Int.J.Curr.Res.Aca.Rev.2026; 14(2): 43-49

International Journal of Current Research and Academic Review

ISSN: 2347-3215 (Online) Volume 14 Number 2 (February-2026)

Journal homepage: http://www.ijcrar.com

doi: https://doi.org/10.20546/ijcrar.2026.1402.006

Lablab (*Lablab purpureus*) Varieties Adaptation Trial at Lowland Areas of Buno Bedele and Ilu Aba Bor Zones, South Western Oromia, Ethiopia

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Abstract

The study was conducted at lowland agro-ecologies of Dabo Hana and Bure districts for three consecutive years in 2022 to 2024 during the main cropping season with the objective of to evaluate and select the best adaptable and high dry matter yielder of lablab varieties for the study areas. Four lablab varieties were evaluated using randomized complete block design with four replications. Data on plant height, leaf to stem ratio, maturity date, disease, dry matter yield and seed yield were collected and analyzed. The result of overall combined mean value reveals that there were a highly significant ($p<0.001$) difference among the tested lablab varieties for plot cover percentage, stand and vigor percentage, plant height, leaf to stem ratio, disease incidence, maturity date, dry matter yield and seed yield. The result of the mean values of dry matter yields ranged from 8.2 to 14.6 t/ha in Dabo Hana district while 9.1 to 16.0 t/ha in Bure district. The result of mean value showed that the highest dry matter yield was recorded by Doli-I followed by Doli-II varieties. Leaf to stem ratio was higher for Doli-I followed by Doli-II while lower for Gebis-17 variety. Disease tolerance was significantly differ ($P<0.05$) among varieties. Doli-I and Doli-II varieties were tolerant to leaf rust. Beresa-55 variety was highly susceptible to leaf rust disease compared to the others varieties. The highest seed yield was also observed for Doli-I and Doli-II varieties. Hence, both Doli-I and Doli-II were well adapted and the most promising varieties that recommended for future demonstration in lowland areas of Dabo Hana and Bure districts and similar agro-ecologies of both Buno Bedele and Ilu Aba Bor Zones.

Article Info

Received: 28 December 2025
Accepted: 29 January 2026
Available Online: 20 February 2026

Keywords

Doli-I, Doli-II, Dry matter yield, Lablab, Leaf to stem ratio, Varieties

Introduction

Livestock production is one of the major components of agriculture in Ethiopia, and it is highly dependent on the quantitative and qualitative adequacy of feed resources (Mengistu *et al.,* 2017). However, livestock production in the country faces significant challenges due to the inadequate supply and poor quality of feed resources (Gelayenew *et al.,* 2016). Livestock remains as a pillar for food security, human nutrition and economic growth of the county (Shapiro *et al.,* 2015). The major livestock feed resources in Ethiopia are natural pasture, crop residues, improved pastures, forage crops and agro industrial by products (Alemayehu, 2004). The traditional livestock production systems depend upon pasturelands and crop residues which are usually inadequate and poor in quality to support reasonable livestock production (Habte, 2000). 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, 2022). The importance of multiple purpose legume cover crop (LCCs) in agricultural production under smallholder farming systems has been recommended due to their dual use in meeting multiple needs of farmers (Nyende and Delve, 2004, Maass, *et al.,* 2010, and Matata *et al.,* 2017). Forage legumes are widely known for their vital contribution in farming systems. They provide quality feeds to livestock. Among forage legumes Lablab (*Lablab purpureus* (L) is self-fertilizing crop belong to the family leguminosae (Kshirsagar *et al.,* 2018). Moreover Lablab helps to improve and balance nutritional requirement of livestock when fed together with other roughages dominated by fiber. Its foliage also could be conserved as hay and silage for livestock feed and could also be used as green manuring crop (Kabirizi *et al.,* 2007). However, lablab varieties have not been evaluated at lowland ecologies of Buno Bedele and Ilu Abba Bora Zones and hence not much information is available for adaptation and performance. Therefore, this experiment was initiated to evaluate and select the best adaptable and high dry matter yielder of lablab varieties for fodder production in lowland areas of the study areas.

Materials and Methods

Description of the study area

The study was conducted for three consecutive years (2022 to 2024) under rain fed conditions at lowland agro-ecologies of Dabo Hana and Bure districts of Buno Bedele zone and Ilu Aba Bor zone, respectively (Figure 1). Dabo Hana district is located at 388 km from the capital city of Ethiopia, Addis Ababa along main road of Nekemte town and 46 km from Buno Bedele zonal capital town, Bedele. Altitude of the district ranged from 1791 to 1990 masl and located between 8º55'26.423" to 8º30'044"N latitude and 36º5'32.953" to 36º26'23.781"E longitude. The mean annual temperature of the district ranged from 15 Cº to 31 Cº whereas mean annual rainfall ranges from 1000-1500 mm. Type of the soil in district are nitisols. The economy of the area is based on mixed cropping system and livestock raring agricultural production system. Bure district is one of districts of Ilu Aba Bor zone, southwestern Oromia and it is bordered to the south by Nono, to the southwest by Gambela Region, to the west by Kelem Welega Zone, to the northeast by Mettu, and to the southeast by Ale district, with the Birbir River marking its western and north boundaries. The district is located at 34°57'-35°17' E longitude and 8°6'-8°31' N latitude with an elevation ranging from 619 to1844 m.a.s.l.

Treatments and experimental design

Four different lablab varieties namely, Gabis-17, Beresa-55, Doli-I and Doli-II were used as experimental materials. The experiment was laid out in randomized complete block design with four replications. All the treatments were randomly allocated to different plots in each replication. A plot size of 3 m x 2 m was used. The distance between each plant was maintained at 20 cm, and the row spacing was set at 40 cm. The plots and blocks were separated by 1.5 m and 2 m, respectively. Seed rate of 25 kg/ha was used while NPS fertilizer at a rate of 100 kg/ha applied during sowing. Weeds were also removed from all plots before flowering

Data collection and analysis

All relevant agronomic and yield data including biomass yield, dry matter yield, plant height, disease (1-5 score), leaf to stem ratio, maturity date at seed harvest and seed yield were collected according to respective standard. Forage biomass yield was estimated by harvesting the forage at 50% flowering stage from two middle rows.. The harvested forage was immediately weighed using sensitive field balance to obtain fresh biomass yield. The harvested samples were manually chopped into small pieces using sickle and a sub-sample of 300 gm fresh weight and oven dried for determination of herbage dry matter yield. Forage DM yield (t/ha) was obtained by using James *et al.,* (2008) formula which is DM yield (t/ha) = (10 x TFW x SSDW)/ (HA x SSFW). Where; 10 = constant for conversion of yields in kg/m2 to tone/ ha, TFW = total fresh weight from harvesting area (kg), SSDW = sub-sample dry weight (g), SSFW= sub-sample fresh weight (g). The recorded data were analyzed using the Gen stat software version 18.1 and significant means separated by using least significance difference (LSD) at 5% probability level.

Results and Discussion

Analysis of variances

The combined mean square analysis of variance result was presented in Table 1. The result showed that there was a statistical ($p<0.001$) variation among the varieties on dry matter yield, plant height, leaf stem ratio, maturity date at forage harvest and seed yield. The result also revealed that the effect of location had a significant effect (p<0.01) on dry matter yield while location did not significantly (p>0.05) affect plant height, leaf stem ratio, maturity date at forage harvest and seed yield. Variation of the year was influenced significantly (p<0.001) on dry matter yield and seed yield but not influenced the other parameters. The interaction of varieties by location has not shown a significant effect (p>0.05) on all parameters. The interaction of varieties with year also has not shown a significant effect (p>0.05) on all parameters. The three way interaction varieties with location and year didn‘t showed a significant (p>0.05) effect on the tested parameters.

Plant height (cm)

The analysis result of plant height of the tested varieties was indicated in the table 2. The combined mean result showed highly significant (p<0.001) variation among all varieties in plant height. Beresa-55 variety showed the highest plant height (175 cm) followed by Doli-I variety (162 cm) while the lowest plant height (153 cm) was recorded by Doli-II variety. The differences among varieties in plant height might be due to the differences in genetic makeup (Gebremedhn *et al.,* 2015). The mean plant height of the current study is significantly higher than the result reported by Adem *et al.,* (2021) who recorded for lablab accession 147 (128.75 cm) and Weldeyesus (2017) reported that lablab accession 147 had shown a plant height of 57 cm and Abduselam *et al.,* (2017) reported that plant height of lablab accession 147 was 87.9 cm which is lower than the current finding. Plant height at forage harvest recorded by Gabis-17 variety was 161 cm which is higher than the result reported by Melkam (2021) who recorded for lablab accession 11614 (121.7 cm) and Gabis-17 (151 cm). In contrast, the current result of plant height was lower than the findings reported by Hidosa *et al.,* (2016) mean plant height of 216 cm. This variation might be due to environmental versions such as soil, temperature and moisture of the study areas.

Leaf to stem ratio

The combined mean analysis of leaf to stem ratio of lablab varieties tested is indicated in Table 2. The result indicated that the leaf to stem ratio varied significantly (p<0.001) among the tested lablab varieties, ranging from 0.83 to 1.61 with a mean of 1.23. The maximum leaf to stem ratio was recorded for Doli-I (1.61) while Gabis-17 produced the lowest (0.83). The combined mean value of leaf to stem ratio of the current study is significantly higher than the result reported by Mulisa *et al.,* (2020) who recorded mean value for different lablab accessions (0.63). The leaf to stem ratio has significant implications on the nutritive quality of the forage as leaves contain higher levels of nutrients and less fiber than stems (Mulisa *et al.,* 2020).

Maturity date at forage harvest

The analysis result for forage harvesting maturity date of lablab varieties was presented in (table 2). Significance (P<0.05) variation among the tested lablab varieties was observed in forage harvesting maturity date. The longest (187) maturity date at forage harvest was recorded for Beresa-55 varieties followed by Gabis-17(185) while the shortest date (128) of maturity was recorded for Doli-II variety in relation to the others.

Seed yield

Seed yield of different lablab varieties was presented in Table 2. The result of combined mean value showed that seed yield was highly significant (p<0.001) different among the lablab varieties. The result of combined mean value showed that seed yield of the tested lablab varieties ranges 10.3- 31.4 qt/ha. Among the tested lablab varieties, Doli-I and Doli-II were produced the maximum seed yield of 31.4 qt/ha and 29.5 qt/ha, respectively. The seed yield of Doli-I and Doli-II in this findings was comparable with seed yield obtained from Gebis-17 (29.3 qt/ha) and Beresa-55 (33.9 qt/ha) varieties that reported by Teshale and Genet, 2021.

Disease and pest occurrence

The occurrence of disease and pests was observed during the experimental period. Leaf rust occurred on Baresa-55 variety. Based on 1-5 scale, Baresa-55 variety scored a mean value of 3.1 while the others varieties scored lower values (1.0) and relatively tolerated the occurrence of the disease (Table 2).

Dry matter yield

There was significant (p<0.05) variation recorded for dry matter yield among all lablab varieties was presented in Table 3. The combined mean values of dry matter yield varied between 8.2 –14.6 and 9.1–16.0 t/ha in Dabo Hana and Bure districts, respectively. The result indicated that the highest dry matter yield (20.3 t/ha) was recorded at Bure district in 2022 by Doli-I variety while the lowest (3.7 t/ha) was recorded in 2024 in Dabo Hana district by Gabis-17.

Table.1 Mean squares of ANOVA for yield and yield related components of Lablab varieties tested at Dabo Hana and Bure districts

Source of variation	DF	DMY	Pht	LSR	Mtdt	SY
Varieties	3	172.75***	1380.8***	1.9741***	16432.5***	2254.98***
Location	1	30.45**	60.5 NS	0.0313NS	98.0NS	18.93NS
Year	2	430.89***	288.0NS	0.0014NS	350.0NS	98.00***
Varieties*Location	3	0.40NS	0.2NS	0.2129NS	0.022NS	0.96NS
Varieties*Year	6	0.07NS	0.013NS	0.051NS	0.044NS	0.031NS
Varieties*Location*Year	6	0.074NS	0.04NS	0.01NS	0.006NS	0.024NS
Error	46	2.98	203.0	0.0961	268.4	11.48

Where, **, and *** show a significance at 0.01, and 0.001%, respectively. NS: Non-significant, DF: Degree of freedom, Pht: Plant height, Mtdt: Maturity date at forage harvest, LSR: Leaf to stem ratio, DMY: Dry matter yield and SY: Seed yield

Table.2 Combined mean performance of lablab yield and yield related at Dabo Hana and Bure districts in three years

Varieties	PC (%)	SV (%)	D50%flwr	Pht (cm)	LSR	DI	Mtdt	SY (qt/ha)
Doli-I	95.1a	95.0a	112 a	162b	1.34b	1.1c	141b	31.4a
Doli-II	95.7a	95.5a	119 ab	153c	1.61a	1.0c	128c	29.5a
Gabis-17	91.2b	90.7b	134bc	161bc	0.83d	2.2b	185a	10.3b
Beresa-55	91.9b	90.8b	143c	175a	1.15c	3.1a	187a	12.0b
Mean	93.50	93.03	127	162.8	1.23	1.82	159.8	20.77
LSD (5%)	1.70	1.91	12.61	8.31	0.19	0.30	9.43	2.79
CV (%)	2.7	3.1	8.2	7.7	22.7	24.9	8.9	20.2
P-Value	***	***	***	**	***	***	***	***

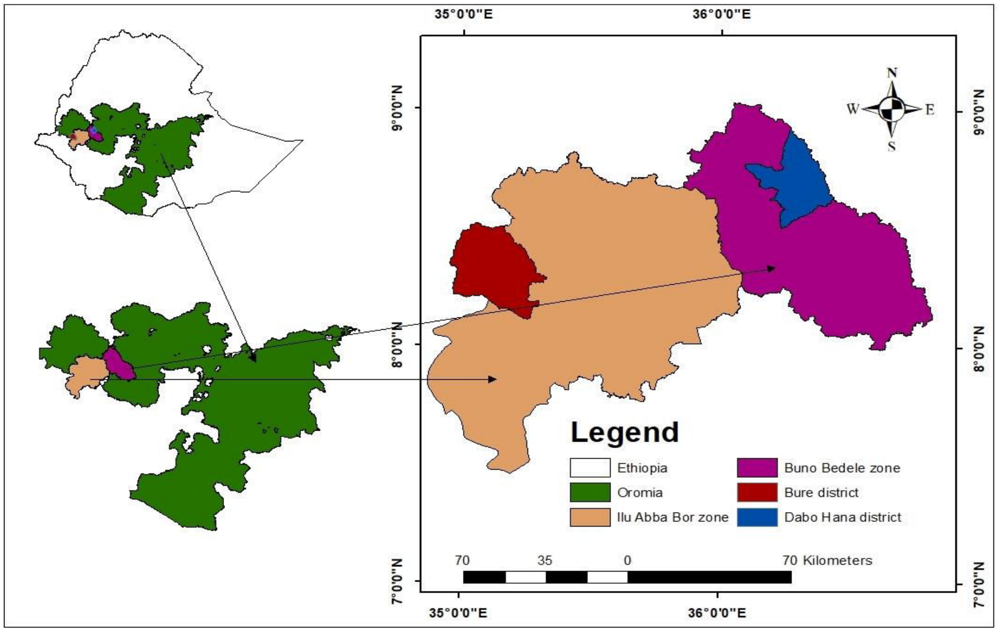
Where, **, and *** show a significance at 0.01, and 0.001%, respectively. PC (%): Plot cover percentage, SV (%): Stand and vigor percentage, D50% flwr: Dates to fifty percent flowering, Pht: Plant height, DI: Disease incidence, Mtdt: Maturity date at forage harvest, LSR: Leaf to stem ratio, DMY: Dry matter yield and SY: Seed yield

Table.3 Dry Matter Yield of Lablab in Dabo Hana and Bure districts during 2022 to 2024

Varieties	Dabo Hana District				Bure District			
	2022	2023	2024	Combined mean	2022	2023	2024	Combined mean
Doli-I	19.6a	14.6a	9.7a	14.6 a	20.3a	14.3a	13.3a	16.0a
Doli-II	17.3a	12.3a	7.3a	12.3 a	18.3ab	12.9ab	11.3ab	13.9a
Gabis-17	13.0b	8.0b	3.7b	8.2b	13.5c	7.5c	6.5c	9.1b
Beresa-55	13.7b	8.7b	4.3b	8.9b	14.5bc	8.5bc	7.5bc	10.2b
Mean	15.91	10.90	6.24	11.02	16.65	10.65	9.65	12.32
LSD (5%)	11.0	3.51	2.99	4.36	4.26	4.60	4.00	3.63
CV (%)	3.51	16.1	24.0	21.1	12.8	20.0	22.1	20.6
P-Value	*	*	**	*	*	*	*	*

Where, *, and ** show a significance at 0.05, and 0.01%, respectively.

Figure.1 Map of study areas



Doli-II variety also recorded high dry matter yield 18.3 t/ha and 17.3 t/ha at Bure and Dabo Hana districts in 2022, respectively. The lowest dry matted yield was recorded for Gabis-17 variety through the years in both Dabo Hana and Bure districts. The result of mean value showed that the highest dry matter yield was recorded by Doli-I variety in 14.6 t/ha and 16.0 t/ha at both Dabo Hana and Bure districts, respectively. Doli-II variety was also the highest dry matter yielder in 12.3 t/ha and 13.9 t/ha at Dabo Hana and Bure districts, respectively. The dry matter yield in the current study was significantly different among lablab varieties and this might be due to their genetic variation of varieties respond to different environments. The highest mean dry matter yield of 16.0 t/ha was recorded at Bure district for Doli-I followed by Doli-II with the mean value of 13.9 t/ha while the lowest dry matter yield of 9.1 t/ha was obtained from Gabis-17 variety. The dry matter yield of lablab observed in this study was higher than dry matter yield 6.8 t/ha that reported by Hidosa *et al.,* (2016). On the other hand Zeleke *et al.,* (2018) reported that dry matter yield of lablab was 15.2 t/ha which is comparable with current results.

In conclusion, the study was conducted for three consecutive years (2022 to 2024) under rain fed conditions at lowland agro-ecologies of Dabo Hana and Bure districts. The result revealed that leaf to stem ratio, dry matter yield, seed yield and other agronomic traits were significantly differ among the tested lablab varieties. The highest production of yield and yield related components of the tested lablab varieties were observed at Bure district rather than Dabo Hana district. Among teste varieties, Doli-I and Doli-II were the highest dry matter yield and seed yielder at both Dabo Hana and Bure districts. Gabis-17 and Beresa-55 varieties were the lowest yield performance throughout the years in the study areas. Therefore, Doli-I and Doli-II were well adapted and the most promising varieties that recommended for future demonstration on-farm evaluation in the study areas and similar agro ecologies of Buno Bedele and Ilu Aba Bor Zones. Furthermore, recommended varieties should be evaluated through animal performance in feeding trials, intercropping to identifying the best food crop-lablab integration methods to use the available small farmland for both crop and livestock feed production and refining the main agronomic practices feeding strategies is also vital to address in the future

Conflict of Interest: The authors stated that there is no conflict of interest between authors and the organization.

Acknowledgement

The author would like to acknowledge Bedele Agricultural Research Center (BeARC) and Oromia Agricultural Research Institute (OARI) for the allocating budget to granting the financial support for the research work.

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How to cite this article:

Muleta Debela and Aberu Bane. 2026. Lablab (*Lablab purpureus*) Varieties Adaptation Trial at Lowland Areas of Buno Bedele and Ilu Aba Bor Zones, South Western Oromia, Ethiopia. *Int.J.Curr.Res.Aca.Rev.* 14(2), 43-49