

Effect of seeding rate on plant performance of *Alysicarpus ovalifolius* under rain-fed in Semi-arid zone, Sudan

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Abstract

This study was conducted at the private farm, Southern part of Alfashir Airport, under the semi-arid condition of North Darfur State, Sudan. The objective was to test the effect of different seed rates (2, 4, 6, and 8 kg/ha) of *Alysicarpus ovalifolius* on plant growth attributes and forage yield, during two consecutive seasons (2017 and 2018) aiming to find the most suitable seed rate under rainfed condition in semi-arid zones to be used in pasture improvement. The experiment was laid-out in a randomized complete block design with four replicates, the plot size was 8x5 m. Data collected included Plant density, plant ground cover and dry matter yield. There were significant effects of seeding rates on plant density, cover and yield. Seed rate of 8kg/ha had highest plant density, cover and yield. But the seed rate of 6kg/ha had the optimum performance, this seed rate was recommended for sowing *Alysicarpus ovalifolius* at semi-arid condition for range improvement. Further research work is needed to assess seeding rates across different ecological zones in North Darfur State.

Keywords: Dry matter yield; Plant density; Seed rate; Vegetation cover

1. Introduction

Alyce clover *Alysicarpus ovalifolius* (Fabaceae, subfamily Faboideae) is a legume species used as forage plant, which is originally native to Africa but today has a pantropical distribution, *Alysicarpus* includes 34 species native to the Old World Tropics [1,2] and is most diversified in southern Asia, especially India [3]. Species of Fabaceae have an immense ecological, agricultural and economic importance as nitrogen fixers [4].

Despite being native to the Old World tropics, some *Alysicarpus* species have been introduced and are now naturalized in other tropical and subtropical areas, mainly the neotropics [5].

Three *Alysicarpus* species, *A. bupleurifolius*, *A. ovalifolius* and *A. vaginalis* are known to occur in the Americas [2], where they are not native. The introduction of plants of these species is usually intentional, due to their use as forage crops [6,7,8], and secondarily also because of their medicinal properties, especially for treating wounds and fractures [2].

1.1. Description

Alyce clover *Alysicarpus ovalifolius* is an erect or spreading annual herbaceous legume (sometimes woody at the base) very variable in size and in shape [9,10]. The stems are decumbent, slightly pubescent when young and almost glabrous with age. The single leaves are alternate; leaflets are oblong or narrowly lanceolate. Inflorescences are pseudo racemes, sometimes paniced. Flowers are orange-buff to pink or reddish-violet, seeds are oblong-ellipsoid [9].

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Alysicarpus ovalifolius is a protein-rich fodder valuable for all types of livestock, it is available during the rainy season and in early stages of drought periods [11]. It is very palatable to animals that graze in rangelands. It may be used as bush straw or bush hay in sheep diets [12]. In Niger, it is a valuable component of vegetation collected and traded as fodder [9]. However, it was not cultivated until recently [11]. An attempt was made in Burkina Faso to sow *Alysicarpus ovalifolius* in order to enhance the value of natural pastures and it proved to settle efficiently after sowing [13].

1.2. Distribution

Alysicarpus ovalifolius is native to tropical Africa, Madagascar, Afghanistan, India, Pakistan, Vietnam and Indonesia. It is widespread throughout the tropics. It is usually growing in savanna and is also frequently found in croplands (as a weed) and fallow lands. It withstands drier conditions and heavier grazing thanks to its capacity to flower and set seeds very quickly [14]. Optimal growth conditions are 200-600 mm annual rainfall on sandy soils. It grows from sea level up to an altitude of 900 m. It has medium drought tolerance [11,9].

2. Material and methods

A field experiment was carried out at Alfashir on special farm which located South of Alfashir Airport, North Darfur State, during rainy season of 2017 and 2018, to study the effect of seed rate on growth and biomass production of Alyce clover (*Alysicarpus ovalifolius*). The annual rainfall was 140.4 and 348.7 mm for seasons 2017 and 2018 respectively (Alfashir Meteorological Station).

2.1. Treatments and Experimental Design

land at the farm was first disc plowed, leveled and then was divided into four plots (4x4m), four seed rates were determined (2kg/ha, 4kg/ha, 6kg/ha and 8kg/ha). The treatments were randomly assigned into a randomized complete block design (RCBD) [15] with four replicates.

2.2. Planting

Seeding of the site was carried out by *Alysicarpus ovalifolius* seeds immediately after the rain showers on the first of August, sown by broadcasting and weeded twice, firstly at seedling stage and secondly at flowering stage.

2.3. Data collection

To determine the plant density (plant/m²), plant ground cover (visual estimate) and dry matter production (kg/ha), 1x1m quadrates was located in each treatment at flowering and maturity stages. Pasture plant legume *Alysicarpus ovalifolius* within quadrate was clipped at 5cm above ground surface and put inside paper bags and was weighted as fresh, then was dried by air to determine dry matter yield.

3. Results and discussion

As shown in Table No.1, during the second season seed rate had no significant effect on plant density which could be due to the lower amount of rain-fall and distribution compared with the second season. This was in line with [16] who stated that direct effect of rain-fall fluctuation may be considered on the number of individuals of each species. However, in the first season seeding rates had significant effect on plant density. The highest plant density was recorded by seed rate of 8 kg/ha, whereas the lower density was recorded by 2 kg/ha, this could be explained by the fact that when the soil moisture content within plant root zone is enough for plant growth, the number of plants increase as the seeding rate increase, this agreed with [17] who found that, high legume sowing rates maintained a satisfactory proportion of legume plants in the pasture.

There was significant effect of seed rate on plant ground cover Table No. 2. Seed rate of 8kg/ha gave the best results at different growth stage during the second season. This agreed with [18] who found that increasing seed rate can be expected to increase the number of emerging seedling and improve establishment particularly in favorable years. Under the low rain conditions sever competition between plants results in week plant, [18] as was the case in first season where lower seed rates gave highest plant ground cover.

Table No. 3 showed seed rate had significant effects on dry matter yield, seed rate of 8kg/ha gave highest dry matter yield for both seasons. High legume seed rate maintain satisfactory performance of legumes in the pasture particularly in favorable conditions [17].

Table 1 Effect of seed rate on plant density of *Alysicarpus ovalifolius*

Seed rate	Season 2017		Season 2018	
	Flowering stage	Maturity stage	Flowering stage	Maturity stage
2 kg/ha	34	31	51	66
4 kg/ha	38	33	74	99
6 kg/ha	56	57	107	136
8 kg/ha	77	64	156	189
SE±	1.11 ^{ns}	1.77 ^{ns}	1.65*	1.37**

^{ns} not significant, * significant at 0.05 level, ** significant at 0.01 level

Table 2 Effect of seed rate on plant ground cover of *Alysicarpus ovalifolius*

Seed rate	Season 2017		Season 2018	
	Flowering stage	Maturity stage	Flowering stage	Maturity stage
2 kg/ha	32.3	41.3	58.7	65.2
4 kg/ha	35	39.8	60.8	68.1
6 kg/ha	41.2	40.3	75.1	81.2
8 kg/ha	31.7	30.8	82.4	92.3
SE±	0.97 *	1.01*	0.98*	1.23*

^{ns} not significant, * significant at 0.05 level, ** significant at 0.01 level

Table 3 Effect of seed rate on dry matter yield (kg/ha) of *Alysicarpus ovalifolius*

Seed rate	Season 2017	Season 2018
2 kg/ha	34.12	55.86
4 kg/ha	35.06	110.13
6 kg/ha	34.75	201.74
8 kg/ha	45.17	246.15
SE±	2.11*	1.49**

^{ns} not significant, * significant at 0.05 level, ** significant at 0.01 level

4. Conclusion

This study was conducted to test the effect of different seed rates on plant growth attributes and forage yield aiming to find the most suitable seed rate under rainfed condition in semi-arid zones to be used in pasture improvement.

The deteriorated rangelands in semi-arid zone of North Darfur State should be rehabilitated and improved by spread seeds of *Alysicarpus ovalifolius*

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of interest

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