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Research Article

Effects of Seed Rate and Nitrogen Fertilizer Rate on Nutritive Value of Oat (*Avena sativa L.*) at Sirinka, Ethiopia

Yidersal Erega*, Fasil Nigusie and Getachew Animut

Department of Animal Production and Technology, Woldia University, Ethiopia

Abstract

The present study was conducted to assess seed rate (SR) and nitrogen rate (NR) effects on nutritional quality of oat (*Avena sativa L.)* at Sirinka Agricultural Research Center, North Eastern Amhara, Ethiopia on July 2018. Levels of SR were 60, 80 and 100 kg/h and that of NL were 50, 100 and 150 kg/ha in the form of Urea (46% N). The experiment was conducted in a 3x3 factorial arrangement of treatments in a Randomized Complete Block Design (RCBD) with 3 replications giving a total of 27 plots, each measuring 2×1.4 m^2. Chemical composition for forage quality measurements were analyzed. Results showed that the interaction between seed rate and nitrogen rate had a significant ($p<0.05$) effect on almost all quality parameters measured. Increasing trend for crude protein content with increasing levels of seed rate and level of nitrogen were recorded, with the crude protein content ranging 7.4 to 8.6%. The NDF, ADF and cellulose contents ranged 51-58, 30-33 and 26-29%, respectively, and tended to increase with increasing seed rate and nitrogen rate of fertilization. Thus, high seed rate and nitrogen rate leads to improved forage quality. Generally, combination of 100 kg/ha seed rate and 150 kg/ha nitrogen recorded higher forage yield with higher quality and higher net return and benefit cost ratio (2.56) over rest of the combinations. Thus, seed rate of 100 kg/ha and nitrogen fertilizer rate of 150 kg/ha Urea can be recommended for better nutritional quality use by farmers in Sirinka area and other areas having similar agro-ecologies and soil type.

Keywords: Nitrogen rate; Nutritive value; Oat; Seed rate

Introduction

Livestock production in Ethiopia has considerable economic and social importance at household and national levels and provides significant export earnings [1]. About 80–85% of the people are employed in agriculture, especially farming [2]. The sector contributes about 46% of total GDP; livestock and their products account for about 47.7% of agricultural GDP [3]. However, livestock productivity is very low attributable to different factors of which poor nutrition is the major one. A large proportion of livestock feed resources in Ethiopia are natural pastures, crop residues and aftermath grazing [1,2]. These feed resources cannot support higher animal productivity due to their low productivity, low nutritive value, and digestibility. For several decades, grazing areas have been shrinking and likely to continue to do so because of rapid expansion of cultivated land for crop production to provide food for the ever-increasing human population. As a result, there is always likely to be limited feed resources for the existing livestock population [4,5].

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***Corresponding author:** Wimalawansa SJ, Endocrinology, Metabolism & Nutrition, 661 Darmody Avenue North Brunswick, NJ, 08902, USA, Tel: 7323056537; Email: suniljw@hotmail.com

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In most tropical countries, inadequate supply of feed is the bottleneck to livestock production [2]. This is due to the dependence of livestock on naturally available feed resources and little development of forage crops for feeding animals [6]. Like in other tropical countries, in Ethiopia, most of the areas in the highlands of the country are nowadays put under cultivation of cash and food crops which resulted in keeping large number of livestock on limited grazing areas leading to overgrazing and poor productivity of livestock [5]. Though, expansion in the cultivation of cereal crops increased the supply of crop residues for animal feeding but, crop residues have low nutritive value and could not support reasonable animal productivity [6].

One of the alternatives to improve livestock feeding, and thereby enhance productivity of livestock is through the cultivation of improved forages and offer them to animals during critical periods in their production cycle and when other sources of feeds are in short supply [2]. The use of cultivated forage crops has received considerable attention for complementing the conventional feed resources especially in areas where feed shortage is the main constraint for livestock productivity [2,6]. From the forage crops, due to short life cycle, suitability in crop rotations and better performance on marginal lands, oat (*Avena sativa L.*) is an important species for integration into the existing farming system [6]. Oats can be easily cultivated, develops rapidly, and yields high amounts of dry matter and green forage of higher quality when managed properly. Oats are forage crop grown at medium to high altitudes (1600-3000 m) on heavy soils (vertisols) where temperate grasses and other improved forages are difficult to establish [2]. The species owes its reputation to its versatility as it can be grown for grain, hay, silage or direct grazing and is being used as feed for dairy cattle, young stock, sheep and goats [7]. Moreover, it has superior recovery after grazing and is highly useful for overcoming critical periods of feed shortage or for finishing animals for market when permanent pastures are of poor quality [8].

With other factors, seed rate, and level of nitrogen fertilizer are key factors, which contribute to the nutritional quality of oat [8]. Improved fodder quality with fertilizer application is due to their favorable effects on plant water relations, light absorption, crop density, plant height, leaf area and nutrient utilizations [9]. The applications of nitrogen fertilizer improve the dry matter, biomass yield and quality of forage [6]. Hence, there is a need to determine an appropriate level of fertilizer application especially in soils deficient in nitrogen and proper seeding rate to positively affect oat production in terms of its nutritional quality. Therefore, to utilize oat as a potential fodder crop in the study area, appropriate seeding rate and level of nitrogen fertilization needs to be determined. Such information appears to be lacking in the study area, and such information are location specific based on the soil fertility status of an area. Hence, this experiment was conducted with the following objectives:

Objective

To investigate the effect of seed rate and nitrogen rate on nutritive quality of oat *(Avena sativa L.)* at Sirinka, North Eastern Amhara, Ethiopia.

Materials and Methods

Description of the Study Area

The study was conducted at Sirinka Agricultural Research Center (SARC), which is located 508 km North of Addis Ababa, the capital of Ethiopia. The site is located at an altitude of 1850 meters above sea level and at 110°451'0011" North latitude and 390°361' 3611" East longitude [10]. The rainfall pattern is bimodal, with two-rainfall seasons, 'belg' (February/March - April) and 'Meher' (July-September) with a mean annual rainfall of 950 mm. The mean daily temperature range is of 16-21°C [8]. The soil type of the experimental fields is clay loam, with a pH of 6.98. The soil, organic carbon is 1.35%, total N was 0.07%, available P 13.7 mg kg^{-1} [2,11].

Experimental materials

The materials used in this experiment was *Lampton* oat variety, which was released by Holeta Agricultural Research center and recommended by Sirinka Agricultural Research Center as a suitable variety for the study area. Nitrogen fertilizer was used as other experimental material in the form of fertilizer grade Urea (46% nitrogen). Both the seed and fertilizers used for this experiment was gained from Sirinka Agricultural Research Center.

Experimental Design, treatments and procedures

The study was a 3 x 3 factorial arrangement of treatments in a randomized complete block design (RCBD). The two factors were seed rate with three levels (60, 80 and 100 kg/ha) and nitrogen fertilization with three levels (50, 100 and 150 kg/ha). The seed rate and nitrogen fertilization rates were the recommendations set by Sirinka Agricultural Research Center for the oat variety. The gross size of the experimental plot was 2 m x 1.4 m length and width respectively, accommodating 7 rows of oats at a spacing of 20 cm between rows. Space of net sampling plot size was 1.8 m x 1 m length and width respectively, in which the two outer most rows and 0.1 m length at both ends considered as border leaving.

Land was prepared using tractor drawn cultivator once and bullock twice. The smoothened land was laid out according to the experimental plan. The oat was planted at middle of July 2018 cropping season with 20 cm between rows with three levels of seed rate. The forage was supplied with three levels of nitrogen, in the form of urea. Nitrogen was applied as per treatment specifications. Half dose of the nitrogen was applied at the time of sowing in band in small furrows opened manually adjacent to the seed line and covered with soil to avoid the losses and the remaining 50 percent nitrogen was applied at tillering stage. Full dose of NPS fertilizer (121 kg/ha) was applied at sowing time for all of the plots as a common treatment. All other necessary field management practices was carried out equally for all experimental units.

Chemical analysis for forage nutritive value

The laboratory analysis for feed quality was carried out at Holeta Agricultural Research Center, Animal Nutrition laboratory. The DM, ash and nitrogen (N) content were determined following the procedure of AOAC [12]. The nitrogen content was analyzed using Kjeldahl procedure and CP was calculated as N x 6.25. The neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) contents were analyzed using the procedure of Van Soest and Robertson [13]. Organic matter content was calculated as 100-ash. Hemicellulose was determined by subtracting ADF from NDF and cellulose subtracting lignin from ADF.

Data analysis

The collected data was subjected to the analysis of variance (ANOVA) using the SAS computer package version 9.1 (SAS, 2004). Mean separation was carried out using least significance difference (LSD). The model for data analysis consist the effects of seeding rate, nitrogen fertilization rate and their interaction. When interaction was significant ($P<0.05$) simple effect means were compared, otherwise main effect means were compared.

The statistical model used was: $\mathbf{Y_{ijk} = \mu + S_i + N_j + B_k + SN_{ij} + \varepsilon_{ijkl}}$;

Where,

Yijk = measurable variable,

μ = overall mean,

Si = the i^{th} seeding rate effect,

Nj= the j^{th} nitrogen fertilization rate effect,

Bk = k^{th} Block effect,

SNij = interaction of seed rate and nitrogen fertilization rate and

εijkl = random error term.

Result and Discussion

Dry matter content

There was significant ($p<0.001$) effect of seed rate, nitrogen rates and their interaction on dry matter content (Table 1). Interaction effect of seed rate and nitrogen rate indicated maximum DM content value for 60 kg/ha seed rate and 150 kg/ha nitrogen rate, and minimum DM value was for 80 kg/ha seed rate and 150 kg/ha nitrogen rate. The dry mater content was lower for 80 kg/ha seed rate than the other high and low seed rates. On the contrary, Kakol [14], reported higher dry matter content of oat with higher seed rate of 100 kg/ha compared to 75 kg/ha seed rate. Nitrogen rates have also significant effect on DM content. The DM content was higher for 100 kg/ha nitrogen rate than 50 and 150 kg/ha nitrogen rates. An optimum N application enhanced the DM contents in the current study. As crops grow towards maturity, dry matter percentage increase with a simultaneous decrease in moisture percentage. An increase in dry matter content of teff grass with nitrogen application has also been reported by Wang [15]. Iqbal [16], also observed that nitrogen application significant improved the DM content. In contrast, Bassegio [17], noted that nitrogen application did not showed significant effect on DM content of oat.

Crude protein content

Protein content is one of the most important parameters affecting the nutritional value of fodder crops. There was a significant ($p<0.05$) difference in crude protein content due to interaction of seed rate and nitrogen rate (Table 1). Maximum crude protein content of 8.56% was recorded for 80 kg/ha seed rate with 150 kg/ha nitrogen rate. The minimum crude protein content of 7.40% was recorded for 60 kg/ha seed rate with 50 kg/ha nitrogen rate. This result indicated that crude protein content responded differently to nitrogen at different seed rates. There was significance ($p<0.001$) increase in crude protein content with increase in seed rate (Table 2). Significantly higher crude protein content was recorded at 100 kg/ha seed rate compared to the 60 kg/ha, while values for the 80 kg/ha seed rate was similar with the other two seed rates. Sadig [18], and Neel [19], also reported that, there was a significance increase in the content and quality parameters of oat including crude protein content with increase in seed rate. Alia [20], reported contradictory result that increase in seed rate resulted in the reduction of crude protein content of oat. The crude protein content was affected significantly ($p<0.001$) by different levels of nitrogen fertilizer (Table 1). The CP content increases with increasing level of nitrogen fertilization from 50 to 150 kg/ha. This could be attributed to improved vegetative growth with higher nitrogen content in the plant tissues as nitrogen fertilization increases. Johnston [21], and Iqbal [16], also reported that application of nitrogen up to 80 kg/ha resulted in significant increase in crude protein content and yield of oat fodder over that of the control. Kumar [9], also reported adequate available nitrogen enhanced protein synthesis, which resulted in higher CP content as well as yield of crude protein in oat. Wang [15], and Marsalis [22], reported contradictory results with the current finding that at the low nitrogen rates, increasing seed rates resulted in reduced crude protein of forage maize.

Total ash content

The interaction of seed rate and nitrogen rate on ash content was significant ($p<0.001$). The maximum total ash (9.13%) was recorded in 100 kg/ha seed rate with 50 kg/ha nitrogen rate followed by a combination of 100 kg/ha seed rate and 150 kg/ha nitrogen fertilizer. The minimum total ash content (7.40 %) was recorded for 60 kg/ha seed rate with 150 kg/ha nitrogen fertilizer. There was no significant difference in total ash content among seed rates (Table 1). However, Kakol [14], reported higher total ash content of oat with higher seed rate of 100 kg/ha compared to 75 kg/ha seed rate. Ayub [23], also noted ash percentage of fodder maize to decrease with increase in seed rate. Differences among studies may be due to the differences in research protocol and differences between forage species. The effect of three levels of nitrogen on ash contents was significant ($p<0.001$) and ash content showed decreasing trend with increase in nitrogen rate (1). Higher ash content was recorded for 50 kg/ha nitrogen rate than the other two levels. The decrease in ash content of oat with increasing nitrogen fertilizer levels is in line with Wang [15], and Ayub [23], who reported that total ash content decreased linearly with increase in nitrogen rate of fertilization. But the current result disagrees with that obtained by Johnston [21], and Alia [20], who reported an increase in total ash content with increase

Table 1: Treatment combinations used in the experiment.

Treatments	Seed rate (kg/ha)	Nitrogen rate (kg/ha)	Treatment combination
T1	S_1	N_1	S_1N_1
T2		N_2	S_1N_2
T3		N_3	S_1N_3
T4	S_2	N_1	S_2N_1
T5		N_2	S_2N_2
T6		N_3	S_2N_3
T7	S_3	N_1	S_3N_1
T8		N_2	S_3N_2
T9		N_3	S_3N_3

S_1= 60 kg/ha seed rate, S_2= 80 kg/ha seed rate, S_3= 100 kg/ha seed rate, N_1=50 kg/ha nitrogen, N_2=100 kg/ha nitrogen, N_3= 150 kg/ha nitrogen

Table 2: Nutritive quality parameters of oat as affected by seed rate and nitrogen rates.

Trt	Chemical composition (% for DM or % DM for others)								
	CP	**DM**	**Ash**	**OM**	**NDF**	**ADF**	**ADL**	**C**	**HC**
Seed Rate (kg/ha)									
60 (S_1)	7.70^{b}	93.71^{a}	8.08	91.91	54.18	31.76^{b}	3.90	27.85^{b}	22.58
80 (S_2)	7.81^{ba}	92.66^{b}	8.21	91.41	54.34	32.15^{a}	4.28	27.87^{b}	22.62
100 (S_3)	7.88^{a}	93.48^{a}	8.58	91.78	54.77	32.41^{a}	3.98	28.42^{a}	21.77
LSD	0.13	0.32	0.45	0.44	1.28	0.34	0.33	0.41	1.46
SL	**	**	ns	Ns	Ns	**	Ns	*	ns
Nitrogen rate (kg/ha)									
50 (N_1)	7.42^{c}	92.99^{b}	8.78^{a}	91.21^{b}	52.52^{b}	31.48^{b}	3.91	27.57^{b}	21.03^{b}
100 (N_2)	7.67^{b}	93.65^{a}	8.14^{b}	91.85^{a}	55.23^{a}	32.29^{a}	4.10	28.44^{a}	22.68^{a}
150 (N_3)	8.30^{a}	93.21^{b}	7.94^{b}	92.05^{a}	55.55^{a}	32.55^{a}	4.14	28.14^{a}	23.25^{a}
LSD	0.13	0.32	0.45	0.44	1.28	0.34	0.33	0.41	1.47
SL	**	**	**	**	**	**	Ns	**	*
Seed Rate x Nitrogen Rate									
S_1N_1	7.40^{e}	93.39^{b}	8.74^{ab}	91.25^{cd}	50.89^{e}	31.94^{bc}	3.62^{cd}	28.31^{b}	18.95^{e}
S_1N_2	7.63^{cd}	93.75^{ab}	8.48^{abc}	91.52^{bcd}	53.99^{cd}	31.90^{bc}	3.49^{d}	28.40^{b}	22.09^{cbd}
S_1N_3	8.08^{b}	94.00^{a}	7.40^{d}	92.59^{a}	58.14^{a}	31.44^{c}	4.60^{ab}	26.84^{c}	26.70^{a}
S_2N_1	7.43^{de}	92.77^{c}	8.49^{abc}	91.51^{bcd}	54.16^{cd}	30.26^{d}	4.05^{bc}	26.20^{c}	23.90^{a}
S_2N_2	7.65^{dc}	93.51^{ab}	8.16^{bcd}	91.83^{abc}	55.25^{bc}	32.92^{a}	4.68^{a}	28.24^{b}	22.33^{cbd}
S_2N_3	8.56^{a}	91.72^{d}	7.59^{d}	92.41^{a}	54.91^{bc}	33.28^{a}	4.10^{bc}	29.18^{a}	21.63^{cbd}
S_3N_1	7.44^{de}	92.83^{c}	9.13^{a}	90.87^{d}	52.50^{de}	32.25^{b}	4.06^{ab}	28.19^{b}	20.24^{de}
S_3N_2	7.74^{c}	93.71^{ab}	7.77^{cd}	92.22^{ab}	56.46^{ab}	32.82^{a}	4.15^{abc}	28.67^{ab}	23.63^{bc}
S_3N_3	8.26^{b}	93.91^{ab}	8.85^{ab}	91.15^{cd}	53.59^{cd}	32.15^{b}	3.74^{cd}	28.40^{b}	21.44^{cd}
LSD	0.22	0.53	0.76	0.76	2.19	0.56	0.54	0.66	2.43
SL	*	**	*	*	**	**	**	**	**
CV	1.04	0.26	4.05	0.36	1.77	0.79	6.27	1.12	4.93
MEAN	7.69	93.28	8.29	91.70	54.43	32.10	4.05	28.05	22.32

$^{a-e}$Means followed by the same letter within a column and category are not significantly different (P < 0.05); ns = Not significant; LSD= Least significant difference; SL = significant level; CP= crude protein; DM= dry matter content; OM= organic matter; NDF=neutral detergent fiber; ADF= acid detergent fibe; ADL=acid detergent lignin; C= cellulose; HC = hemicellulose; *significant at P<0.05; **significant at P<0.01 CV = coefficient of variance.

nitrogen fertilization. Such differences among studies in total ash content, may be due to the fact that many parameters affect the concentration of ash, like temperature, agro ecology, soil type and the likes.

Organic matter content

Interaction effect was significant (p<0.05) regarding organic matter percentage (Table 1). The treatment combination 50 kg per ha seed rate at 150 kg per ha nitrogen recorded significantly higher organic matter percentage (92.59 %). Next best combination was 80 kg per ha seed rate at 150 kg per ha nitrogen (92.41) but statistically par with the previous treatment combination. Significantly least organic matter yield was recorded with 100 kg per ha seed rate at 50 kg per ha nitrogen (90.87). Trend of significant differences for organic matter content is similar to that of ash content. Seed rate did not significantly impact organic matter content, while the effect of nitrogen rate and interaction of seed rate and nitrogen rate on organic matter content was significant (Table 1). In contrast to the finding of this study, Alia [20], reported that there was a decrease in organic matter content of oat with increase in seed rate. Other researchers reported increase in seed rate of forage grasses resulted in an increase in organic matter content [24,25]. There was significant (p<0.001) increase in organic matter yield with increase in nitrogen rate (Table 1). Organic matter content was lower for 50 kg/ha nitrogen rate as compared to the other nitrogen rates. Similarly, various studies reported increased organic matter content under higher levels of nitrogen in fodder sorghum [24-27].

Neutral detergent fiber content

Interaction effect was significant (p<0.001) for neutral detergent fiber content of forage oat (Table 1). The treatment combination 60 kg per ha seed rate with 150 kg per ha nitrogen recorded significantly higher neutral detergent fiber content (58.14 %). It was on par with neutral detergent fiber content (56.46 %) recorded in treatment combination 100 kg per ha seed rate at 100 kg per ha nitrogen. Significantly least neutral detergent fiber (50.89 %) content was recorded with 60 kg per ha seed rate at 50 kg per ha nitrogen. However the result was par with neutral detergent fiber content (52.50 %) recorded at 100 kg per ha seed rate at 50 kg per ha nitrogen. There was no significant effects of seed rates on NDF content (Table 1). Similar result on forage oat was reported by Alia [20], and Sadig [18].

But the effect of nitrogen rate was significant ($p<0.001$) on NDF content. The NDF content of 50 kg/ha nitrogen rate was lower than the other two levels that had similar values. The reason for having more NDF content at higher levels of nitrogen may be attributed to higher stem diameter and longer plant height with higher nitrogen rate of fertilization. This result was in line with the findings of Budakli [28], and Aslam [29], who also reported that increase in nitrogen fertilization rate leads to higher NDF content of forage maize.

Acid detergent fiber content

The interaction effect of seed rate and nitrogen rate on ADF content was significant ($p<0.001$) (Table 1) and 80 kg/ha seed rate at 100 kg/ha nitrogen rate, 80 kg/ha seed rate at 150 kg/ha nitrogen rate; and 100 kg/ha seed rate at 100 kg/ha nitrogen rate recorded significantly higher ADF content. However, the significantly lowest ADF was recorded with 80 kg/ha seed rate at 50 kg/ha nitrogen rate. Acid detergent fiber content was significantly ($p<0.001$) affected by seed rate (Table 1). The ADF was significantly lower for the 60 kg/ha seed rate compared to the other two seed rates that had similar values. This result is in agreement with the findings of Aslam [29], who reported that ADF content of oat was affected by different seed rates with positive relations. Conversely, Kakol [14], reported that there was lower ADF content of maize with increase in seed rate due to thinner plants in higher seed rate or due to higher plant population. Increasing nitrogen rate lead to significant ($p<0.001$) increase in ADF content. Nitrogen rates of 100 and 150 kg/ha increased the ADF content compared to the 50 kg/kg nitrogen rate. The result was in agreement with the findings of Gasim [24], and Ayub [30], that reported increased ADF content of oat with application of nitrogen fertilizer. On the contrary, Wang [15] Johnston [21], noted that ADF content of oat was inversely related to nitrogenous compounds.

Acid detergent lignin content

The interaction effect of seed rate and nitrogen level was significant ($p<0.001$) and treatment combination 100 kg ha-1 seed rate at 100 kg ha-1 nitrogen recorded significantly higher acid detergent fiber content (32.82 %) followed by 80 kg ha-1 seed rate at 150 kg ha-1 nitrogen (33.28 %) which was statistically the same with the previous treatment combinations. However, the significantly lowest acid detergent fiber content (30.26 %) was recorded with treatment 80 kg ha-1 seed rate at 50 kg ha-1 nitrogen (Table 1). Applying different levels of seed rate have no statistically significant effect on acid detergent lignin content (Table 1). Similarly it was evident from the data that acid detergent lignin content was not significantly affected by different levels of nitrogen fertilization (Table 2). The maximum acid detergent lignin content (4.28 %) was produced in seed rate of 80 kg ha-1 which was statistically similar with the rest of seed rates (Table 2). Minimum acid detergent lignin content 3.90 % was recorded when 50 kg ha- 1 seed rate was applied. This is in line with the result of Budakli [28], who reported that seed rate failed to influence acid detergent lignin content of oat. Contradictory to this result Gasim [24], reported that the ADL was significantly less at the higher than lower seeding rate. Linearly maximum acid detergent lignin content (4.14 %) was recorded when forage oat was fertilized with 150 kg ha-1 nitrogen. Minimum acid detergent lignin content 3.91 % was recorded when 50 kg ha- 1 nitrogen was applied which is the lowest nitrogen level used for this experiment but the result was statistically par with the rest nitrogen levels. Abbas [31], and Adam [25], reported different results from this study on effect of nitrogen and showed that acid detergent lignin content of oat increased with addition of nitrogen fertilization level. The variation may be due to differences in research methodology as well as treatment combinations.

Cellulose content

Cellulose content of oat differed significantly ($p<0.001$) due to interaction effect of seed rate and nitrogen rate (Table 1). The 80 kg/ha seed rate at 150 kg/ha nitrogen and 100 kg/ha seed rate at 100 kg/ha nitrogen recorded significantly higher cellulose content. However, significantly lowest cellulose content was recorded for 80 kg/ha seed rate at 50 kg/ha nitrogen, and for 60 kg/ha seed rate with 150 kg/ha nitrogen rate. Cellulose content of oat differed significantly ($p<0.05$) among seed rates (Table 1), the value being higher for 100 kg/ha seed rate as compared to the other seed rates. This result was in agreement with the findings of Aslam [29], who reported increasing seed rate up to 125 kg/ha increase cellulose content of oats. Cellulose content of oat differed significantly ($p<0.001$) among nitrogen rates (Table 1). Application of nitrogen at 100 and 150 kg/ha recorded significantly higher cellulose content as compared to the 50 kg/ha nitrogen rate. This result is in contrast with the results reported by Gasim [24] and Ayub [30], who reported that cellulose content of oat decreased with increasing nitrogen fertilizer applications.

Hemicellulose content

Interaction effect of seed rate and nitrogen rate on hemicellulose content was significant ($p<0.001$). The 60 kg/ha seed rate with 150 kg/ha nitrogen, and 80 kg/ha seed rate at 50 kg/ha nitrogen resulted to higher cellulose content; while 60 kg/ha seed rate at 50 kg/ha nitrogen reduced hemicellulose level. Seed rate did not have effect on hemicellulose content of oat (Table 1). Contrary to the current finding Murtada [32], reported increase in the hemicellulose content of maize as the seed rate increased. Level of nitrogen significantly affected hemicellulose content with the value for 50 kg/ha nitrogen rate being lower than the other two levels. This result is similar to that obtained by Gasim [24], and Ayub [30]. Contrary to this result Wang [15], reported that increasing nitrogen rate lead to reduced hemicellulose content of oats.

Conclusions and Recommendations

A study was conducted to investigate the effect of seed rate and nitrogen rate fertilization on biomass yield, and nutritive quality of the oat (*Avena sativa L.*) at Sirinka from July 2018 to June 2019. Seed rates were 60, 80 and 100 kg/ha, and nitrogen fertilizer (Urea 46%N) at rates were 50, 100 and 150 kg/ha, with experiments arranged in randomized complete block design. As observed from the result seeding rates and addition of nitrogen fertilizer at different levels have great impact on the yield and agronomic parameters as well as nutritive qualities of fodder oats. However, seeding rate and application of fertilizer above optimum level often produce no additional yield and it will not be economically feasible. Therefore, it is important to have the optimum seed rate and fertilizer rate for producing reasonable green fodder and DM with superior nutritional quality of fodder oats.

From these results it can be concluded that:

- High seed rate had more plant population and consequently increased tiller number per meter row length which contributes to higher nutritional quality.
- Increased nitrogen rate increased number of leaves and promotes good plant growth, which leads to improved forage quality (protein).

Based on the above result the following recommendations were forwarded:

- For better nutritional quality of oat, S3N3 *i.e.*, 100 kg/ha seed rate at 150 kg/ha nitrogen can be recommended for use by farmers in Sirinka area and other areas having similar agro-ecologies and soil type.
- To make the current finding valuable, the result needs to be supported with animal evaluation trials.

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