Volume 4 • Issue 3 • 2022

Research Article

Journal of Agriculture and Aquaculture

Determination of Optimum seed rate for increased Dry matter and seed yield of fodder oat in Dara District of Sidama region, Southern Ethiopia

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Received: July 18, 2022; **Published:** August 16, 2022

Abstract

Introduction of high yielding cross bred dairy cattle in the farming system is pushing farming communities to produce high yielding forage crops. The experiment was conducted in 2017 and 2018 cropping seasons for two years at Abera sheep type improvement sub-station with the objective to determine optimum seed rate for high herbage and seed yield. The trial was carried out in randomized complete block design (RCBD) with four replications. Seed rates of 50, 75, 100, 125 and 150 kg/ha were used as treatments. Plant height, stem to leaf ration, DM yield, seed yield and straw yield were significantly affected at (P<0.05) with increase seed rate. The height of fodder oat increased with increasing rate of seed. The highest height value (129 cm) was obtained at seed rate of 150 kg/ha followed by (127.50 cm) at seed rate of 125 kg/ha. Leaf to stem ratio was not significantly affected by seed rate. Dry matter yield was significantly affected by seed rate at (P<0.05) with highest 13.26 t/ha by using seed rate of 125 kg/ha followed by 12.3 t/ha by using seed rate of 1oo kg/h. hence, the DM yield was at seed rates of 50, 75 and 150 kg/ha are significantly different at seed rates of 125 and 150. This could be due to the more competitiveness of oats as weeds at the higher seeding rate and low crop density at lower seed rate. The better seed quality and yield has been recorded at seed rate of 75 kg/ha which is 3.32 t/ha followed by 100 kg/ha which is 3.11 t/ha. Therefore it could be recommended that for those who need to produce seed should use 75 kg/ha of seed rate whereas those who involved in dairy production, should use 100/125 kg/ha seed rate depending viability of seed.

Keywords: *Seed rate; Dry matter yield and Oat*

Introduction

Low quality and quantity of both natural pasture and crop residues calls for improved forage crop production in order to supplement ruminant animal with quality feed. The use of cultivated forage crops has received considerable attention for complementing the conventional feed resources especially in areas where high producing crossbred dairy cows are owned in the Ethiopian highlands (Daniel, 1990). The very nature of the integrated crop-livestock production systems in the Ethiopian highlands requires multipurpose forage species suitable for feed and food or feed and natural resource conservation thereby to address the multifaceted problems of the farming community (Dawit et al 2012). Due to its short life cycle, suitability in crop rotations and better performance on marginal lands, oats is the most important species for integration into the existing farming system (Dawit et al 2012, Gezahegn et al., 2021). Oats appears to be the main forage crop grown at very high altitudes (up to 3000m) or on heavy soils (vertisols) where temperate grasses such as ryegrass, cocksfoot or tall fescue are difficult to establish (Lulseged, 1981, Gezahegn et al., 2021). 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 and sheep (Kipps, 1970; Boonman, 1993) as sited by Dawit et al 2012. 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 (Lovett and Scott, 1997).

As other any food crop, seed rate has to be determined and recommended for forage crops including oat varieties. Seeding rate can be influenced by the type and fertility of the soil, establishment methods (condition of seed bed and seeding method) and quality and size of seed. Using higher and lower seed rate could have a negative impact on herbage DMY and seed yield of forage crops. On the other hand most of the time similar rate is being used for seed production and herbage production. Therefore, this study was aimed to determine optimum seed rate for fodder oat for seed and herbage production in the study area.

Materials and Methods

Experimental sites

The experiment was carried out in 2017 and 2018 cropping seasons via, Hawassa Agricultural Research Center (HARC), Abera sheep type improvement sub-station. The station was found in Dara district of Sidama region, located at 85 km away from Hawassa to the south eastern part of the country. Longitude of 38º 38'-38º 51'E and latitude of 6º 36'-6º 54'N was geographical position of district with altitude ranging from 1200 to 2900 meters above sea level. Average annual maximum and minimum temperature of 28ºC and 19OC respectively, with 1200-1700 mm ranges of total rain fall. From 33 Kebeles of the district, 10 Keble (30.3%) were dega, 16 Keble's (48.5%) were woynadega and 7 Kebles (21.2%) were kola. Mixed crop-livestock production system was agricultural practices of district. The District has livestock population of 122,885 heads of which 19,897 are cattle; 26,595 sheep; 13,440 goats; 45,817 chicken and 6,736 were equines and Important cash crops include corn, wheat, barley, local varieties of cabbage, and potatoes. As reported by Dara district Agricultural office report (DDAO, 2021).

Experimental arrangement

Oat variety 2806 was used for the trial. The trial was carried out in four replications with seed rates of 50, 75, 125 and 150 kg/ha as treatments. Sowing was made by drilling the seeds in 1m apart row spaced on 3 m x 4 m plots. All the plots were hand weeded once a month after sowing and thereafter as required based on occurrence of weeds.

Data collection

For plant height determination, the mean height of five randomly selected plants from net plot area was recorded for each plot. At the forage harvesting stage (soft dough), four interior rows were clipped at 5cm above the ground level to determine the biomass yield. The weight of the total fresh biomass yield was recorded from each plot in the field and the estimated 500g sample was taken from each plot to the laboratory. The sample taken from each plot was weighed to know the total sample fresh weight and oven-dried for 24 hours at a temperature of 105°C for dry matter yield determination. The herbage sample taken from each plot was weighed to know the total sample fresh weight and manually fractionated into leaf and stem. Accordingly, leaves were separated from stems, and the leaf to stem ratio (LSR) was estimated based on the dry matter basis of each component. The remaining inner three rows of each plot were harvested at grain maturity to assess the grain and straw yield performances. The remaining aftermath was harvested from ground level and its fresh biomass was measured and recorded in the field. About 300g samples of the aftermath were taken and oven-dried at 65°C for 72 hours to determine the straw dry matter yield. The residue remaining after grain threshing (chaff) was oven-dried at 100°C overnight and added to the aftermath dry matter for estimation of straw dry matter yield.

Statistical analysis

Analysis of variance was performed using the statistical analysis system (SAS) software SPSS version 25 in order to determine the agronomic difference between different levels of seed rate and mean separation was carried out using Least Significant different (LSD) test.

Results and Discussion

Plant height of fodder oat at different seed was illustrated in table 1. The highest plant height (129.5 cm) was recorded with seed rate of 150 kg/ha and followed by 125 kg/ha respectively. The lowest plant height (122.59 cm) was recorded at seed rate (50kg/ha). The height of fodder oat was significantly affected by seed rate 137.9 was reported by Gezehagn et al., 2021 for the same variety at seed rate of 100 kg/ha. Similar studies also indicated that plant height increased with increasing seeding rate indicating competition for light (Reddy and Reddi, 1992, Dawit et al, 2012). Singh et al. (1989) observed non-significant difference for plant height among different seed rates, at 125 kg seeds per ha as compared to 100 kg seeds per ha with two sowing methods at four nitrogen levels. The better

plant height might have contributed for better forage yield of fodder oats. A crop provided enough of plant nutrients to meet out its requirements expected to perform better than crop provided less than its requirements.

Seed rate	Mean plant height	Std. Error	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
50 Kg	122.59	0.57	121.23	123.94
75 kg	124.13	0.35	123.30	124.95
100 kg	125.88	0.81	123.96	127.79
125 kg	127.50	0.50	126.32	128.68
150 kg	129.50	0.38	128.61	130.39
Mean	125.92	0.45	125.00	126.84

Table 1: *Effect of seed rate of Oat on plant height of fodder oat.*

In the current study there is no significant different in leaf to stem ratio due to difference in seed rates though there looks numerical difference. The lower mean leaf to stem ratio (0.50) was recorded in this study in contrary to (Gezahegn et al 2021) who reported mean values of (1.11) for different genotypes and almost similar with Dawit et al 2012 who reported 0.56. The variation in leaf to stem ratios might be due to varietal, environmental and other extraneous factors. The higher leaf to stem ratio is required for any fodder crop because it affects diet selection, quality, and intake of forage (Smart et al., 2004). The leaf to stem ratio is associated with the high nutritive value of the forage because the leaf is generally of higher nutritive value (Tudsri et al., 2002) and the performance of animals is closely related to the amount of leaf in the diet (Gezahegn et al, 2021).

Seed rate	Mean Leaf to stem ratio	Std. Error	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
50 Kg	0.49	0.01	0.48	0.51
75 kg	0.50	0.00	0.49	0.52
100 kg	0.51	0.00	0.50	0.52
125 kg	0.51	0.00	0.50	0.52
150 kg	0.50	0.00	0.49	0.50
Mean	0.50	0.00	0.50	0.51

Table 2: *Effect of seed rate of Oat on Stem to leaf ratio of fodder oat.*

The DM yield of fodder oat increased with increasing level of seed rate without significant difference at ($P<0.05$). This could be due to the more competitiveness of oats as weeds at the higher seeding rate. The highest value (13.26 t/ha) dry matter yield was obtained at seed rate of 125 kg/ha and followed by 12.30 t/ha at seed rate of 100 kg/ha by using 100 kg/ha NPS fertilizer. In this study there was significant difference at ($p<0.05$) in dry matter yield at seed rates of 50, 75 kg/ha with other seed rates (100, 125 and 150 kg/ha). In contrary to Dinesh K., et al, 2006 relatively higher seed yield was obtained in this study; they reported that increase in seed rate beyond 60 kg/ha will minimize dry matter yield. Similarly, Dawit et.al, 2012 reported higher dry matter (15.02 t/ha) for 80 kg/ha seed rate with utilization 50kg UREA and 150 kg DAP application per hectare. Similarly, (Gezahegn et al. 2021) reported mean 14.6 t/ha dry matter yield for different genotypes at 100 kg/ha seed rate. Urea fertilizer promotes vigorous plant growth and a larger leaf area that contribute to the dry matter yield of the fodder oat but economic considerations might affect urea fertilizer at farming community level. Similarly, the increasing trend of green forage yield in response to increasing level of N fertilization was also observed by many authors (Sultana et al., 2005; Khan et al., 1996). Younie (1976) reported that the sowing rate had no significant effect on dry matter yield but 150 kg per ha sowing rate was found adequate. Singh et al. (1979) reported that increasing seed rate from 50 to 75 kg per ha resulted in higher green forage as well as dry matter yield, but such differences were statistically non-significant during 1976 and 1977. Similarly, higher seed rates (100 and 125 kg/ha) did not bring any improvement in the forage yield over 75 kg per ha during both the years with four genotypes at three sowing dates. In the current study the DM yield was not significantly affected at seed rate level of 100, 125 and 150 kg/ha. Hence it would be recommended to use 100 kg/ha.

Seed rate	Mean Dry matter yield	Std. Error	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
50 Kg	9.37	0.22	8.85	9.89
75 kg	10.15	0.35	9.32	10.97
100 kg	12.30	0.32	11.54	13.06
125 kg	13.26	0.20	12.77	13.74
150 kg	11.74	0.26	11.11	12.36
Mean	11.36	0.26	10.84	11.88

Table 3: *Effect of seed rate on mean dry matter yield of fodder oat.*

Seed yield

The highest seed yield (3.41 t/ha) was obtained at seed rate of 75kg/ha followed by 3.11 t/ha at the seed rate of 100 kg/ha which is statistically significant at (<0.05) than other seed rates sown. While the lower seed yields 2.38 t/ha and 2.46 t/ha were obtained at seed rate of 50kg/ha and 150 kg/ha respectively. The current study is in contrary to (Dawit et al, 2012) who reported 4.4 t/ha seed yield at the seed rate of 70 kg/ha with additional utilization of 50 kg urea and 150 kg di-ammonium phosphate (DAP). Gezahegn et al, 2021, reported combined mean value of 2.25 t/ha seed yield for research that was conducted on different genotypes at different location in two years by using 100 kg/ha seed rate and 100 kg/ha DAP. The current study indicated that increase in seed rates above 75kg/ha is more likely to reduce size and quality of seed.

Seed rate	Mean Seed yield	Std. Error	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
50 Kg	2.38	0.04	2.29	2.48
75 kg	3.41	0.08	3.22	3.59
100 kg	3.11	0.12	2.82	3.40
125 kg	2.79	0.07	2.64	2.94
150 kg	2.46	0.07	2.30	2.62
Mean	2.83	0.07	2.69	2.97

Table 4: *Effect seed rate on mean seed yield of fodder oat.*

Straw yield

The mean straw yield of oat was indicated in (table 5). The mean straw yield ranged from 7.53 -10.25 t/ha in 50-150 kg/ha seed rates. The highest straw yield was recorded in 125 kg/ha seed rate where lowest was recorded in 50 kg/ha seed rate which indicates that there is significant difference in seed rates of 50, 705 kg/ha seed rates and seed rate of 100, 125 and 150 kg/ha. Gezahegn et al, 2021 reported a straw yield of mean combined value 10.6 t/ha which was done on different genotypes for different locations and for two years. Oat straw is used as animal feed because it is softer and has more digestible organic matter and metabolic energy to livestock than other cereal crops. It is a preferred feed of all animals and its straw is soft and superior to wheat and barley. Moreover, the straw is used as a bedding material (Fekede, 2004) due to its softness and better absorbent nature.

Seed rate	Mean Straw yield	Std. Error	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
50 Kg	7.53	0.26	6.91	8.14
75 kg	8.55	0.29	7.87	9.24
100 kg	9.72	0.37	8.85	10.58
125 kg	10.75	0.36	9.89	11.60
150 kg	9.30	0.24	8.73	9.86
Mean	9.17	0.22	8.73	9.61

Table 5: *Effect of seed rate on mean straw yield of fodder oat.*

Conclusion and Recommendation

As observed from the result seeding rates at different levels have great impact on the yield and agronomic parameters of fodder oats. However, seeding rate above optimum level often produce no additional yield. Therefore, it is important to have the optimum seed rate level for producing reasonable DM and seed yield of fodder. Hence, the optimum seed rate level to get reasonable DM yield will be at seed rate of 100 kg/ha by using100 kg NPS. While if the target is for seed production, seed rate of 75 kg/ha 100 kg NPS is very optimum to farmers in order to get maximum forage and seed production.

Acknowledgement

The author would like to thank the technical staff of livestock research work process TAs' of Hawaasa Agricultural Research Centre for their involvement in data collection and compilation. The financial support provided by Southern Agricultural Research Institute (SARI) and logistics arrangement by Hawassa agricultural research centre is also dully acknowledged.

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