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Effect of harvest management on growth performance and seed yield of fodder oat (*Avena sativa* L.) in Rasuwa district, Nepal

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Abstract

Fodder shortage in the winter season is the major issue for livestock rearing farmers. Fodder oat (*Avena sativa*) is commonly grown in Nepal during the winter season as a dual purpose fodder for both herbage and seed. This study was conducted in 2024/25 at Dhunche, Rasuwa, Nepal in split-plot design replicated thrice, to evaluate the effect of harvest managements on growth and seed yield of fodder oat. Two oat varieties, Monida and Parbati, were tested as main plots, while harvest managements were tested as sub-plots. Harvesting for fodder production at different dates showed that variety had similar effects on plant height, leaf area, tiller numbers, and dry herbage yield. In contrast, harvest date after sowing, significantly affected plant height, leaf area, tiller number and dry herbage production. Maximum dry herbage was achieved when harvest at 60 days after sowing as compared to harvested at 30 days after sowing. Furthermore, under harvesting up to 60 days after sowing, the highest dry herbage was produced from Monida followed by Parbati if harvested at latter. In addition to this, the highest fresh straw and seed were produced under zero harvest (harvest only at seed maturity stage) and early harvest at 30 days after sowing for fodder and then left for seed production. Plant height, leaf area, and tiller numbers contributed significantly to straw yield, while leaf area and tiller number contributed significantly to seed yield. The findings demonstrated that harvest management had a significant role in herbage, fresh straw, and seed production for enhancing livestock production in Nepal.

Keywords: Fodder oat, harvest management, straw, seed production

1. Introduction

Supply of green and dry herbage for livestock production is a major problem during the winter season in Nepal. Oat (*Avena sativa* L.) is the major winter fodder and plays a vital role in filling the seasonal feed gap. Mostly, oat can be grown for green herbage, silage, and straw. As the need of animals for nutrients increases during the winter season, the demand for oat is increasing. Balancing herbage mass and seed production is a major concern for oat producing farmers by adopting effective management practices (Kim *et al.*, 2006) [6]. However, the animal husbandry sector depends on consistent supply of fodder and seed throughout the nation. One of the most effective agronomic strategies for this implementation is harvest management. Oat is nutritious, versatile, has multicut ability with a high number of tillering capacity and can be grown to mitigate the fodder scarcity. Effective harvest management at an appropriate growth stage significantly affects growth, forage yield and seed quality (Tessema *et al.*, 2010) [15]. Therefore, identification of the most suitable harvest days after sowing and then left for maximum seed production without any effect on seed quality is essential (Ahmad *et al.*, 2014) [1]. However, the production of fodder seed has been limited in Nepal. The country needs a large amount of fodder seed. Due to scarcity, fodder seed are imported from foreign countries (Singh & Singh, 2019) [13]. Based on this background, the experiment was conducted to evaluate the effect of harvest management on growth performance, herbage production, as well as seed yield of fodder oats.

Materials and Methods

The experiment was carried out at 1850 masl, Dhunche, Rasuwa, Nepal during the F.Y. 2024/25. Oat seeds were sown on 07th October, 2024 using a split plot design. Two varieties, Monida (A1) and Parbati (A2), were assigned to the main plots, while harvest managements were allocated to the sub-plots. The four different harvest managements were

- **B1:** First cut at 30 days after sowing for fodder production, then left for seed production
- **B2:** First cut at 45 days after sowing for fodder production, then left for seed production
- **B3:** First cut at 60 days after sowing for fodder production, then left for seed production
- **B4:** Zero cut for fodder production; only left for seed production

Each treatment was replicated in three times. Seed was sown at the rate of 80kg/ha with 25 cm row to row spacing. Farmyard manure (FYM) was applied at the rate of 10 t/ha. Chemical fertilizers were applied at the rate of 80:60:40 kg/ha N:P:K. The full dose of FYM, phosphorus, and potassium, along with half of the nitrogen, was incorporated during final land preparation. The remaining nitrogen was applied in two split dose. The first half was top dressed one month after sowing, and the second half was top dressed one month after first harvest. For the zero-cut treatment, the second half of nitrogen was top dressed one month after the first application. The growth parameters plant height, leaf length, leaf breadth and number of tillers per plant were recorded by selecting five plants randomly from each plot. The leaf area was calculate using formula = (leaf length x leaf breadth) x 0.75 (Musa & Usman, 2016) [7]. Green herbage was recorded from each 1x1 m² quadrat from each plot. 200 gram fresh sample was taken to estimate further dry herbage. Dry matter was determined by oven drying fresh herbage at a constant temperature of 72 °C

for 24-48 hours. At the time of seed maturity, fresh straw and seed production per square meter was measured. 1000 seed weight was also measured in gram. The production per square meter was converted to t/ha. All the datas were analyzed using R software (R Studio, 2020) [11].

Results and Discussion

Plant performance and dry herbage yield at different harvest dates

Plant performance and dry herbage production at different harvest dates is presented on Table 1. There was no significant ($p > 0.05$) effect of the variety on plant height, leaf area, tiller number and dry herbage production. Furthermore, the harvest times had significant ($p < 0.001$) effect on plant height, leaf area, tiller number and dry herbage production. Plants harvested at 30 days after sowing had shorter plant height, smaller leaf area, fewer tillers, and less dry herbage compared to those harvested at 60 days. Additionally, the interaction between variety and harvest management was significantly ($p < 0.001$) affected plant height, leaf area, tiller number, and dry herbage production. Accordingly, the highest plant height, tiller numbers per plant, leaf area and dry herbage production, was obtained by both varieties if harvested at 60 days after sowing. This indicates that harvest timing is the dominant factor, while varietal differences remain minimal. The highest herbage production at the late stage of maturity was due to higher plant height, leaf length, leaf breadth, and tiller numbers (Amanullah *et al.*, 2004) [2]. The difference herbage production at the same harvest period of different varieties may be due to different genetic trait. Varietal characteristics, climatic condition, and soil nature play a major role in herbage production (Baral *et al.*, 2024; Pant *et al.*, 2022; Singh *et al.*, 2018; Zaman *et al.*, 2006) [3, 8, 14, 16].

Table 1: Plant performance and dry herbage production at different harvest date

Treatments	Plant height (cm)	Leaf area (cm ²)	Numbers of tiller/plant	Dry herbage (t/ha)
Varieties (A)				
A1	40.41	33.39	4.67	1.53
A2	38.23	32.30	4.67	1.50
CV%	12.5	9.7	10.3	11.2
F probability	NS	NS	NS	NS
Harvest managements (B)				
B1	24.70 ^c	23.53 ^c	3.41 ^c	1.09 ^c
B2	41.57 ^b	33.19 ^b	5.09 ^b	1.46 ^b
B3	51.68 ^a	41.81 ^a	5.49 ^a	2.00 ^a
CV%	10.7	11.4	5.3	10.4
F probability	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$
Interaction (A*B)				
A1B1	25.24 ^c	25.21 ^c	3.41 ^c	1.08 ^c
A1B2	42.67 ^b	33.24 ^b	5.19 ^b	1.48 ^b
A1B3	53.33 ^a	41.73 ^a	5.40 ^a	2.04 ^a
A2B1	24.17 ^c	21.86 ^c	3.42 ^c	1.10 ^c
A2B2	40.48 ^b	33.14 ^b	5.00 ^b	1.44 ^b
A2B3	50.03 ^a	41.89 ^a	5.59 ^a	1.96 ^a
CV%	10.5	9.8	12.6	11.8
F probability	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

Note: CV=Coefficient of Variation; NS = Non- Significant *Mean values in the same column bearing different superscripts differ significantly

Straw and seed production

Effect of harvest managements on plant growth, straw and seed yield of oat varieties is presented in Table 2. At the time of seed harvest time, the varieties of oat had similar effect ($p > 0.05$) on plant height, leaf area, straw yield, seed production and 1000 seed weight. However, harvest management

significantly affected plant height ($p < 0.001$), leaf area ($p < 0.001$), fresh straw weight ($p < 0.05$), seed production ($p < 0.05$), and seed weight ($p < 0.05$). In addition, it was found that harvest management had similar effect ($p > 0.05$) on tiller numbers. Accordingly, the highest plant height leaf area, fresh straw weight, seed production and seed weight were obtained

by zero harvest (no for fodder cut, harvested only at seed maturity stage), followed by first harvest at 30 days after sowing for fodder production and left for seed production. Seed quality was also superior, with the highest 1000-seed weight under this harvest date. The least plant height, leaf area, dry herbage, straw weight as well as seed yield and 1000 seed weight were found when fodder was harvested at 60 days after sowing.

The interaction between variety and harvest management had significant effect ($p < 0.05$) on plant height, leaf area and fresh straw weight. However, the interaction between variety and harvest management had similar ($p > 0.05$) effect on seed yield, 1000 seed weight and tiller numbers. Accordingly, the highest plant height, leaf area, fresh straw weight was obtained by zero harvest (no for fodder cut, harvested only at seed maturity stage) on both varieties followed by first harvest at 30 days after sowing and then left for seed production. These findings are consistent with previous researchers. Harvest at any stage in multi cut varieties induces

physiological stress redirecting energy towards plant regrowth rather reproductive development. The uncut fodder utilize full energy for both vegetative and reproductive growth leading higher herbage as well as more seed production. Accordingly, stress free condition enhance vegetative growth (Sadeghipour, 2009) [12]. Similarly, Croce *et al.* (2024) [5] reported that maximum photosynthesis increased the crop yield, which is consistent with our finding that maximum seed production was obtained under zero harvest treatment. Our results also highlighted the advantage of earlier harvest as compared to late. Furthermore, Rauf *et al.* (2021) [10] observed that earlier cut produced higher number of tillers and high yield as compared to late cut. As our finding Baral *et al.* (2024) [3] reported that varietal effect on seed yield is minimal. Additionally, Bhakuni *et al.* (2025) [4] reported that harvest times had significant effect on herbage production and fresh straw yield. This consistent to our finding that harvest time is more influential than variety.

Table 2: Effect of harvest managements on plant growth, fresh straw and seed yield of oat varieties

Treatments	Plant height (cm)	leaf area (cm ²)	Number of tillers/plant	Fresh straw weight (t/ha)	Seed yield (t/ha)	1000 seed weight (g)
Varieties (A)						
A1	135.54	69.12	6.25	21.79	2.37	37.50
A2	135.27	68.15	6.30	20.26	2.33	37.75
CV%	7.5	8.4	11.8	11.4	9.6	10.7
F probability	NS	NS	NS	NS	NS	NS
Harvest managements (B)						
B1	141.40 ^{ab}	65.39 ^b	6.30	21.62 ^b	2.45 ^a	38.50 ^a
B2	131.55 ^b	64.95 ^b	6.00	20.40 ^c	2.36 ^{ab}	37.00 ^{ab}
B3	120.06 ^c	60.52 ^c	6.30	18.91 ^d	2.05 ^b	36.00 ^b
B4	148.62 ^a	83.67 ^a	6.50	23.17 ^a	2.52 ^a	39.00 ^a
CV%	11.3	7.8	12.0	10.6	8.8	10.2
F probability	$p < 0.001$	$P < 0.001$	NS	$p < 0.05$	$p < 0.05$	$p < 0.05$
Interaction (A*B)						
A1B1	142.47 ^{bc}	65.95 ^{bc}	6.40	23.11 ^a	2.48	39.00
A1B2	132.70 ^c	67.04 ^b	6.00	21.54 ^b	2.35	37.00
A1B3	120.57 ^d	60.88 ^c	6.20	19.37 ^c	2.09	36.00
A1B4	146.43 ^a	82.60 ^a	6.40	23.16 ^a	2.54	38.00
A2B1	140.32 ^{bc}	64.84 ^{bc}	6.20	20.12 ^b	2.42	38.00
A2B2	130.41 ^c	62.87 ^c	6.00	19.27 ^c	2.37	37.00
A2B3	119.56 ^d	60.17 ^c	6.40	18.46 ^c	2.01	36.00
A2B4	150.80 ^a	84.74 ^a	6.60	23.18 ^a	2.50	40.00
F probability	$p < 0.05$	$p < 0.05$	NS	$p < 0.05$	NS	NS

Note: CV=Coefficient of Variation; NS = Non- Significant *Mean values in the same column bearing different superscripts differ significantly

Contributions of growth attributes on fresh straw and seed production

Contributions of plant height, leaf area and tiller numbers on fresh straw yield and seed production is presented in Table 3. However, Plant height ($p < 0.05$), leaf area ($p < 0.05$) and tiller numbers ($p < 0.05$) of fodder oat had significant contribution to fresh straw production. It revealed that fresh straw production was increased by 0.23 unit with one unit change in plant height, increased 0.14 unit with one unit change in leaf area and increased 0.07 unit with one unit change in tiller numbers.

Plant height of fodder oat did not show significant effect on seed production ($p > 0.05$). However, leaf area and tiller number had significant effects ($p < 0.05$). It revealed that seed production was increased by 0.06 unit with one unit change in leaf area, as well as increased 0.09 unit with one unit change in tiller number. Our findings showed a positive correlation between the growth parameters of fodder oat (plant height, leaf area, and number of tillers) and fresh straw production. In

addition to this, leaf area and tiller number were positively correlated with seed production. The higher number of tillers bears higher number of leaves per plant. This enhanced the photosynthetic efficiency that increased overall seed and fresh straw production. These findings were supported by previous studies by Pierce *et al.* (2014) [9]; Amanullah, *et al.* (2004) [2].

Table 3: Contribution of growth attributes on fresh straw and seed production

Independent variables	Fresh straw weight		Seed production	
	Beta	P value	Beta	P value
Plant height	0.23	0.007	0.05	0.130
Leaf area	0.14	0.031	0.06	0.021
Tiller numbers	0.07	0.020	0.09	0.010
F	12.71		10.22	
R ²	0.411		0.38	

Conclusion

The study demonstrates that harvest management plays a

significant role in balancing fodder and seed yield in oats, while varieties had little effect under the tested conditions. Harvest at late stage maximizes fodder yield, but delaying harvest hampered the seed and fresh straw production. Early harvest at 30 days after sowing provides good amount of herbage and seed. The highest amount of fresh straw and seed was produced under zero harvest (harvest only at seed maturity stage) and early harvest at 30 days after sowing for fodder and then left for seed production. Plant height, leaf area and number of tiller had significant correlation with fresh straw yield. However, leaf area and tiller number had significant correlation with seed production. These findings suggest that adopting harvest management can reduce the fodder scarcity and reliance on imported seed, thereby strengthen seed supply and support livestock production system.

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Conflict of Interest

Not available

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