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Research Article

Productivity of different Lablab (Lablab purpureus) Accessions as Influenced by different Height Support Structures

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Abstract

A trial was conducted to evaluate different height support structures on agronomic and seed yield attributes of Lablab purpureus accessions in Hawassa Zuria Woreda of Sidama region. Three L. purpureus accessions (L. purpureus 147, 11609 and 6529) and three support structures with different height (0, 100 and 150 cm height) in three time replication were used in randomized complete block design. Support structures height (SS) had significant effect on plant height (PH)), number of branches per plant (NBPP), forage dry matter yield (DMY)), and seed yield (SY) at ($P < 0.05$). 1.5 m height support structure had significantly influenced all the measured parameter as higher plant height, number of branches per plant, dry matter yield and seed yield in regardless of accession. Similarly, variation in accession had shown significant effect at ($P < 0.05$) on plant height, number of branches per plant, dry matter yield, and seed yield. The interaction effect of support structures and different accessions was non-significant at ($P < 0.05$) in all measured parameters and this indicates that performance of the different accessions was stable in all height levels, there is increase in all measured value as heightof support structure increases. Therefore, it can be suggested that it would be better to use best adapted forage species with increased height of support structure. From the three evaluated L. purpureus accessions L. purpureus (147) at the height of 1.5 m support structure produced higher dry matter and seed yield. The support structures could be agroforestry trees, stand tree, stick structures that could be easily accessible and least cost. So, that it can be recommended for unemployed youths who involved in lablab seed production could be profited by using 1.5 m high support structure and accession 147.

Keywords: Accessions; Lablab Purpureus; Dry matter yield; support structures

Introduction

Despite the significant importance of livestock in the country, animal productivity is low as sited by (Ashmael et.al 2021), this is due to bottlenecks like inadequate feed, wide occurrence of disease, poor health care services, and poor genetic potential of indigenous animals and lack of good husbandry practices (CSA, 2018; Shapiro et al., 2015). (Shapiro et al., 2015, Gezahegn et. al. 2020) reported shortage of feed in terms of quantity and quality as most limiting factors for livestock production). The feed sub-sector is central for all livestock commodities and is a key pillar of livestock growth and transformation from various perspectives. From production point of view, animal production is essentially a conversion of feed into animal product. From economic point of view about 70 percent of the cost of animal production is feed cost (Seyuom et al., 2018), suggesting economic feasibility of animal agriculture is mainly a function of quantity or quality of feed and the science of feeding. Additionally, animal feed is a point of convergence and critical commodity which all livestock production competes for and it is a major pillar towards ensuring economic, social and environmental goals of livestock production at a macro level (Makkar, 2016).

Improved forage crop production is a feasible, appropriate, and sustainable feed source for livestock. In Ethiopia, the overall average productivity of improved fodder crops per unit area has been found to exceed the productivities of seasonally rested and continuously grazed native pastures by about 3 fold and 10 fold, respectively (Fekede et al., 2015). However, area coverage of cultivated forage crops is insignificant in the country due to various reasons. The success of forage development also depends upon the establishment of a sound forage seed production system.

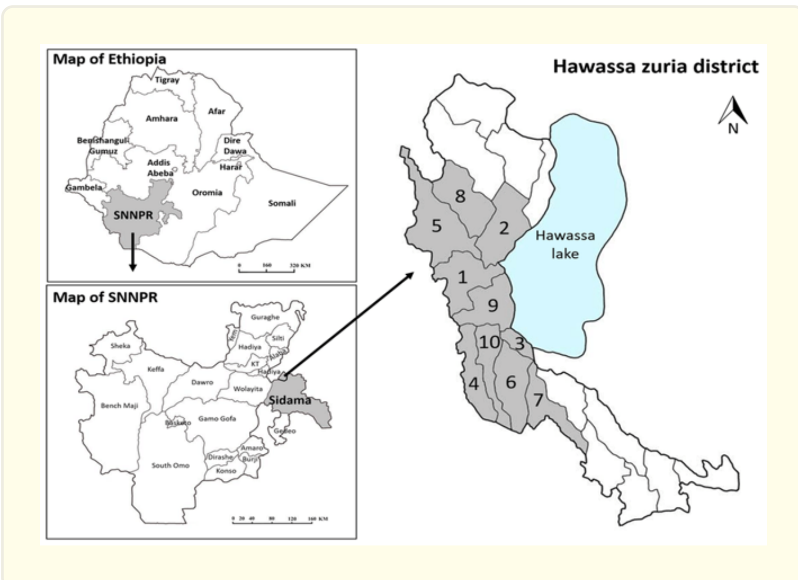
Use of productive cultivated forage legumes could be a viable means of correcting the livestock feed constraint in the study area. It is also used for intercropping systems with the cereals such as maize and sorghum because it is dual-purpose legume (human consumption and animal feed). Moreover, it could be sustainably used to improve the feeding value of poor quality crop residues and pastures, especially for resource-poor smallholders and farmers through supplementation of forage legumes (Melkam Aleme 2022).

Lablab is among the improved annual legume forages species that has moisture stress-tolerant ability and contains high protein contents form other legumes, according to previous studies in other countries (Ashmael A. et.al. 2021). However, in study area there was inadequate information on agronomic characteristics, forage yield in use of support structures with different height. It is therefore, important to further evaluate lablab accessions to determine if support structure would affect its ability to increase seed yield and yield attributes, which is important for re-establishment of subsequent crops, information that is currently unknown. Therefore, current study was initiated to evaluate the effects of accessions and different heighted structures on agronomic characteristics, biomass yield and seed yield of lablab accessions in Hawassa Zuria Woreda, Sidama Region, Ethiopia.

Materials and Methods

Description of the study area

The trial was conducted in Hawassa Agriculture Research Center at Hawassa Zuria Woreda in Sidama Region, Ethiopia. Hawassa Zuria Woreda woreda is located at (07° 01′ 54″ to 07° 50′ 36″ N and 38° 15′ 39″ to 38° 25′ 43″ E) is found 290 km away from Addis Ababa in the South in the Sidama Region, of Ethiopia, This district has a total population of 124,472, of whom 62,774 are men and 61,698 women (CSA, 2015). The altitudinal range is 1700 m to 1850 m.a.s.l. The annual mean maximum and minimum temperatures are 30 °C and 17 °C, respectively, and the mean annual rainfall is 1015 mm. The size of the district is 22,643 ha and the dry zone accounts for 75% [SZFEDB 2011] and consists of 23 kebeles (farmers' associations).



Experimental treatments and Design

Three accessions of lablab purpureus accessions (L. purpureus 147, 11609 and 6529) were collected from Melkassa Agricultural research center (MARC). Before sowing, the experimental land was first cleared of weeds and unwanted debris and it was ploughed and leveled by oxen two times before subdividing it into blocks and plots. The experiment was conducted as two factorial approaches. The first factor was accessions (147, 11609 and 6529) and second factor was support structure at the height of (0, 100 and 150 cm). The experiment had 12 treatment combinations having three replications and a total of 36 plots in the total experiment. The accessions were planted in 3 m x 4 m by considering 12 m2 areas for each experimental plot using a randomized complete block design (RCBD) with three replications at the beginning of the main rainy season. Planting has been conducted 10 cm between seeds and 30 cm between rows. Spacing between plots and replications were 1.5 and 2 m, respectively. Sowing was conducted according to their recommended seed rates 15-20 kg/ ha.

Weeding was done earlier the sowing season and was regularly done two times per month until the final harvest is accomplished, to eliminate re-growth of undesirable plants and removal of the dry root in order to promote fodder re-growth by increasing soil aeration.

Data collection

Plant height (PH)

A measurement of plant height was undertaken at the time of 50% flowering. From the total of seven rows within each plot the middle three rows were selected by excluding the two border rows and then five plants were randomly selected for the measurement of plant height. It was measured from the base of a plant to tip of the upper leaves of the main stem and mean height was calculated for each treatment.

Number of branches per plant (NBPP)

The numbers of branches per plant were counted from the randomly selected sample of five plants of each plot from middle of three rows at 50% flowering from net plot area and mean was calculated for individual plant.

Dry matter yield (DMY)

The dry matter yield was determined at 50% flowering stage of lablab accessions. To estimate dry matter yield the three rows at the middle of each plot were cut at the height of five cm above the ground. A fresh herbage yield was measured immediately after harvesting and weighed right on the field, soon after harvesting using a sensitive spring balance having sensitivity of 0.1 g. The samples were weighed while fresh using a spring balance and then sub-samples of about 500 g fresh plants were taken from the sample and were oven dried to at hawassa agricultural research center Soil laboratory at 1050c for 24 hours. On the basis of the DM% and fresh biomass yield from the sample area of each plot were used to calculate total dry matter yields for each plot, thereafter, converted to metric ton per hectare.

Estimation of Grain Yield

The grain yield was estimated from the inner two rows of the plot harvested at maturity of the seeds. The whole biomass was harvested by sickle about 5 cm above the ground and sun-dried. The dried biomass was threshed manually. After threshing, grain and residues were separated. Grain yield was weighed, and yield per hectare was estimated.

Statistical Analysis

Analysis of variance (ANOVA) procedures of SPSS general linear model (GLM) was used to analyse the quantitative data. LSD test at 5% significance was used for comparison of means.

Result and Discussions

Different height Support structures on agronomic parameters and seed yield of lablab accessions was indicated in table (1, 2, 3 and 4). Agronomic parameters of lablab were significantly affected at ($p < 0.05$) by different height support structure and lablab accessions. Lablab accessions grown by using 1.5 m support structure had better agronomic characteristics and dry matter yield than other heights which might be due to the fact that higher aeration while supported improved growth of lablab.

Plant height (PH)

The result indicated that height of different support structure and accession had significant effect on plant height of lablab at ($P < 0.05$) as indicated in (Table 1). The longest plant height (190.25 cm) was recorded from lablab accession 147 by using 1.5 m height support structure which is higher than (Woldeyesus, 2017) which is 57 cm and (Abduselam et al. 2017) reported 87.9 cm and in contrary to this Hidosa et al. (2016) reported 216 cm for lablab accession 147. The result indicated that use of 1.5 m height support structure had shown significant height growth in all labalab accession regardless of genotype. With regard to accession accession no. 147 had shown greater growth in than other accessions in all height class of support structure.

Accessions	*Height of support structures*	*Mean*	*Std. Error*	*95% Confidence Interval*	
				Lower Bound	*Upper Bound*
1109	control/ no support structure	147.750	1.682	144.299	151.201
	1 m height support structure	172.000	1.682	168.549	175.451
	1.5 m height support structure	173.500	1.682	170.049	176.951
6529	control/ no support structure	161.000	1.682	157.549	164.451
	1 m height support structure	167.750	1.682	164.299	171.201
	1.5 m height support structure	176.750	1.682	173.299	180.201
147	control/ no support structure	167.750	1.682	164.299	171.201
	1 m height support structure	169.750	1.682	166.299	173.201
	1.5 m height support structure	190.250	1.682	186.799	193.701

Table 1: Effect of height of support structures and accession on plant height.

Number of branches per plant (NBPP)

The height of support structure and accessions had shown significant difference at ($P < 0.05$) on number of branches per plant (NBPP) of lablab accessions table 2. The maximum number (13) of branches per plant was recorded in lablab accession 147 at 1.5 m height support structure which is significantly higher at ($P<0.05$) from 1 m height support structure (11) and non-supported group (9.25). As accession point of view accession 147 has significantly higher NBPP than accession 6529 and 1109. Regarding the overall mean of accessions, the maximum NBPP were recorded from 147 (11.32) followed by 6529 lablab (8.58) while the lowest NBPP (7.5) was recorded from lablab accession 1109. Generally, the increase in NBPP at all height groups, might be due to the fact that aeration effect have added some access to sun light which may comfort for more additional number of braches per plant. The values reported in current study are lower than Ahmed (2007) who reported (16.1) and (14.6) NBPP by using 100 kg/ha and 50 kg/ha DAP fertilizer respectively.

On the other hand scholars reported lower NBPP by using different level of fertilizer and Jaisankar and Manivannan (2018) reported (10.89) and (7) NBPP by using (100 kg /ha) and 50 kg/ha respectively. Samapika et al. (2019) reported (7.17 and (7) number of branches per plant by using NPK fertilizer (150 kg /ha)) and 100 kg/ha respectively. The result difference from other Authors in current study might be due to difference in heights of support structure accession difference, environmental conditions, and season and management systems.

Accessions	Height of support structures	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1109	control/ no support structure	6.250	.391	5.448	7.052
	1 m height support structure	7.250	.391	6.448	8.052
	1.5 m height support structure	8.000	.391	7.198	8.802
6529	control/ no support structure	6.750	.391	5.948	7.552
	1 m height support structure	8.750	.391	7.948	9.552
	1.5 m height support structure	10.250	.391	9.448	11.052
147	control/ no support structure	9.250	.391	8.448	10.052
	1 m height support structure	11.000	.391	10.198	11.802
	1.5 m height support structure	13.000	.391	12.198	13.802

Table 2: Effect of height of support structures and accession on number of branches.

Dry matter yield of lablab (DMY)

Height of support structure and accession had shown significant difference at (P < 0.05) on dry mater yield (DMY) of lablab accessions. Lablab accession 147 had shown highest DMY than other two accession at (P<0.05) with record of (7.56 t/ha), (6.68 t/ ha) and (6.05 t/ha) from 1.5 m, 1.00 m height support structure and control treatment respectively. Similarly, the highest DMY was 6.5 and 5.67 t/ha were recorded in the lablab accession 6529 from height of support structure (1.5 and 1 m) respectively followed by control group (5.22 t/ha). Relatively lower DMY yield was recorded from lablab accession 1109 was (6.44) in the (5.67 t/ha) while the lowest was from control group (4.81 t/ha) which is not significantly different from accession no. 6529 at height of 1.5 m, 1 m and non-support structure group respectively.

Generally, the highest DMY was from all 1.5 m height support structure, this might be that increase in height have added aeration which were merited for more additional number of leaves, branches per plant, length leaves per plant and longer plant height. The DMY in the current study were significantly different among lablab accessions and this might be due to their genetic potential of accession respond to height of support structure to produce higher DMY.

Higher dry matter yield was reported by different authors by using irrigation and different level of fertilizer as (Ashmael A. et.al. 2021) reported (21.46 t/ha), (20.91 t/ha, (19.08 t/ha) fertilizer and (16.95 t/ha) DMY from accession Tulu by using 150 kg/ha, 100 kg/ha, 50kg NPS application and from control treatment respectively. Similarly, Hidosa et al. (2016) reported a 10.68 t/ha, Zeleke et al. (2018), reported 15.2 t/ha, Weldeyesus (2017) reported 8.3 t/ha and Akter et al. (2018) reported (13.07 t/ha). The current overall mean of DMY (7.5 t/ha) result was lower than aforementioned findings; this is mainly due to difference in accession, irrigation and other management differences.

Seed yield

Height of support structure and accession had shown significant difference at (P < 0.05) on seed yield (SS) of lablab accessions. Lablab accession 147 had shown highest SY than other two accession at (P<0.05) with record of (3.4 t/ha t/ha), (2.8 t/ ha ha) and (2.5 t/ha) from 1.5 m, 1.00 m height support structure and control treatment respectively. Similarly, the highest SY was 2.9 and 2.65 t/ha were recorded in the lablab accession 6529 from height of support structure (1.5 and 1 m) respectively followed by control group (2.28 t/hat/ha). Relatively lower SY yield was recorded from lablab accession 1109 which was (2.71 t/ha) and (2.3 t/ha) while the lowest was from control group 2.15 t/ha) which is not significantly different from accession no. 6529 at height of 1.5 m, 1 m and non-support structure group respectively.

Accessions	Height of support structures	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1109	control/ no support structure	4.805	.342	4.104	5.506
	1 m height support structure	5.673	.342	4.972	6.373
	1.5 m height support structure	6.438	.342	5.737	7.138
6529	control/ no support structure	5.218	.342	4.517	5.918
	1 m height support structure	5.888	.342	5.187	6.588
	1.5 m height support structure	6.515	.342	5.814	7.216
147	control/ no support structure	6.048	.342	5.347	6.748
	1 m height support structure	6.683	.342	5.982	7.383
	1.5 m height support structure	7.520	.342	6.819	8.221

Table 3: Effect of height of support structures and accession on dry matter yield.

The current study has shown relatively higher seed yield than some reports by Ewansiha et al. (2007), a seed yields of 0.6-2.4 t/ ha, Amodu et al. (2003) similarly reported a seed yields of 1.6-2.3 t/ha. On the other hand S.A. Ogedegbe et.al, 2012 reported (0.98 t/ha) seed yield which is quite lower than current study. The variation might be due environmental factors like soil, temperature, and might be also due to variation in accessions.

Accessions	Height of support structures	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1109	control/ no support structure	2.150	.088	1.970	2.330
	1 m height support structure	2.325	.088	2.145	2.505
	1.5 m height support structure	2.707	.088	2.527	2.888
6529	control/ no support structure	2.275	.088	2.095	2.455
	1 m height support structure	2.650	.088	2.470	2.830
	1.5 m height support structure	2.912	.088	2.732	3.093
147	control/ no support structure	2.500	.088	2.320	2.680
	1 m height support structure	2.815	.088	2.635	2.995
	1.5 m height support structure	3.403	.088	3.222	3.583

Table 4: Effect of height of support structures and accession on seed yield.

Conclusion

The study indicated that height of supporting structures had positive effect on total growth height, number of branches per plant and dry matter and seed yield of lablab purpureus. The interaction effect of height of support structure and genotype was non-significant for all measured parameters and this indicates that performance of the accessions were stable across the all height of support structure. From the evaluated lablab purpureus accessions 147 at the height of 1.5 m support structure produced higher dry matter and seed yield. So, that it can be recommended that for un employed youths who were involved in lablab seed production could get better seed and similarly dry matter yield by using 1.5 m high support structure and 147 lablab accession.

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