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Effect of Urea and foliar application of Nano Urea on growth and yield of different varieties offodder oat (*Avenasativa* L.) under north western Punjab condition

Jyoti Sharma, Rajeev*, Shailja Sharma, Sourabh Kumar Manisha Chaudhary, Boreddy Jagadeeswar Reddy and Suhail Fayaz

Department of Agronomy, School of Agriculture, Lovely Professional University Phagwara Punjab-144401, India

Abstract

A field experiment was performed in the Rabi season, 2021-2022 at the agricultural fields of Lovely Professional University, Phagwara, and Punjab. In split-plot design, the experiment has been replicated three times and, with six treatment combinations. The treatment combination includes six urea and nano urea (nitrogen) levels, 0, 100% urea, 75% urea and @4 ml nano urea spray, 75% urea and @2 ml nano urea spray, 50% urea and @4 ml nano urea spray and 50% urea and 2 ml nano urea spray and two oat varieties (kent and hybrid). The kent variety has maximum plantheight at the time of 60 days of sowing is T2 (100% RDF) (95.4 cm) and minimumhybrid variety plant height is T1 (control) (34.8 cm) at the same period of time. Themaximum no. of leaves/plant in kent variety T2 (28) and lowest leaf/plant in hybridvariety T1 (18), leaf area is more in kent variety T2 (97.92 cm 2) and lowest in hybrid T1(44.37cm 2), after harvesting the maximum green fodder yield in kent variety T2 (29.38t/ha) and dry fodder yield (6.39 t/ha) and the lowest green and dry fodder yield inhybrid T1 (18.31 t/ha) and (2.97t/ha) respectively.

Keywords: *Oat, Leaves, Nano Urea, Plant height, Fodder quality, Yield and Kent*

Introduction

Green fodder is an economic source of nutrients for dairy animals. It is highly palatable and digestible. Micro-organisms present in green fodder help in improving thedigestibility of crop residues under a mixed feeding system. It also helps in maintaining goodhealth and improving the breeding efficiency of animals. Increased use of green fodder in theration of animals may reduce cost the of milk production. Fodder from common cereal crops like Maize, Sorghum and Oats are rich in energy and leguminous crops like Lucerne, Berseem and Cowpea is rich in proteins. These leguminous crops are a good source of major and micro minerals, which are critical for rumen microbes as well as animal systems. Green foddercrops are known to be a cheaper source of nutrients as compared to concentrates and are henceuseful in bringing down the cost of feeding and reducingthe need for the purchase of feeds/ concentrates from the market. In case surplus fodder is available in some seasons it can be stored in form of silage or hay for the lean season. India is presently under heavy stress on account of large-scale exploitation for the mismanagementof fuelwood, timber and fodder.

Nano fertilizers are mostly synthetic or modified forms of conventional fertilizers, bulk fertilizer ingredients, or botanical, microbial, or animal extracts [2]. As nano fertilizer release nutrients at a slower pace throughout the crop growing period; hence plants absorb the maximum of nutrients without wasting them in leaching [10]. The nano fertilizers can easily be absorbed by plants because of their high surface area to volume ratio [3] and can reduce the loss of nutrients which gives higher (20-30 per cent) use efficiency as compared to conventional fertilizer application. The objective of this study was to record the growth, yield and quality of fodder oats under

**Corresponding Author: Rajeev*
E-mail Address: - rajeev.26421@lpu.co.in
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varying combinations of urea and nanonitrogen. Forest resources and frequent fires. There is an acute shortage of fodder especially green nutritious fodder, which is a major cause of low productivity of livestock, especially in hilly areas. The main reasons for low productivity is insufficient and low-quality fodder and feed including grazing facilities[12]. So, management practices play an important role in determiningthe productivity of grasslands[4]. The presence of inferior and unproductive grass species, lack of fertilizer application, absence of legume component, improper cutting and indiscriminate grazing are some of the important factors responsible for poor productivity of grasslands. There exists a wealth of indigenous knowledge for its proper utilization and management of natural resource base but farmers because of increasing population pressure and declining land productivity are not using it[8].Awareness creation about fodder production technology isthe utmost needs to organize methodsresult in demonstrations and organizing field days showing the monetary gain and benefits of cultivation of high-yielding varieties of fodder crops[9].

Material and Method

A field experiment was performed in the Rabi season, 2021-2022 at the agricultural fields of Lovely Professional University, Phagwara, Punjab to study the Effect of Urea and foliar application of Nano Urea on the growth and yield of different of varieties fodder oat. In the split-plot design, the experiment has been replicated three times and, with six treatment combinations. The treatment combination include six urea and nano urea (nitrogen) levels, 0, 100% urea, 75% urea and @4 ml nano urea spray, 75% urea and @2 ml nano urea spray, 50% urea and @4 ml nano urea spray and 50% urea and 2 ml nano urea spray and two oat varieties (kent and hybrid). The first dose of nitrogen was applied at the time of sowing and a second dose 30 days after sowing with nano urea. Three replications were selected randomly for each plot and were tagged properly for recording the observations at the required stages. Germination percentage was recorded at 10th DAS by counting the germinated seeds per plot.

Result and Discussion

The plant height was recorded at 20 th, 40 th and 60 th DAS from the main ground level to the last branch of plant. The average height of the plant was expressed in centimetres. Number of leaflets were counted per plant from randomly selected plants on 20 th ,^{40} th and 60 th DAS and the average was calculated. The green fodder weight in kg will do at the time of harvesting in the field to each plot. The weight of 1000 grains was recorded in grams. The total seed yield was measured obtained from each plot was recorded. Data were analysed by Duncan's multiple range tests (DMRT) for separation of means with a probability p& lt;0.05. The difference between mean values was evaluated by analysis of variance (ANOVA) using the software SPSS16 [19].

Critical examination of data indicated that on days 20, and 40 the plant height had recorded in 12 different treatments with similari.e. 12.5cm, and (34.8 cm),under T2, and T4 in which 100% RDF will apply in T2 and in T4 75% urea with@4ml nano urea spray with water respectively. However, non-significant 5.9, and 14.5 differences in plant height were observed in comparison the several of treatments.At 60 DAS, the highest plant height (93.9 cm) was recorded for T4 plot where 100% RDF will apply, although non-significant 14.5 differences among all treatment were there in terms of plant height.It was observed that thehighest plant height (120.2 cm) was noticed under T2 at the time of harvesting and which is also statistically at par with T4 control treatment at 60 DAS. Hence, The T1 (control) shows theleast plant height till at the time of harvesting. Whereas, 165.8 were found non-significant differencerecorded under the treatments at harvesting time presented in (Table no.1).Differences in plant height among the two varieties are expected due to thegenetic makeup of the varieties [21]. The significant effect of variety on plant height in the present study is in agreement with previous findings [14], [7], [11]. Similar current findings about plant height were published previously by [23] and [5].

It was found that at harvesting time, the highest number of leaves were recorded for T2 (100% RDF) and T4 (75% urea + @ 4ml nano urea). The lesser number of leaves per plant was recorded in V2T1 (control) and V2N5 (50% urea + @ 2ml nano urea). Whereas, 30.0 were the non-significant difference recorded under the treatments at 60 DAS presented in (Table no.1).Highest number of leaves were recorded for T2 (100% RDF) and T4 (75%urea + @ 4ml nano urea). Whereas 5.53 were the non-significant difference recorded underthe treatments at 20 DAS. Whereas, at harvesting time, the highest number of leaves were recorded for T2 (100% RDF) and T4(75% urea + @ 4ml nano urea). The lesser number of leaves per plant was recorded in V2T1(control) and V2N5 (50% urea + @ 2ml nano urea). Whereas 30.0 were the non-significantdifference recorded under the treatments at 60 DAS.

The analyses of the number of tillers per plant were observed at different periods of time.At the time of maturity, the T2 (100% RDF) shows the maximum number of tillers whereas T1 (control) show less number of tillers. The comparisons were done between both varieties (kent and hybrid) and kent has the maximum number of tillers. The non-significant difference was 10.9 which wasrecorded under the treatments at the harvesting stage shown in (Table no. 1).It is clear from the data that the number of tillers/ m2 increased with the advancement in the growth period of crops under all varieties.In this study, the higher level of nitrogenfavoured greater oat tillering, although the tillering was more persistent at lower nitrogen level applications at the end of the cycle [15]. The other parameter was the highest number of the leaves which was analyzed in this study.At 20 DAS, the highest length of leaves were recorded for T2(100% RDF) and T4 (75% urea + @ 4ml nano urea). The lesser length of leaves were recorded in V2N3 (75% urea + @ 2ml nano urea). Whereas 4.7 were the non-significant difference recorded under the treatments at 20 DAS shown in (Table no. 1).The next phase of examination was doneat 40 DAS. The highest length of leaves was recorded for T2(100% RDF) and T4 (75% urea + @ 4ml nano urea) where T2 was significantly at par with T4. The lowest length recorded was T1 plants. Whereas 8.2 were the non-significant difference recorded under the treatments at 40 DAS.The observation which was recorded at 60 DAS, showed the highest length of leaves for T2(100% RDF) and T4 (75% urea + @ 4ml Nano urea). The lesser length of leaves was visualised in T1 (control) and T6 (50% urea + @ 2ml nano urea). Whereas 9.04 were the non-significant difference recorded under the treatments at 60 DAS.These results are in close conformity with the findings of [17], [20] and [22]. The overall improvement of crop growth reflected into a better source-sink relationship, which in turn enhanced the yield attributes [16].

The other growth parameter like leaf width which was examined at 20 DAS appeared the highest width of leaves for T2(100% RDF) and T4 (75% urea + @ 4ml nano urea). The lesser width of leaves was displayed in T1 (control) and T6 (50% urea + @ 2ml nano urea). Whereas 0.03 were the non-significant difference recorded under the treatments at 20 DAS shown in (Table no. 1).In addition to this the width of leaves at 40 DAS, showed the highest leaf width for T2 (100% RDF) and T4 (75% urea + @ 4ml nano urea) where T2 which was significantly at par with T4. The lowest width recorded was T1 plants. Whereas 1.11 was the non-significant difference recorded under the treatments at 40 DAS. Apart from this at 60 DAS, the highest width of leaves was recorded for T2 (100% RDF) and T4 (75% urea + @ 4ml nano urea). The lesser width of leaves was recorded in T1 (control) and T6 (50% urea + @ 2ml nano urea). Whereas 0.8 were the non-significant difference recorded under the treatments at 60 DAS.

The analytic examination of leaf area (LA) varied significantly ($p \leq 0.05$) among different treatments at 20, 40, 60 and 90 DAS. At 20 DAS, LA reached a maximum in V1T2being statistically the same as V1T4 and the lowest LA was noted in V2T6. At 60 DAS, LA reached a maximum in V1T4 which was same as V1T2 and the lowest LA was noted in V2T1. At 90 DAS, oats had the higher LA in V1T4, followed by V1T2, and the lowest LA was noted in V2T1. Whereas 6.63 were the non-significant difference recorded under the treatments at the harvesting stage shown in (Table no. 1). The various studies observed that leaf area showed a positive relationship with an increase in leaf length. The excessive applications of nitrogen decreased leaf length significantly species with more rapidly and it elongate the leaves which results in a faster increase in leaf position under theleaf expansion rate (LER), leaf width and leaf area, higher relative leaf area expansion rates, and more biomass allocation to leaf sheaths [6].

For analysis of dry matter content the plant samples were dried and dry matter content (%) was measured resulted from the highest percentage of dry matter content in T2 (100% RDF), and the lowest percentage of dry matter content in T1 (control) treatment respectively as shown in (Table no. 2).Whereas 9.2 were the non-significant difference recorded under the treatments after harvesting.

The inspection of crude protein inkent oat fodder was observed in T2 (10.6%) and the lowest crude protein in T1 (7.5%). Remaining the hybrid oat fodder crop the maximum crude protein in T2 (6.9%) and lowest percentage of crude protein in T1 (2.9%) as shown in (Table no. 2). The data revealed that the different nitrogen levels had a major impact on all quality parameters of fodder oats, but the interaction effect between nitrogen levels on quality parameters

Table 1: Growth attributes (cm) under different treatments in fodder oat

Treaments	Leaf length (cm)			Leaf width (cm)				Leaf area (cm ^{2})
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	At Harvest	At Harvest
V1N1	9.9	27.6	30.1	0.2	1.4	1.8	2.1	60.5
V1N2	12.6	36.1	41.4	0.4	1.5	2.1	2.4	98.0
V1N3	10.1	33.8	35.9	0.2	1.4	1.9	2.1	75.9
V1N4	12.2	34.8	37.3	0.3	1.4	1.9	2.2	88.1
V1N5	9.7	29.5	31.6	0.2	1.3	1.7	2.2	70.0
V1N6	10.0	27.5	31.8	0.3	1.4	1.6	2.1	65.0
V2N1	7.7	25.0	26.5	0.2	1.2	1.7	1.7	44.7
V2N2	9.2	30.1	31.8	0.2	1.2	1.8	1.8	59.5
V2N3	7.5	26.5	27.9	0.2	1.3	1.5	1.4	41.1
V2N4	8.8	27.5	29.0	0.3	1.5	1.5	1.6	49.6
V2N5	8.2	26.9	27.2	0.2	1.2	1.8	1.8	48.7
V2N6	7.9	25.0	26.9	0.1	1.1	1.4	1.7	47.6
S. Em (±)	2.173124	3.770188	4.107927	0.015713	0.507232	0.380383	0.426296	3.012484
CD. (P=0.05)	4.783014	8.298129	9.041486	0.034585	1.116409	0.837218	0.938271	6.630433
Interaction	NS	NS	NS	0.034585	NS	NS	NS	NS

Treaments	Plant height (cm)				No. of leafs/plant				No. of tillers
	20 DAS	40 DAS	60 DAS	Harvest	20 DAS	40 DAS	60 DAS	Harvest	Harvest
V1N1	10.4	26.9	72.9	102.4	2.7	11.3	24.3	34.3	8.3
V1N2	12.5	34.8	92.8	120.2	3.7	13.3	25.3	43.3	9.0
V1N3	10.4	31.5	90.2	79.4	2.0	11.7	24.7	33.7	8.0
V1N4	11.5	35.0	93.9	119.5	2.7	12.7	25.3	41.7	9.0
V1N5	10.1	29.1	85.7	110.4	2.3	11.7	26.7	35.0	8.0
V1N6	9.8	27.7	89.0	111.6	2.3	13.0	25.0	35.3	8.7
V2N1	7.0	26.9	34.6	35.8	2.3	11.7	16.0	20.3	1.7
V2N2	9.2	34.8	67.2	68.5	2.7	12.0	20.0	25.3	2.7
V2N3	7.9	31.5	57.0	65.0	2.3	11.3	18.3	23.3	3.0
V2N4	8.8	35.0	61.4	65.0	2.7	12.7	18.7	21.3	2.7
V2N5	7.6	29.1	57.8	61.5	2.0	11.7	16.3	19.7	2.7
V2N6	7.5	27.7	60.7	66.3	2.0	11.0	18.0	21.7	3.0
S. Em (±)	2.70926	6.62315	8.29883	75.3364	2.51416	3.944053	9.130062	13.66802	4.95411
CD. (P=0.05)	5.96305	14.5775	18.29883	165.814	5.53362	8.680803	20.09513	30.08311	10.90392
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

was found to be non-significant.Whereas 2.9 were the non-significant difference recorded under the treatments after harvesting.

The maximum total ash content (%) was observed in thekent oat fodder crop the maximum for T2 (8.31%) and the lowest total ash content in T1 (7.9%). Remaining the hybrid oat fodder crop the maximum total ash content in T2 (5.9%) and the lowest percentage of total ash content in T1 (3.9%) as shown in (Table no. 2). The data revealed that the different nitrogen levels had a major impact on all quality parameters of fodder oats, but the interaction effect between nitrogen levels on quality parameters was found to be non-significant. Whereas 7.7 were the non-significant difference recorded under the treatments after harvesting. Similar findings have been published by [1].

The examination of maximum crude fibre content (%) in thekent oat fodder cropwas observed in T2 (34.1%) and the lowest crude fibre content in T1 (29.9%). Remaining the hybrid oat fodder crop the maximum crude fibre content in T2 (26.9%) and lowest percentage of crude fibre content in T1 (23.9%) as shown in (table no. 2). Whereas 6.0 were the non-

Table 2: Quality attributes under different treatments in fodder oat

Treaments	Dry matter content(%)	Crude protein(%)	Total ash content(%)	Crude fibre content(%)	Plant nutrient content(%)(N,P,K)		
					N content(%)	P content(%)	K content(%)
V1N1	58.0	7.5	7.7	30.4	1.2	1.2	2.1
V1N2	89.0	10.8	8.7	35.2	1.6	2.4	2.6
V1N3	72.5	8.8	8.7	33.6	1.4	2.3	2.2
V1N4	84.5	9.8	8.4	33.9	1.5	2.1	2.3
V1N5	68.9	8.1	8.3	32.4	1.3	1.6	2.2
V1N6	70.3	8.5	8.6	33.5	1.4	1.2	2.2
V2N1	55.4	2.5	4.1	24.0	0.3	0.9	1.2
V2N2	63.6	6.6	5.8	26.9	1.1	1.8	1.7
V2N3	57.6	5.6	5.5	24.2	0.6	1.5	1.9
V2N4	58.0	6.4	5.7	25.5	0.9	1.6	1.4
V2N5	57.3	3.8	4.3	24.0	0.4	1.2	1.3
V2N6	58.1	5.1	5.1	24.6	0.8	1.1	1.3
S. Em (±)	4.185985	1.353733	3.537733	2.727003	0.628539	0.73755	0.916537
CD. (P=0.05)	9.213291	2.979546	7.786498	6.002092	1.383406	1.623337	2.017284
Interaction	NS	NS	NS	NS	NS	NS	NS

Table 3: Effect on yield attributes and yield under different treatments in fodder oat

Treaments	**Green fodder yield(t/ha)**	**Dry fodder yield(t/ha)**
	At Harvest	**At Harvest**
V1N1	**21.8**	**5.4**
V1N2	**26.5**	**5.5**
V1N3	**27.4**	**5.6**
V1N4	**23.9**	**5.1**
V1N5	**22.9**	**5.3**
V1N6	**23.3**	**4.6**
V2N1	**20.0**	**2.5**
V2N2	**22.9**	**4.2**
V2N3	**22.2**	**3.5**
V2N4	**22.2**	**3.7**
V2N5	**22.6**	**3.3**
V2N6	**22.6**	**3.6**
S. Em (±)	**9.760263**	**3.522856**
CD. (P=0.05)	**21.48219**	**7.753754**
Interaction	**NS**	**NS**

significant difference recorded under the treatments after harvesting. Similar results regarding quality parameters were confirmed with earlier observations recorded by [5].

The data examination of different nitrogen levels had a major impact on all quality parameters of fodder oats, but the interaction effect between nitrogen levels on quality parameters was found to be non-significant. The results revealed that raising the nitrogen dose from (0 kg N ha-1) to (120 kg N ha-1) gives rise to thesubstantial increase in nitrogen per cent in yield. The application of V1N2(100% RDF) resulted in a significantly higher yield of nitrogen%, potassium%, and phosphorus% than the other treatment. Treatment V2N1(control) had the lowest nitrogen%, potassium%, and phosphorus% as compared to all other treatments. Similar results regarding quality parameters were confirmed with earlier observations recorded by [5].

The censorious examination wasdone at the timeof harvestingshowed that V1T2 has maximum green fodder yield and the lowest green fodder yield in V2T1. (Table no. 3).It revealed information about the yield of fodder oats. At the time of each cutting, green fodder yield and dry matter yield were recorded. The data demonstrate that different nitrogen levels had a major impact on fodder oat yield parameters, but the interaction effect between different nitrogen levels on yield parameters was found to be non-significant. The findings revealed that raising the nitrogen dose from T1 (0 kg N ha-1) to T2 (150 kg N ha-1) resulted in a substantial increase in green fodder yield and dry matter yield[24].Whereas 21.4 were the non-significant difference recorded under the treatments after harvesting shown in (Table no. 3).This variability in different yield attributing characters was mainly due to their genetic behaviour. These results are related to the findings of [17], [20] and [22]. The overall improvement of crop growth reflected into a better source-sink relationship, which in turn enhanced the yield attributes[18].

For the analysis of dry fodder yield the sample was harvested and dried in hot air oven for 48 hrsat 150^{0}celsius for drying the plant sample. The weight of theplant sample for each treatment plot was done and the result was revealed that the maximum dry fodder yield in treatments T2 and T4 respectively. The lowest dry fodder yield in V2T1 and V2T6 is shown in (Table no.13).Whereas 7.7 were the non-significant difference recorded under the treatments after harvesting. The related findings in terms of green forage yield and dry matter yield were verifiedby earlier observations made by[13] and [23].

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Conflict of interest

This is the certified that Any author have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria: educational grants, participation in speakers, bureaus , membership, employment, consultancy, stock ownership, or other equity interest, and expert testimony or patent- license) or non-financial interest in the subject matter or materials discussed in the manuscript.

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