | | | | | | | | |
| Kent | 12.3 | 8.1 | 28.9 | 8.84 | 9.52 | 2.34 | 8.84 | 9.52 | 47.1 | 49.9 |
| JHO-851 | 12.2 | 8.0 | 29.4 | 8.80 | 9.26 | 2.22 | 8.80 | 9.26 | 47.0 | 49.7 |
| JHO-822 | 12.4 | 8.1 | 29.0 | 8.85 | 9.39 | 2.38 | 8.85 | 9.39 | 46.8 | 49.9 |
| JHO-99-2 | 12.5 | 8.4 | 28.1 | 8.97 | 9.65 | 2.47 | 8.97 | 9.65 | 47.5 | 50.2 |
| JHO-2000-4 | 12.3 | 8.1 | 29.0 | 8.86 | 9.45 | 2.37 | 8.86 | 9.45 | 46.8 | 49.7 |
| S. Em± | 0.03 | 0.04 | 0.08 | 0.05 | 0.04 | 0.02 | 0.05 | 0.04 | 0.08 | 0.12 |
| C. D. (P=0.05) | 0.10 | 0.11 | 0.22 | 0.14 | 0.12 | 0.06 | 0.14 | 0.12 | 0.23 | 0.36 |
| **Nitrogen levels (kg/ha)** | | | | | | | | | | |
| 80 | 12.1 | 7.9 | 29.0 | 8.78 | 9.29 | 2.29 | 8.78 | 9.29 | 47.4 | 50.3 |
| 100 | 12.4 | 8.2 | 28.9 | 8.85 | 9.41 | 2.35 | 8.85 | 9.41 | 46.9 | 50.0 |
| 120 | 12.6 | 8.4 | 28.8 | 8.96 | 9.66 | 2.43 | 8.96 | 9.66 | 46.8 | 49.3 |
| S. Em± | 0.03 | 0.03 | 0.06 | 0.04 | 0.03 | 0.02 | 0.04 | 0.03 | 0.06 | 0.10 |
| C. D. (P=0.05) | 0.08 | 0.08 | NS | 0.11 | 0.09 | 0.05 | 0.11 | 0.09 | 0.17 | 0.28 |

NS: Non significant.

makeup of varieties or higher biomass production which leads to higher nitrogen uptake resulted in higher crude protein content. The findings are in agreement with findings of Choudhary and Prabhu (2016). Significantly higher crude fibre was registered under JHO-851 (29.4 and 30.6 per cent during first and second cut, respectively). JHO-99-2 also recorded significantly higher ether extract (3.05 and 2.47 per cent during first and second cut, respectively), ash content (8.97 and 9.65 per cent during first and second cut, respectively) and nitrogen free extract (47.5 and 50.2 per cent during first and second cut, respectively) over rest of the varieties. The probable reason for such variations is genetic makeup of the variety and higher dry matter yield compared to other varieties. The findings are in conformity with Rana *et al*. (2009), Dar *et al*. (2014) and Patel (2014).

Increased nitrogen levels also showed significant variation in crude protein, crude fibre, ether extract, ash content and nitrogen free extract. The significantly higher crude protein (12.6 and 8.4 per cent during first and second cut, respectively) was observed with the application of 120 kg N/ha over 80 and 100 kg N/ha. This might be due to the fact that application of nitrogen leads to adequate availability of nutrient which causes more uptakes of nutrients and corresponding increase in crude protein content of fodder. Also the nitrogen is the constituent of various metabolites including amino acids and protein, so increase in nitrogen content in plant with increase nitrogen rate increased synthesis of protein. The positive and significant correlation between crude protein content and nitrogen content (r = 0.998** and 0.994** during first and second cut, respectively) validates this hypothesis. The results are in agreement with Neelar (2011), Midha *et al.* (2015), Dabhi *et al.* (2017), Jat *et al.* (2017) and Sheoran *et al.* (2017). Crude fibre content of fodder oat not influenced significantly due to various nitrogen levels during course of study. This might be due to fact that nitrogen have failed to produce fibroid components in plants *i.e*. cellulose and lignin. However, significantly higher ether extract (2.98 and 2.43 per cent during first and second cut, respectively) and ash content (8.96 and 9.66 per cent during first and second cut, respectively) were observed with the application of 120 kg N/ha over 80 and 100 kg N/ha. The higher application of nitrogen correspondingly increased meristematic activity due to which absorption of mineral salts increase which leads to rapid respiration process and conversion of most of the carbohydrates into fat takes place. It might be the reason for higher ether extract and ash content due to higher nitrogen application. Significantly higher nitrogen free extract (47.4 and 50.3 per cent during first and second cut, respectively) was recorded with the application of 80 kg N/ha over 100 and 120 kg N/ha. This is due to the fact that nitrogen plays major role in protein synthesis and the nitrogen free extract is a part of carbohydrate. These results are in close conformity with the findings of Neelar (2011) and Jat *et al*. (2017).

**Nutirent content and uptake**

The Table 2 and 3 inferred that different varieties under study significantly influenced the nitrogen, phosphorus and potassium content and uptake of nutrients by fodder oat. Variety JHO-99-2 registered significantly higher nitrogen (2.00 and 1.34 per cent during first and second cut respectively), phosphorus (0.51 and 0.27 per cent during first and second cut, respectively) and potassium content (0.93 and 1.01 per cent during first and second cut, respectively) over rest of the varieties. Significantly higher nitrogen (143.3 and 106.4 kg/ha during first and second cut, respectively), phosphorus (37.2 and 27.7 kg/ha during first and second cut, respectively) and potassium (67.8 and 83.1 kg/ha during first and second cut, respectively) uptake by crop were also registered under JHO-99-2 over rest of the varieties. The improvement in nutrient status of plant under JHO-99-2 might be due to genetic makeup. It is generally believed that plant extracted nutrients are used for maintaining their critical concentration that can be used for plant growth and development of structures. Thus, the greater availability of nutrients with variety JHO-99-2 seems to have critical concentration of cellular level and fulfilled their requirements for profuse plant growth. This is evident from higher dry matter accumulation, plant height and leaf stem ratio in variety JHO-99-2 as compared to other varieties. As the uptake is a product of total biomass and nutrient content, considerable increase in either of component may increase the nutrient uptake. In the present study, variety JHO-99-2 recorded higher dry fodder yield and nutrient content which resulted in higher uptake of N, P and K. A significant and positive correlation existed between dry fodder yield and N, P and K uptake. These results are in accordance with findings of Sikha and Singh (2018).

Different doses of nitrogen significantly influenced the nitrogen, phosphorus and potassium content and its uptake by fodder oat. Application of 120 kg N/ha recorded significantly higher nitrogen

TABLE 2

Nitrogen, phosphorus and potassium content (%) of oat as influenced by varieties and nitrogen levels

| Treatment | Nitrogen content | | Phosphorus content | | Potassium content | |
|---|---|---|---|---|---|---|
| | 1st cut | 2nd cut | 1st cut | 2nd cut | 1st cut | 2nd cut |
| **Varieties** | | | | | | |
| Kent | 1.97 | 1.30 | 0.49 | 0.26 | 0.92 | 1.00 |
| JHO-851 | 1.96 | 1.28 | 0.47 | 0.25 | 0.92 | 0.99 |
| JHO-822 | 1.98 | 1.29 | 0.51 | 0.27 | 0.93 | 1.00 |
| JHO-99-2 | 2.00 | 1.34 | 0.51 | 0.27 | 0.93 | 1.01 |
| JHO-2000-4 | 1.97 | 1.31 | 0.49 | 0.26 | 0.92 | 0.99 |
| S. Em± | 0.006 | 0.006 | 0.003 | 0.004 | 0.005 | 0.005 |
| C. D. (P=0.05) | 0.016 | 0.018 | 0.008 | 0.011 | NS | NS |
| **Nitrogen levels (kg/ha)** | | | | | | |
| 80 | 1.94 | 1.26 | 0.48 | 0.25 | 0.89 | 0.96 |
| 100 | 1.98 | 1.31 | 0.49 | 0.27 | 0.92 | 1.00 |
| 120 | 2.01 | 1.34 | 0.51 | 0.28 | 0.96 | 1.03 |
| S. Em± | 0.004 | 0.005 | 0.002 | 0.003 | 0.004 | 0.004 |
| C. D. (P=0.05) | 0.013 | 0.014 | 0.006 | 0.009 | 0.011 | 0.011 |

NS : Non significant.

TABLE 3

Nitrogen, phosphorus and potassium uptake (kg/ha) by fodder oat as influenced due to different varieties and nitrogen levels

| Treatment | Nitrogen uptake | | Phosphorus uptake | | Potassium uptake | |
|---|---|---|---|---|---|---|
| | 1st cut | 2nd cut | 1st cut | 2nd cut | 1st cut | 2nd cut |
| **Varieties** | | | | | | |
| Kent | 129.3 | 100.3 | 32.2 | 20.0 | 60.6 | 77.0 |
| JHO-851 | 121.8 | 91.8 | 27.9 | 17.6 | 54.6 | 68.3 |
| JHO-822 | 134.7 | 97.3 | 34.5 | 20.6 | 63.2 | 75.2 |
| JHO-99-2 | 143.3 | 106.4 | 37.2 | 22.7 | 67.8 | 83.1 |
| JHO-2000-4 | 132.0 | 102.6 | 32.5 | 20.6 | 61.7 | 77.6 |
| S. Em± | 1.82 | 1.30 | 0.47 | 0.38 | 0.95 | 0.88 |
| C. D. (P=0.05) | 5.28 | 3.75 | 1.37 | 1.09 | 2.74 | 2.55 |
| **Nitrogen (kg/ha)** | | | | | | |
| 80 | 123.5 | 92.3 | 29.8 | 17.8 | 55.3 | 69.4 |
| 100 | 130.9 | 99.8 | 32.7 | 20.4 | 61.0 | 76.0 |
| 120 | 142.2 | 107.1 | 36.1 | 22.7 | 68.4 | 83.4 |
| S. Em± | 1.41 | 1.00 | 0.37 | 0.29 | 0.73 | 0.68 |
| C. D. (P=0.05) | 4.09 | 2.91 | 1.06 | 0.84 | 2.12 | 1.97 |

(2.01 and 1.34 per cent during first and second cut, respectively), phosphorus (0.51 and 0.28 per cent during first and second cut, respectively) and potassium (0.96 and 1.03 per cent during first and second cut, respectively) content over 80 and 100 kg N/ha. This might be due to increased absorption of nutrient at higher nitrogen level. These findings are in collaboration with the findings of Jehangir *et al.*, (2012). Significantly higher nitrogen (142.2 and 107.1 kg/ha during first and second cut, respectively), phosphorus (36.1 and 22.7 kg/ha during first and second cut, respectively) and potassium (68.4 and 83.4 kg/ha during first and second cut, respectively) uptake was also registered with the 120 kg N/ha over 80 and 100 kg N/ha. This might be due to the reason that higher dry matter yield and nitrogen, phosphorus and potassium content were recorded with higher nitrogen level which results in higher nitrogen, phosphorus and potassium uptake. The findings are in conformity with Rawat and Agrawal (2010) and Jehangir *et al*., (2012).

## CONCLUSION

On the basis of result, it can be concluded that oat variety JHO-99-2 provided with 120 kg N/ha significantly produces good quality fodder, higher NPK content and uptake of nutrients by fodder.

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