Research Article

Evaluation of Improved *Sesbania Sesban* Varieties at highland of Guji Zone, Oromia, Ethiopia

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Abstract

The study was conducted to evaluate the performance of four Sesbania sesban varieties including local check at Songo Baricha on station of Bore Agricultural Research Center (BOARC) during the main cropping season of 2019. The treatments evaluated were Sesbania sesban (DZF-092), Mancarata, Sesbania sesban (No-136) DZF-403 and local check in a Randomized Complete Block Design (RCBD) with three replications. The collected data includes dry matter yield (DMY/tha^{-1}), number of pruning, number of regeneration, Leaf to stem ratio and plant height.The analysis data showed that there were significant ($p<0.05$) difference among tested variety in dry matter yield, leaf to stem ratio, number of pruning and regeneration. The higher dry matter yield were recorded from Mancarat variety (6.87tha^{-1}) followed by (DZF-092) (5.66tha^{-1}).Leaf to stem ratio traits were also showed statistical significant ($p<0.05$) difference. Sesbania sesban (N0-136) performs higher (83%) followed by DZF-092 (72%). Seed yield was not shown statically significant ($p>0.05$) differences among tested varieties however, numerically, the maximum seed yield was obtained from Mancarata (3.75qha^{-1}) followed by local check (3.07qha^{-1}). Therefore, the Mancarata variety could be recommended for the study areas and similar agro-ecology however, further research should be done to put the recommendation on a strong basis.

Keywords: Dry matter yield; Fodder tree; Leaf to stem ratio; Sesbania sesban; Performance

Introduction

The livestock subsector supports and sustains livelihoods for 80% of the total rural population [1]. Despite the importance of livestock in the country, productivity is low [2]. One of the major constraints leading to such low productivity is shortage of feed in terms of both quantity and quality, especially during the dry season [3-4], combined with high feed prices [5].

Tree legumes are multipurpose, and their superior rooting depth delivers excellent water use efficiency and drought and water logging tolerance [6]. The use of woody leguminous species in agro forestry, alley cropping and browse coppice systems is one of the key elements of sustainable agricultural systems in Ethiopia [7]. The economic benefit of *Sesbania sesban* in terms of milk and meat has shown considerable success both under research and farmer's condition as well as, their dual roles in animal nutrition and the improvement of soil fertility hence crop production [8]. Contour strips of forage legumes combined with grasses increase the sustainability and productivity of most soils whilst also providing high quality forage to supplement low quality roughages and crop residues [8].

Sesbania [*Sesbania sesban* (L.) Merril.]Belongs to family Fabaceae and is a multipurpose small stature tree [9]. It is grown as a short duration perennial green manure deep rooting shrub with high-quality foliage, and it serves as a protein supplement [9]. As production systems intensify, the inability of farmers to adequately feed their livestock year round will be even more important. The outstanding value of legumes in general is needed to meet the dry season feed gap, with the additional benefit of increased intake of associated poor quality roughage [10]. *Sesbania sesban*is adapted to a wide variety of soil types, ranging from loose sandy soils to heavy clays. It has an excellent tolerance to water logging and flooding [11]. Therefore, the objective of this experiment was to evaluate the performance and dry matter yield of *Sesbania sesban* varieties at songo on-station of Bore agricultural research center.

Material and Methods

Description of the Study Area

The study area is located in Guji zone, southern Oromia 420

km far from Addis Ababa. Astronomically this station is located between 06⁰ 24' 080'' and 038⁰ 35' 080'' northing and east-ing latitude respectively. Bore district is characterized by two type of temperate zone, namely Dega (locally known as 'Bada') which starts in early April up to October and Woina dega (locally known as 'Bada-dare') which starts late November up to reaches beginning of March. It is the most humid and sub-humid moisture condition, which relatively longer growing season. The rainfall is about (1400-1800) mm and the minimum and maximum temperatures are 11.2 C⁰ and 21C⁰ respectively. Its Geographically elevation is about 1600-2900 meters above sea level having soil type clay loam (BOARC Profile, 2002).

Treatments and Experimental Design

The experiment was carried out during the 2019 main cropping season in the highland agro-ecology of Guji zone at Songo Baricha on-station. The source of planting materials of *Sesbania sesban* was obtained from Debre Zeyit Agricultural Research Center. The experiment was started using four (4) *sesbania sesban* varieties like; *sesbania sesban* (DZF-092), *Sesbania sesban* (No-136) DZF-403, Mancarata and Local check were used as experimental materials. The plot size of comprises 4m×3m (12m²) and planted at spacing 2mand 1m between blocks and rows respectively and 50 cm between plants and also having 24 number of plant per plot**.** Recommended fertilizer rate of 100 kgha⁻¹NPS were used during experimental period. All data of *Sesbania sesban* varieties were collected for three consecutive years at the time of six months after frequently pruned except seed yield.

Methods of Data Collection

Measurement and Data Collection

Survival rate: count all plants after transplanted for a month on total plot size that was survived.

Plant height: was measured at six months interval after the plants survived and taken average per annuals from the ground level to the tip from five randomly taken plants and was averaged on per plant basis by using 5 m scaled meter.

Leaf to stem ratio: is the ratio of dry leaf weight to dry stem weight and the other important data collected were establishment date, re-generation percentage after pruning, disease and pests, and days of 50% flowering, seed yield were carefully collected during the second and third year consecutively and biomass yield (total fresh weight and dry matter yield) were collected.

Statistical Analysis

Data were analyzed using analysis of variance (ANOVA) of the General Linear Model (GLM) procedure of the statistical analysis system [12] version 9.1. Treatment means was separated using Tukey HSD test for separation at 5% probability level. The statistical model for the analysis was: $Y_{ijk} = \mu + A_j + B_i + e_{ijk}$

Where; Y_{ijk}= response of variable under examination, μ = overall mean, A_j = the jth factor effect of treatment, B_i = the ith factor effect of block/ replication, e_{ijk} = the random error.

Result and Discussions

Growth Parameters, Yield and Yield Components

Germination Percentage and Survival Rate

The results of germination percentage and survival rates at

Table 1: Germination percentage (%) and survival rate of *Sesbania sesban* varieties.

Varieties	Germination (%)	Survive rate (%)		
		Six months	1ˢᵗ year	2ⁿᵈ year
Sesbaniasesban (DZF-092)	100	86.1ᵃ	80.5ᵃ	77ᵃ
Sesbaniasesban (No- 136) DZF-403	100	33.3ᵇ	30.5ᵇ	25ᵇ
Local check	100	47.2ᵇ	41.6aᵇ	36.1ᵃᵇ
Mancarata	100	33.3ᵇ	33.3ᵇ	30.5ᵇ
Mean	100	49.8	47.1	42.3
CV	5.5	34.3	46	50.9
LSD	NS	*	**	**

Table 2: Plant height at different harvesting years.

Varieties	Plant height (PH cm) at different years		
	First year	Second year	Third year
Sesbania sesban (DZF-092)	124.7ᵇ	198.3ᵇᶜ	296.67
Sesbania sesban (No-136) DZF-403	128.17ᵇ	176.7ᶜ	271.83
Local check	123.0ᵇ	200.0ᵇ	313.3
Mancarata	296.70ᵃ	268.3ᵃ	220
Mean	168.12	210.8	275.5
CV	28.2	23.01	36
LSD	*	*	NS

Means with different superscripts in a column are significantly different from each other (p<0.05); PH cm= Plant Height in centimeter; CV=Coefficient of Variation; LSD=Least Significance Difference; * = Significant; NS= None Significance Difference

different age were indicated (Table 1). All tested *Sesbania sesban* varieties were fully germinated (100%). The survival rates were decline when the ages of plant was increased gradually and they were shown differences among varieties at 1st and 2nd year of ages. At the ages of six months, *sesbania sesban* (DZF-092) variety had recorded high percentage of survival rate than the other varieties. At the age of 1st year, the *sesbania sesban* DZF-092 variety had shown maximum survival rate (80.5%), while minimum survival rate of 41.6%, 33.3% and 30.5% were recorded from local check, *Mancrata* and *sesbania sesban* (No-136) DZF-403 respectively. The current study was corroborated with the previous result of [13].

Plant Height (PH cm)

The mean performance plant height of different *sesbania sesban* varieties at the first year age and second year age indicated statically significant (p<0.05) difference among the tested variety of *Sesbania sesban*. However, at third years age, plant height were not shown significant (p>0.05) difference among the tested varieties. The Local check variety performs (313.3cm) which washigher than the other varieties followed by DZf-092 (296.67cm) while, *Mancarata* perform slower (220 cm) than the others left varieties at third year of age. The average of the first year of plant heights (168.12 cm). The current study is disagreed with the result of scholars [13,14]. The differences of plant height observed were probably due to the frequency of harvesting, species difference and seasonal variation.

Number of Pruning and Regeneration Percentage

Number of pruning and number of regeneration were shown statistical significant (p<0.05) difference among tested varieties (Table 3).All the tested varieties were pruned at the age of 75cm height above the ground and number of pruned and number of regenerated of *sesbania sesban* (DZF-092) was higher (9.7) and (8.7) respectively followed by *Mancarata* (4) and lower for

Table 3: Number of Plant Pruned (NPP), Percentage of Plant Re-generated (NPR) and Regeneration Percentage (%).

Varieties	NPP	NPR	Reg %
Sesbania sesban (DZF-092)	9.7[a]	8.7[a]	91.70
Sesbania sesban (No 136) DZF-403	3.3[b]	3.3[b]	100.00
Local check	3.7[b]	3..3[b]	94.43
Mancarata	4.0 [b]	4.0[b]	100.00
Mean	5.2	4.8	96.5
CV	49.2	40.3	9.7
LSD	*	*	NS

Means with different superscripts in a column are significantly different from each other (p<0.05); NPP=Number of Plant Pruned, NPR= Number of Plant Regenerated, Reg %= Regeneration Percentage, CV= Coefficient of Variation; LSD= Least Significance Difference; * = Significant; NS= None Significance Difference

Table 4: Leaf to Steam Ratio (LSR), Dry Matter Yield (DMYtha^{-1}) and Seed Yield (Syl qha^{-1}).

Varieties	LSR	DMY (tha^{-1})	Syl(qha^{-1})	NBrch
DZF-092	0.72[ab]	5.66[a]	2.21	19.42
Mancarata	0.63[b]	6.87[a]	3.75	17.7
Local check	0.62[b]	3.63[b]	3.07	17
(N0-136)	0.83[a]	3.72[b]	1.3	22.5
Mean	0.7	4.97	2.78	19.1
CV	8.6	16.2	55.05	22.5
LSD	*	*	NS	NS

Means with different superscripts in a column are significantly different from each other (p<0.05); LSR =Leaf to Stem Ratio; DMYtha^{-1}= Dry Matter Yield tone per hectare; SYqha^{-1}= Seed Yield quintal per hectare; NBrch: Number of Branches; CV= Coefficient of Variation; LSD= Least Significance Difference; * = Significant; NS= None Significance Difference.

sesbania sesban (No-136) DZF-403(3.3) compared with each other's. The regeneration percentage was not shown significant (p>0.05) differences among treatments.

Number of Branches

The result obtained from number branches per plant were not shown statistical significant (p>0.05) difference among treatments. Numerically the maximum value number of branches was recorded from the variety (No-136) DZF-403 (22.25), followed by DZF -092 (19.42) and Mancarata with (17.7) while, the minimum number branches were recorded from local variety which was [17].

Leaf to Stem Ratio

Leaf to stem ratio were shown statically significant (p<0.05) different among treatments (Table 4). Mean leaf to stem ratio recorded was (0.7). The highest leaf to stem ratio obtained from *Sesbania sesban* (No-136) was (0.83) followed by *Sesbania sesban* (DZF-092) (0.72) while, the yield of local check was (0.62) which means lower than other varieties.

Dry Matter Yield

Dry matter yield were statically shown significant (p<0.05) different between treatments (Table 4). Fodder dry matter yield were harvested at 2nd year old and collected from leaves and soft stems. The highest forage dry matter yield was recorded from Mancarat (6.87 tha^{-1}) followed by *Sesbania sesban* DZF-092 (5.663tha^{-1}), while the lower dry matter yield was recorded from Local check (3.63 tha^{-1}). The current study was disagreed with different scholars ([13-15], that DZ-96 produced maximum Dry Matter Yield (DMY) 27.64 tha^{-1}, while minimum Dry Matter Yield (DMY) 9.88 tha^{-1} was recorded from DZ-104 in the second year. The variation might be due to varietal differences, frequency of harvesting and seasonal variations.

Seed Yield

Seed yield were not statically shown significant (p>0.05) different among treatments. The mean of *sesbania sesban* seed yield recorded from the current study was (2.78 qha^{-1}). Numerically the higher seed yield among the tested Sesbania sesban varieties were recorded from Mancarata (3.75 qha^{-1}) followed by Local check (3.07) while, the lower seed yield was obtained from DZF- 092(1.13 q ha^{-1}) which was lower than all the rest varieties. The current study was agreed with result of [14].

Conclusion and Recommendation

The performance of *Sesbania sesban* was evaluated at Songo on-station of Bore agricultural research center,at the main cropping season of highland of Gujizone of southern Oromia.

The result of this study showed that significant (p<0.05) variation among the variety of *Sesbania sesban*, within the parameters of Leaf to Stem Ratio (LSR), Dry Matter Yield (DMY), Number of Pruning per Plant (NPP), Number of Re-generated Plant (NRP), and Plant Height (PH) during thefirst year and second year. From the tested *Sesbania sesban* variety *Mancarata,Sesbania sesban*DZF-092 had high dry matter yield but, numerically Mancarata variety performs higher in both dry matter yield (DMYt/ha^{-1}) and seed yield. Further, research on its genotype environmental interaction necessary to do in the future. Generally, this study was concluded that the Mancarata variety was the recommended fodder tree from all variety and it has to be demonstrated in the study area and the same agro ecological condition of Ethiopia.

Author Statements

Acknowledgements

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