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Research Article

Growth and yield of different oat (*Avena sativa*) varieties in Lalitpur district of Nepal

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ABSTRACT

Oat (*Avena sativa*) is considered as one of the best fodders to mitigate the present seasonal feed deficit for ruminants in Nepal. The study was undertaken to evaluate eleven oat varieties for fodder and seed yield at the Khumaltar condition from December 2021 to April 2022. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The fodder oat varieties; Ever leaf, Titan, Baler no. 1, Sweet oat, Monida, Qingyin no. 1, Qinghai no. 444, Kona, Swan Pak, Longford, and Netra (as a check variety) were used as the treatments. An experimental unit was a 4 m × 3 m sized plot with the row to row spacing of 0.30 m and continuous sowing within a row. A total of two cuttings were taken for fodder. The observations on growth and yielding characters comprising of plant height, leaf area, number of tillers plant^{-1}, number of leaves/tiller, fodder dry matter, seed and straw yield were recorded. The results showed the fodder dry matter yields ranged from 2.35 to 3.58 t/ha and were not significantly different ($p>0.05$) among the varieties. The seed and straw yields were obtained statistically different ($p<0.05$) among the varieties. Netra (2.90 t/ha) and Kona (2.88 t/ha) produced higher seed yields. Similarly, the highest straw yield was produced for the variety Longford (8.73 t/ha).

Keywords: Fodder yield, yield attributing characters, seed yield, straw yield

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INTRODUCTION

Ruminant livestock production is important economic and livelihood activity for the farming families of Nepal. Quite the reverse, their productivity is constrained by the deficit of nutrients. Feed shortage, particularly during winter seasons is the major limiting factor to reducing meat and milk production of ruminants in Nepal (Singh & Singh, 2019). The oat, considered as one of the best winter fodders, globally ranked sixth as food crop and first as the fodder crop (FAO, 2011). Oat performs better in cool moist climatic conditions and can be sensitive to hot, dry weather from head emergence to maturity (Suttie & Reynolds, 2004). The oat fodder is mostly fed green and the excess is converted into silage or hay for animal feeding during fodder deficit periods (Suttie & Reynolds, 2004). Its importance is inclined due to better fodder yield during winter, better fodder quality and superior hay making potential.

On the other hand, the insufficiency of good quality seeds of fodder oat is one of the major limitations of fodder production in Nepal (Singh & Singh, 2019). Limited (six) numbers of improved varieties of various oat crops have been released by Nepal Agricultural Research Council for the different agroecological regions (Ghimire, 2019). In this context, oat seed production can be promoted by selecting new varieties having better seed yield as well as

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fodder biomass potential (Ahmad *et al*., 2014). It can attract farmers through better economic returns.

Increased nutritional demand for high animal performance challenges the oat producers to select superior fodder oat variety and to combine good management practices to produce crops with high yield and favorable quality characteristics (Kim *et al.*, 2006). In addition, the attraction of farmers to seed production of fodder oat can be made possible by introducing superior varieties which have the potential of producing higher seed yields. Therefore, the fodder and seed productivity of introduced oat varieties were evaluated at Khumaltar, Lalitpur with the objective of identifying and screening the superior oat varieties for fodder and seed yields for the winter season.

MATERIALS AND METHODS

Experimental site and climate

The experiment was conducted at the experimental site of the National Pasture and Fodder Research Program (NPFRP), Khumaltar, Lalitpur (27°38'50.45" N, 85°19'26.10" E and 1335 masl) from November 2021 to April 2022.

The climatic data of the experimental site is presented in Table 1. The total rainfall received during the experimental duration was 128.9 mm.

Table 1. Weather records during the experimental period at Khumaltar, Lalitpur, 2022

Parameters	Months					
	November	December	January	February	March	April
Maximum temperature (°C)	22.20	16.60	17.10	17.70	26.20	28.40
Minimum Temperature (°C)	11.20	4.20	4.40	4.40	11.00	15.20
Average Temperature (°C)	16.70	10.40	11.05	11.05	18.60	21.80

Source: National Agronomy Research Centre (2022)

The soil of the experimental site was clay loam textured with a pH value of 5.29. The nitrogen content was medium (0.15%), phosphorous was high (88.32 kg/ha P_2O_5), potassium was low (52.72 kg/ha) and 3.10% organic matter.

Fodder genotype and experimental design

The fodder oat genotypes were received from China and the lists of fodder genotypes evaluated are presented in Table (2). The experiment was laid out in Randomized Complete Block Design with three replications for each treatment. The treatment comprised 10 introduced fodder oat varieties along with Netra as the check variety.

Table 2. The fodder oat genotypes evaluated at Khumaltar, Lalitpur , Nepal

Treatments	Varieties
T1	Everleaf
T2	Titan
T3	Baler no.1
T4	Sweet oat
T5	Monida
T6	Qingyin no.1
T7	Qinghai no. 444
T8	Kona
T9	Swan Pak
T10	Longford
T11	Netra (as check)

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Crop management

The experimental plot was ploughed 2-3 times with a disc harrow and made the soil friable. The size of an experimental plot was of 4m × 3m. Continuous sowing was done at 0.30 m row to row spacing. The seed was sown at the rate of 80 kg/ha. Nitrogen, phosphorous and potash were applied at the rate of 80:60:40 kg/ha, respectively. Phosphorous and potash were applied during land preparation while nitrogen fertilizer was applied in two split doses, half at the time of land preparation and the remaining half after first cut (60 days after sowing). Farm yard manure was applied at the rate of 10 t/ha during the time of land preparation. The first irrigation was applied after sowing and successive were in 15 days interval. Weeding and hoeing were done as and when basis. A total of two cuttings were taken for fodder. The first cut was taken after 60 days of sowing and second cut was taken at 30 days after first cut.

Data collection and statistical analysis

The data on fodder biomass yield and its attributing characters and seed yield were collected. Half of the plot was used for the fodder observations and another half was used for seed yield observations. The green biomass yield was recorded and used to calculate the fodder dry matter. The morphological characteristics (plant height, leaf length, leaf breadth and leaf numbers) were taken from randomly selected five plants from each plot at 60 days after sowing. Leaf area was calculated by multiplying the product of length and width by a factor of 0.73 (Premy, 2002).

The collected data was processed and analyzed for ANOVA. Mean comparison of the treatments was done using Tukey's test. Statistical software GenStat discovery 18th Edition (VSNi, 2015) was used to analyze the data.

RESULTS AND DISCUSSION

Growth and yield attributing characters

The plant height and leaf area varied significantly ($p<0.05$) among the varieties during the first cut (Table 3).

Table 3. Yield attributing characters of different varieties of fodder oat at Khumaltar, Lalitpur, Nepal

Varieties	Plant height (cm)	Leaf area (cm^2)	Number of tillers/plant	Number of leaves/ tiller
Ever leaf	36.00^{cd}	21.48^{ab}	3.80	4.40
Titan	36.13^{cd}	19.91^{ab}	3.73	4.40
Baler no. 1	37.53^{cd}	20.34^{ab}	3.33	4.33
Sweet Oat	45.33^{bc}	25.91^{ab}	4.00	4.33
Monida	29.73^{e}	17.32^{b}	4.60	4.13
Qingyin no. 1	57.4^{a}	32.48^{a}	3.53	4.46
Qinghai no. 444	49.4^{ab}	30.42^{a}	3.80	4.20
Kona	39.53^{bcd}	25.74^{ab}	3.60	4.46
Swan Pak	46.33^{bc}	23.14^{ab}	3.60	4.33
Longford	34.93^{cd}	24.80^{ab}	3.66	4.46
Netra	31.70^{e}	21.16^{ab}	3.46	4.20
SEM	4.85	4.37	0.29	0.16
F-test	***	*	ns	Ns
LSD (0.05)	10.12	9.12	0.61	0.34
CV (%)	14.7	22.4	13.5	4.7

SEM: Standard Error of Mean, LSD: Least Significant Difference, CV: Coefficient of Variation, ns: Non-Significant, Values followed by different letters within a column are significantly different at P= 0.05

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Qingyin no. 1 had attained the tallest plant height followed by Qinghai no. 444, whereas it was lowest for Monida. Likewise, leaf area was highest for Qingyin no.1 and the lowest for Monida. However, number of tillers plant^{-1} and the number of leaves/tiller were statistically similar ($p>0.05$) among the genotypes with the range of 3.33 to 4.60 tillers/plant and 4.20 to 4.46 leaves/tiller, respectively.

Fodder, seed and straw yield

The fodder dry matter yield was not significantly different ($p>0.05$) for the tested varieties (Table 4). However, the seed yield and straw yield were significantly different ($p<0.001$). The check variety Netra and Kona produced the highest seed yield which were *at par* with Qingyin no. 1 and Titan. The seed productivity was lower ($p<0.001$) for the varieties Ever leaf and Longford in comparison to other tested varieties. The straw yields were obtained higher ($p<0.01$) for Longford and Titan, and was lowest for Swan Pak variety.

Table 5. Fodder dry matter yield, seed yield and straw yield of different oat varieties at Khumaltar, Lalitpur

Varieties	DM yield (t/ha)	Seed yield (t/ha)	Straw yield (t/ha)
Ever leaf	2.44	0.67^{e}	7.30^{abc}
Titan	2.66	2.20^{ab}	8.49^{a}
Baler no. 1	2.35	1.68^{bc}	5.36^{cd}
Sweet oat	2.95	1.86^{bc}	6.39^{abc}
Monida	2.68	1.94^{bc}	7.66^{ab}
Qingyin no. 1	3.49	2.26^{ab}	4.61^{de}
Qinghai no. 444	2.59	2.06^{bc}	7.97^{ab}
Kona	3.58	2.88^{a}	7.90^{ab}
Swan Pak	2.83	2.31^{ab}	2.62^{e}
Longford	2.81	1.43^{d}	8.73^{a}
Netra	2.67	2.90^{a}	6.49^{abe}
SEM	0.62	0.30	1.22
F-test	ns	***	**
LSD (0.05)	1.30	0.63	2.56
CV (%)	27	18.4	22.5

DM: Dry matter, SEM: Standard Error of Mean, LSD: Least Significant Difference, CV: Coefficient of Variation, ns: Non-Significant, Values followed by different letters within a column are significantly different at P= 0.05

Many parameters influence the seed and straw yields of fodder crops. The plant height which is largely dependent on the genetic make-up of a variety was also obtained varied for different varieties. Zaman *et al.* (2006) explained that the plant height may be different in varieties due to genetic make-up and environmental conditions which in turn cause variations in hormonal balance and cell division rate in a particular environment. The plants of Kona, Qingyin no.1 and Qinghai no. 444 were obtained taller in the experiment. This might be the reason for the variations in the seed and straw yields of the evaluated varieties. Pariyar (2007) reported that the taller plant had increased seed and straw yield.

In another experiment by Amanullah *et al.* (2004), the leaf area also influenced the seed yield and straw yield. The results of this study were also in agreement with this report. Higher leaf areas which were observed in Qinghai no. 444, Qingyin no.1 and Kona varieties could have been attributed by better interception, absorption and high utilization of radiation energy leading to higher photosynthetic rate and hence more accumulation of dry matter by the plants, which helped to improve the accumulation of dry matter by the plants and ultimately

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resulted the higher seed yield and straw yield. These results are nearly close conformity with the findings of Siloriya *et al.* (2014), Amanullah *et al*. (2004) and Naeem *et al.* (2002).

CONCLUSION

The study revealed that Kona, Titan, Swan Pak and Qingyin no. 1 were found better in terms of seed yield (2.87 t/ha) which was *at par* with the check variety- Netra. For fodder productivity, all the varieties had shown similar yields. Therefore, further experimentation during the second year is necessary to confirm the results of the present study.

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Authors' Contributions

Mr Shankar Raj Pant: Experimentation, data processing, analysis and prepare manuscript of article. Dr Ram Prasad Ghimire: Project and experiment design, guide to implementation, regular monitoring, providing necessary guidelines for research, editing manuscript. Mr Prenil KC: Providing necessary guidelines in research.

Conflicts of Interest

The authors have no relevant financial or non-financial interests to disclose.

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