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Research Article

Performance Evaluation of Lablab Genotypes across Various Locations of Ethiopia

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This study was conducted evaluate the performance of Lablab genotypes across various locations of Ethiopia. Twelve accessions of L. purpureus obtained from ILRI Genebank and a check registered variety from Bako Agricultural Research Center were sown under a 3×13 factorial experiment in a randomized complete block design (RCBD) during the rainy season in 2020, across three locations, namely Tepi, Bechi, and Kite sites of South West Ethiopia. The data were collected on the establishment, days to different physiological stages, forage yields, soil properties, and other related parameters. The data were subjected to analysis of variance using the general linear model of SAS and mean comparison via list significance difference test. A significant difference ($p \leq 0.01$) was observed across locations for most of the studied agronomic traits. The highest average dry matter (DM) forage yield recorded for T6 (accession 11613), T8 (acc. 10953), T5 (acc. 14417), and T4 (accession 11612) was 10.3, 8.7, 6.8, and 7.4 t/ha-1, respectively. Dry matter forage yield was positively associated and regressed with plant height and leaf-to-stem ratio. Lablab accessions are well adapted to the ecology tested. Lablab could also be produced in these locations without any remarkable disease problems. It is recommended that five top forage producing accessions be advanced for the next step of yield evaluation in standard multi-location. This leads to recommending best lablab accessions to be registered for the Tepi area and other similar agroecologies. Furthermore, recommended varieties should be evaluated through animal performance through feeding trials. Refining the main agronomic practice such as time of sowing, application of fertilizer, harvesting time, identifying best food crop-lablab integration methods, and feeding strategies is also vital to address in the future.

1. Introduction

Ethiopia has the largest livestock population in Africa with an estimated 60.4 million cattle, 31.3 million sheep, 32.7 million goats, 2.0 million horses, 0.5 million mules, 8.9 million donkeys, 1.4 million camels, and 56.1 million chickens [1]. The livestock subsector has significant contributions to the national economy. The country earns about 2.5 and 5.1 billion USD from the sale of 3.8 billion liters of milk and 1 million tons of beef per year, respectively. Livestock are means of livelihoods for households and are used as income, food, employment, transport, draft power, manure, savings, insurance, and social status [2, 3].

Lablab (*Lablab purpureus* (*L*) *Sweet*) is predominantly self-fertilizing herbaceous forage crop among cultivated plants belonging to family Leguminosae with chromosome number-2n = 22 [4]. It has great potential as a crop species because of higher grain yields than cowpea and its ability of adaptability in the different agroecology [5].

Given the overwhelming attempts of forage production, the introduction of new varieties of highly productive forage species is very important [6]. Despite that, there is inadequate evaluation of forage crops in the study areas and hence the very limited recommendation of forage crop existed that was not fulfilling the feed requirement in livestock production system for large-to-small scale producers. In terms of protein, source feed needs to undertake more available feeds such as lablab and cowpea, and these are wider adaptive that are used as supplementary feed. The mean crude protein content of lablab herbage was 17% with a range of 10% to 22% on a dry matter basis. Leaf crude protein varied from 14.3% to 38.5%, while the stem crude protein content ranged from 7.0% to 20.1% [7].

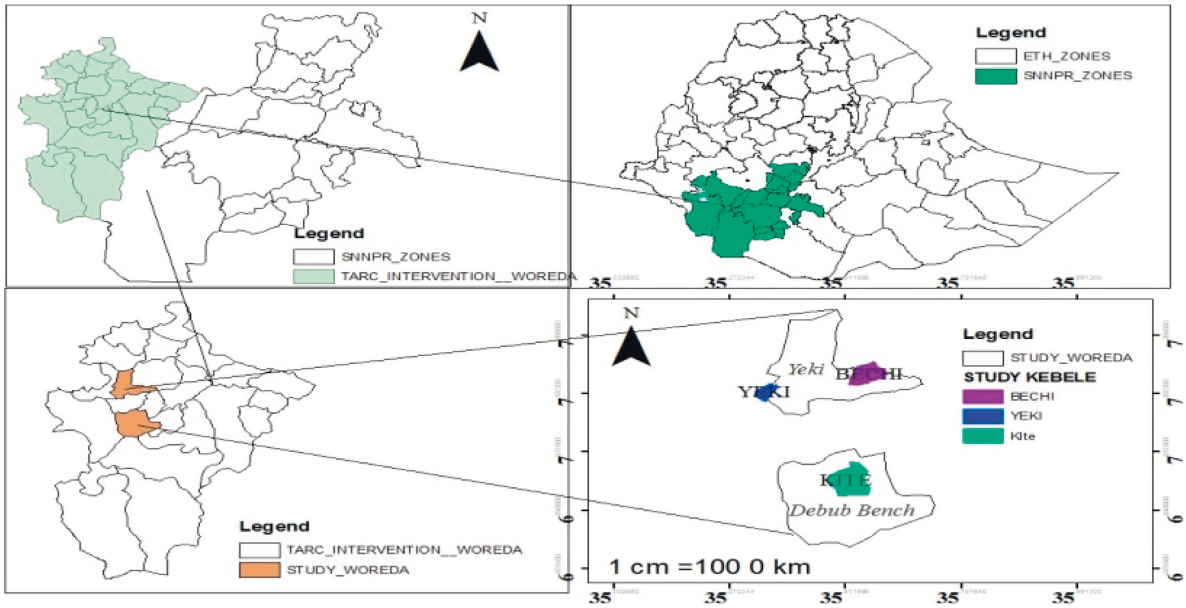

Figure 1: Map of Ethiopia showing Bench Maji and Sheka zones including the experimental sites Tepi, Bechi, and Kite kebeles.

Table 1: Description of the study areas.

Location	Name	Latitude	Longitude	Altitude	Annual rainfall	Annual temperature (°C)	Soil pH	Soil type
1	Tepi	7°19′ N	35°42′ E	1200	1559	16.09–30.23	6.3	Clay
2	Bechi	7°22′ N	35°53′ E	1276	1574	16.09–30.23	5.9	Clay
3	Kite	6°95′ N	35°51′ E	1200	1200	15.1–27.5	5.1	Clay loam

Source: field map on coordination system and laboratory work, 2020 [10, 11]

Hence, the 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. The adaptability of improved forage crops and their performance in terms of agronomic and nutritive value to the local environment need to be adequately studied. Therefore, the current experiment was initiated to evaluate the fodder production potential of different varieties of lablab for lowland agroecologies with the specific objectives, to evaluate agronomic performance and forage and grain productivity of lablab varieties, and to evaluate disease tolerance of lablab varieties.

2. Methodology

2.1. Description of Experimental Site. The study was conducted in three locations in South West Ethiopia, at Bench Maji Zone (Kite kebele) and Sheka Zone (Tepi and Bechi kebeles) (Figure 1).

Agroecologically, Kite kebele is lowland (1200 m.a.s.l) (Table 1). The mean annual temperature varies from 15.1°C to 27.5°C with the mean annual rainfall of 1200 mm. The soil type of Kite is clay to sandy loam with a pH of moderately acidic to neutral (5.6–6.78) [8, 9].

The second and third experimental sites were located in the Sheka zone namely Tepi Agricultural Research Center and Bechi Kebele. Tepi Agricultural Research Center is located at a distance of 611 km from the capital city, Addis Ababa, at an altitude of 1200 m.a.s.l (Table 1). It was characterized by hot humid with an average annual rainfall of 1559 mm and mean maximum and minimum temperatures of 30.23°C and 16.09°C, respectively. The soil type of Tepi Agricultural Research Center is classified as clay soil, dominated by a loam texture with a pH range of 5.54 to 7.10 [10].

The third site Bechi kebele is located 591 km from Addis Ababa and 20 km from Tepi Agricultural Research Center. Agroecologically, it is under low land categories with an altitude of 1276 m.a.s.l (Table 1) and characterized by humid and low land area. An average annual rainfall reaches 1574 mm, and mean maximum and minimum temperatures are 30.23°C and 16.09°C, respectively. The soil type of Bechi kebele is classified as clay soil, which is dominated by silt with pH values ranging between 5.30 and 5.65 [11].

2.2. Description of Experimental Materials. Ninety-eight lablab (*Lablab purpureus*) accessions, obtained from International Livestock Research Institute (ILRI) forage diversity genebank in Addis Ababa, were evaluated for two consecutive years under a preliminary observation screening trial

Table 2: List of lablab (*Lablab purpureus* (*L*). *sweet*) genotypes used in the study obtained from International Livestock Research Institute (ILRI) Genebank, Addis Ababa, Ethiopia.

S/N	*Lablab purpureus* ILRI* accession numbers
1	11615
2	14459
3	6528
4	11612
5	14417
6	11613
7	14425
8	10953
9	14435
10	11619
11	14445
12	11614
13	Gebisa (check)

Source: *International Livestock Research Institute, 2018.

conducted at Tepi Agricultural Research Center (TARC). The accessions were evaluated for their forage and grain yield performance and disease tolerance under the warm humid environmental condition of Tepi (Table 2). From these preliminary screenings, twelve accessions were advanced for further evaluation of forage and grain yield performance and disease tolerance in a replicated trial. The lablab variety used as a check was a registered variety by the Ministry of Agriculture variety registry and released by Bako Agricultural Research Center in 2017.

2.3. Experimental Design. The experiment was a 3×13 factorial arrangement in a randomized complete block design (RCBD) with three replications. The factors were as follows: location at three levels (Tepi, Kite, and Bechi kebeles) and accessions at 13 levels (ILRI 11615, ILRI 14459, ILRI 6528, ILRI 11612, ILRI 14417, ILRI 11613, ILRI 14425, ILRI 10953, ILRI 14435, ILRI 11619, ILRI 14445, ILRI 11614, and Gebisa).

2.4. Planting and Field Management. Planting was done at the beginning of the main rain season in June 2020, on a moldboard plowed, harrowed, and leveled field. Seeds were planted in rows spaced at 40 cm and the spacing between plants was at 30 cm on a plot size of 3×2.4 m, which becomes 7.2 m^2 [12]. The spacing between plots and blocks was 1 and 1.5 m, respectively. The treatments were randomly assigned to each plot in a block.

Phosphate (DAP) is 46 kg of P_2O_5 and 18 kg/N during sowing [13]. Planting was done manually in rows. The forage was planted with a seed rate of (20 kg/ha), which was 14.4 g per plot [12]. Weeding was manually done by hand after thirty days of planting. In this study, forage and seed were estimated from each plot. Harvesting for forage was made manually by sickle at the stage of about 50% flowering days, while the estimation of seed production was made at maturity days. All the field and agronomic data and samples required were collected from planting to harvesting.

2.5. Soil Sampling. Three core samples of soil (0–20 cm) were randomly collected using auger holes, from the blocks for each location in zigzag manner before planting [14]. The samples were bulked and mixed thoroughly, and composite samples were made. The composite soil samples collected from each location (Tepi, Bechi, and Kite sites) were air-dried and ground to pass 1 mm sieve size. The samples were subjected to laboratory chemical analysis for the determination of pH, organic carbon, available minerals (P, N, K, Ca and S, and Mg), soil type, soil texture, and cation exchange capacity (CEC).

Soil pH was determined from 1 : 2.5 soil-to-water ratio suspension using a glass electrode attached to a digital pH meter (potentiometer) after a thorough stirring. The total nitrogen (TN) was determined by the Kjeldahl procedures. Organic carbon was determined by destroying organic carbon by K2Cr2O7, and then, titration was done with ammonium sulphate using an indicator (diphenylamine). Phosphorus was extracted using ammonium fluoride in an acid solution, which allowed removing phosphate ions. Potassium is extracted with Morgan's solution and measured from the extract by the photometer. Calcium was determined by direct titration with ethylenediaminetetraacetate solution. Magnesium was precipitated as magnesium hydroxide by adding ethylenediaminetetraacetate solution. Sulphur was determined by an oxidizing sample at 11000 c with tungstic anhydride, then oxidation of sulphur is formed, and finally the gas is trapped in chromatography. Cation exchange capacity was determined by measuring the total amount of a given cation needed to replace all the cations from a soil exchange site and expressed in cent moles per 100 g soil (C mol.100 g soil). Soil size (silt, clay, and loam) is determined from soil density, and water suspension is measured with a Bouyoucos hydrometer calibrated for reading in g/litter [15].

2.6. Data Collected

2.6.1. Establishment and Growth Characteristics. After planting, data on germination percentage after one month of sowing, number of seedlings per plot, numbers of branches per plant, number of leaves per plant, number of seeds per pod, number of pods per plant, days to seed harvest, and hundred seed weight were recorded using two middle rows per plot [16].

Dates of the different phonological stages, fifty percent flowering, and seed harvest were also recorded. During establishment, data on incidences and severity of disease occurrence were checked regularly and recorded.

At 50 percent flowering stage, where lablab is recommended for forage, harvest different agronomic parameters were recorded. Plant height was measured from the ground to the tip of the flag leaf from randomly selected five plants in the middle rows. Leaf numbers per plant and leaf area were measured from randomly selected five plants from the middle rows. Leaf area was measured using photoelectric leaf area measure GDY-500 [17].

2.6.2. Disease Assessment. The progress of disease on plants was observed several times during pathogen epidemics. The extent of disease was done at each observation using scales that were based on disease incidence and severity [18]. The middle row per plot for each accession was used to collect the data on disease incidence and percentage severity index.

The assessment of incidence of the disease in the experimental plots was done every ten days after the appearance of the disease. Initial scoring for disease incidence was done when lesions were visible on the leaves of the plants. Numbers of plants in the plot/in the row were recorded, and their means were converted into percentage. The leaf spot (Cercospora capeskins) disease was observed, and the incidence of disease was calculated by the following formula:

$$\text{Disease incidence } (\%) = \frac{\text{Number of plant infected}}{\text{number of plants observed}} \times 100. \quad (1)$$

The incidence and severity of disease were recorded at ten days of interval commencing from the appearance of disease on plants in field up to maturity.

The assessment of the disease symptom of leaf spot of lablab purpureus recorded on 12 (twelve) randomly pre-tagged plants in the plot for each accession was made with the help of the descriptive scale developed by [19]. The evaluation of the disease was performed stating from the appearance of the disease every ten days using 0–5 scale rating. Leaf spot observed on the leaf estimated by using percentages as 1–10, 11–25, 26–50, 51–65, and >75 scored one, two, three, four, and five labels, respectively.

The severity of grades was converted into percentage severity index (PSI) for analysis [20].

$$\text{PSI} = \frac{\text{Sum of numerical ratings}}{\text{No.of plants scored X maximum score on scale}} \text{ x } 100. \quad (2)$$

2.6.3. Estimation of Forage Yield. Forage yield was estimated by harvesting two inner rows of each plot of lablab at the stage of 50% flowering. Harvesting was done about 5 cm above the ground manually using sickles. After harvesting, two samples were taken. The dry matter percentage was determined from the fresh forage sample. The samples were weighed and oven-dried at 65°C to constant weight, and the dried forage sample was kept for chemical analysis. DM percentage was estimated by dividing the dry weight by the fresh weight and multiplying by 100 [21].

$$\text{DM\%} = \frac{\text{Dry forage sample weight}}{\text{Fresh sample weight}} \times 100. \quad (3)$$

DM% was used to estimate dry matter yield per hectare.

DM forage yield (t ha^{-1}) = total fresh yield in t/ha^{-1} x DM %. The fresh yield (t ha-1) was calculated as follows:

$$\text{Fresh forage yield}\left(\text{t ha}^{-1}\right) = \frac{\text{plot yield in kg}}{\text{plot size in } m^2} \times 10. \quad (4)$$

The second fresh sample was taken to estimate the proportion of different botanical fractions. A fresh sample size of 250–300 g was taken and fractionated to leaf and stem. Then, fractions were dried and their proportion was estimated on dry matter basis.

Table 3: Laboratory soil analysis results for Tepi, Bechi, and Kite testing sites

Parameters		Location		
		Tepi	Bechi	Kite
pH		6.3	5.9	5.1
P		13.4	11.2	7.9
K		528	495	227
N		0.3	0.3	0.3
OC		3.9	3.7	3.4
S		12.5	12.5	12.5
CEC		0.2	0.14	0.1
Ca		3227.6	3025.8	1684.9
Mg		438.8	411.4	256.7
Texture (%)	Clay	70	52	39
	Sand	17	19	21
	Silt	13	29	40
Soil type		Heavy clay	Clay	Silt clay loam

pH: power of hydrogen (1 : 2.5; soil: water ratio). OC: organic carbon (%). K: potassium (%). N: nitrogen (%). S: sulphur (%). Ca: calcium (mg/kg (ppm)). CEC: cation exchange capacity (m/equ/100)g soil). Mg: magnesium (mg/kg(ppm)). P: phosphorus ((mg/kg) in P_2O_5). PPM: parts per million.

2.6.4. 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 five centimeters 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. Seed characteristics in terms of hundred grain weight were recorded.

2.6.5. Soil Physicochemical Analyses. The collected and sun-dried soil samples were ground to pass through 1 mm sieve size and stored in air-tight container until required for chemical analysis. They were analyzed for pH, organic carbon, available P, available N, available K, available Ca and available S, Mg, soil texture, and cation exchange capacity (CEC) (Table 3).

2.7. Data Analysis. The data were analyzed by SAS, and mean comparison did use the list significance difference test [22], version 9.4. Bartlett's test for homogeneity of variance was carried out to determine the validity of the individual experiment. Different transformation methods were used to transform these data, which could not exhibit homogeneity of variance for agronomic and nutritional parameters. The statistical model for data analysis was as follows:

$$Y_{ijk} = \mu + T_i + B_{j(k)} + L_k + (T * L)_{ik} + E_{ijk}, \quad (5)$$

where Y_{ijkl} = the response variable (the observation in jth block ith treatment and lth interaction effect); μ = the overall mean; Ti = the treatment effect; Bj(k) = the effect of block j in location k; (gradient) L_k = the location effect;

Table 4: Number of days to fifty percent flowering of lablab accessions at Tepi, Bechi, and Kite testing sites.

Lablab accessions	Days to fifty percent flowering			Mean
	Tepi	Bechi	Kite	
11615	129.0^{ab}	85.0^{de}	102.7^{b}	105.6^{bcd}
14459	130.3^{ab}	97.0^{abcd}	111.0^{a}	112.8^{ab}
6528	132.0^{ab}	107.7^{abc}	106.3^{ab}	115.3^{ab}
11612	110.0^{b}	89.7^{cde}	104.7^{ab}	101.4^{cde}
14417	114.0^{b}	80.3^{de}	87.3^{c}	93.9^{ef}
11613	106.7^{bc}	75.0^{e}	105.0^{ab}	95.6^{def}
14425	82.3^{c}	84.7^{de}	89.3^{c}	85.4^{f}
10953	111.0^{b}	98.7^{abcd}	106.7^{ab}	105.4^{bcd}
14435	129.3^{ab}	114.3^{a}	111.3^{a}	118.3^{a}
11619	129.3^{ab}	94.3^{bcde}	108.3^{ab}	110.7^{abc}
14445	145.3^{a}	109.7^{ab}	109.7^{ab}	121.6^{a}
11614	132.7^{ab}	83.3^{de}	87.0^{c}	101.0^{cde}
Gebisa	142.7^{a}	90.3^{bcde}	105.7^{ab}	112.9^{ab}
Mean	122.7	93.1	102.7	106.2
LSD	26.5	19.9	7.3	10.9
CV (%)	12.8	12.7	4.1	10.9
p Value	**	***	**	***

Means followed by different letters within a column are significantly different ($p \leq 0.05$). ** and ***Significant at 1% and 0.1%, respectively.

Table 5: Average leaf area at the stage of forage harvest (50% flowering) at Tepi, Bechi, and Kite testing sits.

Lablab accessions	Leaf area (cm^2)			Mean
	Tepi	Bechi	Kite	
11615	80.3	76.8^{bcd}	27.2	61.4^{bc}
14459	76.0	69.0^{cd}	30.2	58.4^{bc}
6528	71.0	88.9^{ab}	31.3	63.9^{abc}
11612	63.9	72.2^{bcd}	34.0	56.7^{bc}
14417	90.4	80.4^{bcd}	36.4	69.1^{ab}
11613	89.5	83.9^{bc}	31.7	68.4^{ab}
14425	53.9	69.4^{cd}	29.2	50.8^{c}
10953	75.2	76.7^{bcd}	32.9	61.6^{bc}
14435	88.1	77.6^{bcd}	34.2	66.6^{ab}
11619	87.5	73.9^{bcd}	32.9	64.8^{ab}
14445	75.7	69.2^{cd}	33.5	59.4^{bc}
11614	92.1	104.8^{a}	31.5	76.1^{a}
Gebisa	71.3	65.3^{d}	37.9	58.2^{bc}
Mean	78.1	77.5	32.5	62.7
LSD	35.2	17.2	1.3	13.4
CV (%)	27.9	13.2	17.6	22.8
p Value	NS	**	NS	***

Means followed by different letters within a column are significantly different ($p \leq 0.05$). **, ***, and NS are significant level at 1%, 0.1%, and nonsignificant, respectively.

$(T^*L)_{ik}$ = interaction effect of treatment and location; and E_{ijkl} = the random error.

3. Result and Discussion

The result was partitioned, and the collected data were analyzed for thirteen lablab genotypes as homogenous and heterogeneous characters. The characters that were heterogeneous were subject to be analyzed for each location and the combined mean was also done with respect to each treatment, whereas homogenous characters were analyzed by combining the treatments and done with the combined mean with respect to the three experimental sites.

3.1. Days to Fifty Percent Flowering. Days to 50% flowering of the different accessions showed significant differences across all the locations (Table 4). All accessions reached 50% flowering within 82.3–145.3, 75.0–114.3, and 87.0–111.3 days after planting (DAP) at Tepi, Bechi, and Kite, respectively. The early maturing genotype was for T7 or accession 14425 at 82 days followed by T6 (accession 11613) (106.7 days) at Tepi, whereas T6 (accession 11613), T5 (acc. 14417), T12 (acc. 11614), and T1 (acc. 11615) reached harvest at 75.0, 80.3, 83.3, and 85.0 DAP at Bechi. T12 (acc. 11614), T5 (acc. 14417), and T7 (accession 14425) reached harvest at 87.0, 87.3, and 89.3 days, respectively, at Kite. On the other hand, T11 (145.3 days) and T13 (142.7 days) at Tepi, T9 (114.3 days) at Bechi, and T2 (111.0 days) and T9 (111.3 days) at Kite were late to reach days to 50% flowering. Lablab accessions reach 50% flowering early in Bechi and late in Tepi. These might be the difference in soil chemical composition across the study sites (Table 3).

The combined analysis of variance indicated that accessions in T7 (85.4 days) were the early maturing variety, while T9 and T11 were the late maturing varieties (Table 4). The present finding is in agreement with [23]. 81–130 days were available in 50% blooming lablab genotypes and also 57–115 days [24]. However, Kankwatsa [14] reported shorter days to 50% flowering (52–69 days) and ranged from 65 to 83 days; these variations might be caused due to agroecological conditions, soil type, and inherent characteristics of the varieties [25].

3.2. Leaf Area. The average leaf area of the tested accessions did not show differences ($p > 0.05$) at Tepi and Kite, while leaf areas of accessions were different at Bechi ($p < 0.01$) (Table 5). The highest leaf area was recorded for T12 (104.8 cm^2) followed by T3 (88.93 cm^2), whereas the smaller values were recorded for the control Gebisa (65.3 cm^2) at Bechi location. The mean value leaf area recorded in this study was 78.12, 77.53, and 32.53 cm^2 at Tepi, Bechi, and Kite locations, respectively (Table 5).

The average leaf area for the locations was highest for T12 (76.1 cm^2) followed by T5 (69.1) and T6 (68.4) with the grand mean value of 62.7 cm^2. A relatively higher value of leaf area was recorded in this study than early report summarized as an average value of 36.67 cm^2 by Singh and Abhilsh [26] and maximum and minimum values of 52.4 and 47.9 cm^2 reported by Dhangada *et al.* [13]. It is generally recognized that leafiness is one of the good indicators of forage quality as it positively correlated with quality in terms of nutrient content, digestibility, and animal performance.

3.3. Number of Leaves per Plant. The number of leaves per plant for the different accessions was significantly different in all the locations ($p < 0.01$) (Table 6). It ranged between 37.8–92.0, 50.3–84.0, and 18.1–63.4 with the mean values of 48.1, 61.3, and 44.4 for Tepi, Bechi, and Kite locations,

Table 6: Number of leaves per plant of lablab accessions at forage harvesting stage of 50% flowering at Tepi, Bechi, and Kite testing sites.

Lablab accessions	Number of leaves per plant			Mean
	Tepi	Bechi	Kite	
11615	32.3^{h}	62.3^{c}	47.2^{ab}	47.3^{def}
14459	51.3^{cd}	52.0^{d}	41.8^{ab}	48.4^{de}
6528	43.3^{efg}	55.0^{d}	36.6^{b}	45.6^{ef}
11612	39.7^{fgh}	84.0^{a}	43.4^{ab}	55.7^{b}
14417	61.0^{ab}	72.6^{b}	56.3^{a}	63.3^{a}
11613	55.0^{bc}	63.0^{c}	49.7^{ab}	55.9^{b}
14425	65.0^{a}	56.3^{cd}	44.5^{ab}	55.3^{bc}
10953	40.3^{fg}	55.1^{cd}	51.6^{ab}	49.0^{cde}
14435	50.3^{cde}	53.1^{d}	55.7^{a}	53.0^{bcd}
11619	37.8^{gh}	50.3^{d}	44.1^{ab}	44.1^{ef}
14445	49.5^{cde}	78.3^{ab}	49.3^{ab}	59.1^{ab}
11614	53.0^{cd}	52.1^{d}	18.1^{c}	41.1^{f}
Gebisa	46.4^{def}	62.4^{c}	36.7^{b}	56.0^{cd}
Mean	48.1	61.3	44.4	51.3
LSD	7.9	8.9	16.1	6.5
CV (%)	9.8	8.6	21.6	13.4
p Value	**	***	**	***

Means followed by different letters within a column are significantly different ($p \leq 0.05$). ** and *** are significant at 1% and 0.1%, respectively.

Table 7: Dry matter forage yield (t ha^{-1}) of *lablab accessions* at Tepi, Bechi, and Kite testing sites.

Lablab accessions	Dry matter yield (t ha^{-1})			Mean
	Tepi	Bechi	Kite	
11615	10.1^{bc}	8.2^{bcde}	2.1^{ef}	6.8^{cde}
14459	9.5^{bcd}	10.5^{ab}	2.3^{def}	7.5^{bc}
6528	11.2^{ab}	10.7^{ab}	1.6^{gf}	7.8^{bc}
11612	10.8^{ab}	8.4^{bcd}	3.2^{bcd}	7.4^{bc}
14417	10.7^{ab}	7.4^{bcde}	2.3^{def}	6.8^{cde}
11613	14.2^{a}	12.6^{a}	4.0^{a}	10.3^{a}
14425	9.9^{bc}	9.5^{abc}	1.7^{gf}	7.0^{bcd}
10953	12.8^{ab}	10.1^{abc}	3.2^{abc}	8.7^{ab}
14435	7.1^{cd}	5.7^{de}	3.6^{ab}	5.5^{de}
11619	9.6^{bcd}	9.3^{abcd}	2.7^{cde}	7.2^{bc}
14445	10.8^{ab}	8.7^{bcd}	3.4^{abc}	7.6^{bc}
11614	9.8^{bc}	4.7^{e}	1.2^{g}	5.2^{e}
Gebisa	6.1^{d}	6.8^{cde}	3.3^{abc}	5.4^{de}
Mean	10.2	8.7	2.6	7.2
LSD	3.5	3.7	0.8	1.7
CV (%)	20.6	25.4	17.5	24.8
p Value	**	**	***	***

Means followed by different letters within a column are significantly different ($p \leq 0.05$). ** and *** are significant at 1% and 0.1%, respectively.

respectively. The lowest mean values of number of leaves per plant were recorded at Kite. This might be due to the relatively acidic properties of the soil compared with others (Table 3). Normally under wet and warmer weather conditions, the plants gain high vegetative growth and produce more leaves [14]. Among the accessions, the highest mean number of leaves per plant was recorded for T7 (65.0) followed by T5 (61.0) at Tepi, while at the Bechi test site, T4 (84.0), followed by T11 (78.3), was the highest and T5 (56.3) and T9 (55.7) were the highest at Kite.

This study agreed with the previous report by Hidosa *et al.* [25] in which the number of leaves per plant ranges from 17.0 to 127.4. However, Adem *et al.* [27] recorded the highest value ranging from 119.6 to 150.3 leaves per plant. These might be the variation in soil characteristics, weather conditions during cropping season, and genetics of the crop in lablab variety.

3.4. Dry Matter Yield. Forage dry matter productivity of accessions was found different ($p < 0.001$) across all the locations (Table 7), and this was caused by variation in fresh biomass yield at the field (Figure 2). The values varied between 6.1–14.2, 4.2–12.6, and 1.2–4.0 DM t/ha^{-1} with the mean value of 10.2, 8.7, and 2.6 at Tepi, Bechi, and Kite, respectively. Locations have also shown a difference ($p < 0.01$) in dry matter productivity where average forage yield was highest at Tepi and lowest at Kite like that of leaf area, and number of leaves per plant showed variation across location. This might be due to the differences in soil nutrient composition where it was acidic and poor at Kite, especially in terms of P, Ca, Mg, and K contents (Table 3). Plant growth and yield are also varied with weather; under wet and warm weather conditions, the plant normally gain high vegetative parts producing more leaves and accumulating higher dry matter yield [14]. The dry matter yield of lablab observed in this study was within the range of values 1.8–12.9 DM t/ha^{-1} reported by Mihailovic *et al.* [28]. However, lower dry matter yields 6.8 and 6.0 t/ha^{-1} for Lablab purpureus and intoritum, respectively, in South Omo Zone, SNNP region of Ethiopia reported by Hidosa et al. (2016) than the overall average of this finding [29].

The highest forage dry matter yield of 14.2 was recorded at Tepi for T6 (11613) followed by T8 and T3 with the mean value of 12.8 and 11.2 t/ha^{-1}, respectively, at Tepi, while the lowest yield of 6.1 t/ha^{-1} was obtained from the control (Gebisa). At Bechi, T6 (12.58 t/ha^{-1}), T3 (10.7 t/ha^{-1}), and T2 (10.5 t/ha) were the highest forage yielders and the lowest yield of 4.7 t/ha was obtained from T12. On the other hand, the highest forage at Kite, which was 4.0 DM t/ha^{-1}, was produced from T6 and the lowest (1.2 t/ha^{-1}) was produced from T12. The dry matter forage yield obtained in this study was found within the range of dry matter yields and was reported [28]. In addition, medium-level yield of 2.4 to 7.1 t/ha^{-1} reported by [30,31] might be due to variations in genotype and other related factors. The present study that obtained an inline value of dry matter yield with the previous report [32] was recorded with the highest yield of 10.2 t/ha Ogedegbe *et al.* [33] reported that dry matter yield in warm season legumes was largely dependent on rainfall.

3.5. Number of Seeds per Pod. The number of seeds per pod among the tested accessions was significantly different ($p < 0.05$) at Kite location but not Tepi and Bechi (Table 8). The average number of seeds per pod was 3, 3.4, and 3.6 at Tepi, Bechi, and Kite, respectively. Among the accessions, T7 produced the highest number of seeds per pod across all the locations. A wide range of number of seeds per pod (2.1–5.7) is reported by Muir *et al.* [34], which is more number

(a) (b) (c)

Figure 2: Field photograph illustrations to Tepi (a), Bechi, (b) and Kite (c) testing sites.

Table 8: Average number of seeds per pod of different accessions of *Lablab purpureus* at Tepi, Bechi, and Kite testing sites.

Lablab accessions	Average number of seeds per pod			Mean
	Tepi	Bechi	Kite	
11615	2.7	3.1	3.9[ab]	3.2[bcd]
14459	3.4	3.6	3.6[abc]	3.5[ab]
6528	2.8	3.2	3.2[cd]	3.0[cd]
11612	2.9	3.4	3.8[ab]	3.4[bcd]
14417	3.4	3.1	4.0[ab]	3.5[ab]
11613	3.1	3.5	3.9[ab]	3.5[ab]
14425	3.4	4.0	4.1[a]	3.9[a]
10953	3.2	3.5	3.7[ab]	3.5[abc]
14435	2.6	3.5	3.7[ab]	3.3[bcd]
11619	3.4	2.9	3.5[abc]	3.3[bcd]
14445	2.7	3.2	3.5[abc]	3.1[bcd]
11614	3.2	3.4	2.5[d]	3.0[d]
Gebisa	2.9	3.1	3.4[bc]	3.1[bcd]
Mean	3.0	3.4	3.6	3.4
LSD	1.0	0.7	0.04	0.4
CV (%)	19.8	12.6	7.3	14.2
p Value	NS	NS	*	*

Means followed by different letters within a column are significantly different ($p \leq 0.05$). * and NS are significant level at 5% and nonsignificant, respectively.

recorded, and this might be the variations in agroecology and the genotypes. On the other hand, this study resulted in the lower number of seeds per pod compared with results reported by Peer *et al.* [35] with the range of 3.4–5.3 and the mean value of 3.9 in India. The current result of number of seeds per pod from all lablab accessions and locations was under the range of the findings of this report.

3.6. Disease Severity Index. Lablab leaf spot was detected and observed in the tested sites (Figure 3). The recorded disease severity index revealed that accessions differed

Figure 3: Lablab diseased leaf photograph during field observation.

significantly ($p < 0.001$) between the three locations (Table 9).

The average recorded value, as a percentage of the disease severity index, was 3.1, 2.9, and 2.9 in Tepi, Bechi, and Kite, respectively. At Tepi, T12 (11614) was severely observed followed by T2, T10, and T11. However, T5, T10, T11, and T12 were severely observed for the Bechi site, while at Kite T5 and T10 and monitoring were heavily affected. Lablab accessions that were tolerant of leaf rust in the study area were T3, T4, T6, T7, T9, T1, and T8 in all three sites. In this study, lablab accessions are relatively more tolerant to disease than Hidosa *et al.* [25] who reported 6.5–13.6 disease severity index. According to Kankwatsa [14], there were lablab accessions that displayed higher disease resistance levels in Uganda. The damage to legume by disease is well known, and increased precipitation may create favorable

Table 9: Disease severity index of different accessions of *Lablab purpureus* at Tepi, Bechi, and Kite testing sites.

Lablab accessions	Disease severity index (%)			Mean
	Tepi	Bechi	Kite	
11615	2.9^{bcdef}	2.2^{c}	2.2^{b}	2.4^{cd}
14459	3.9^{abc}	2.2^{c}	2.3^{b}	2.8^{c}
6528	2.2^{ef}	2.1^{c}	2.3^{b}	2.2^{d}
11612	2.0^{f}	2.2^{c}	2.2^{b}	2.1^{d}
14417	3.4^{bcde}	4.3^{a}	2.9^{a}	2.8^{b}
11613	2.0^{f}	2.3^{c}	2.2^{b}	2.2^{d}
14425	1.9^{f}	2.1^{c}	2.3^{b}	2.1^{d}
10953	2.8^{cdef}	2.3^{c}	2.2^{b}	2.4^{cd}
14435	2.3^{def}	2.1^{c}	2.3^{b}	2.2^{d}
11619	4.0^{abc}	4.2^{a}	4.2^{a}	4.1^{ab}
14445	4.1^{ab}	4.2^{a}	3.8^{a}	4.0^{ab}
11614	5.0^{a}	4.2^{a}	4.2^{a}	4.5^{a}
Gebisa	3.5^{bcd}	3.5^{b}	4.2^{a}	3.7^{b}
Mean	3.1	2.9	2.9	3
LSD	1.3	0.3	0.47	0.46
CV (%)	25	6.7	9.48	16.28
p Value	***	***	***	***

Means followed by different letters within a column are significantly different ($p \leq 0.05$). *** Significant at 0.1%.

environment for disease, thus negatively affecting the biomass production [25].

3.7. Genotype and Environment Interaction Effect on Agronomic Traits of Lablab purpureus. The error mean squares over all locations were homogenous for most of the studied traits indicating that selecting these locations might not be based on performance evaluation of the variety. Therefore, the combined analysis was also performed in this study (Table 10).

The combined analysis of variance (ANOVA) showed that accessions were significantly different for most agronomic traits due to the effect of location (L), genotype (*G*), and their interaction (G*L) effects. However, plant height, number of branches per plant, and leaf-to-stem ratio did not show variation (p>0.05) at accession level (Table 10). These would be likely indicated that the studied varieties were good materials for future breeding and varietal development research activities. The finding of [36,37] indicated that environments, genotype, and their interaction effects displayed significant variations for plant height. Where there is high variation of the testing environments, it may be expected that the genotype and environment interactions will also be high. In line with this, Tulu *et al.* [30] reported significance variation due to location, variety, and the interaction effect on seed productivity. The seed yield and hundred seed weight in this study showed significant variation ($p < 0.05$) due to the effects of location and accession and their interactions. The present study was in agreement with Kebede et al. [37] (2014) and a significant variation was observed among location, accessions and interaction effect for hundred seed weight and seed yield in the evaluation of vetch and their accessions for their agronomic and nutritive value performances.

Table 10: Mean squares of agronomic traits from combined analysis of variance for *lablab purpureus* varieties at Tepi, Bechi, and Kite locations

Traits	Mean square (MS)			
	L (df = 2)	G (df = 12)	L*G (df = 24)	Error (df = 72)
Germination percentage	239.4*	437.1***	117.6**	58.3
Plant height	1.4***	0.01ns	0.01**	0.003
Number of branches per plant	0.1***	0.01ns	0.01**	0.01
Leaf-to-stem ratio	1.8***	0.1ns	0.1*	0.1
Disease incidence	9.3*	305.7***	33.6***	2.9
Number of pod per plant	0.8***	0.04***	0.02***	0.003
Days to seed harvest	13734.5***	603.6***	323.6*	169.2
Hundred seed weight	184.6***	27.5***	12.4***	2.24
Seed yield	177364.6***	149383.0***	56673.6***	9920

L = location, G = genotype, L*G = location interaction with genotype. *, **, ***, and. ns = significant level at 5%, 1%, 0.1%, and nonsignificant, respectively.

Table 11: Mean performance of different agronomic traits of *Lablab purpureus* at Tepi, Bechi, and Kite testing sites.

Agronomic traits	Location			Mean	CV (%)	LSD	P Value
	Tepi	Bechi	Kite				
GP	80.3^{b}	82.3^{ab}	85.2^{a}	82.6	9.3	3.5	***
PH	223.5^{a}	225.1^{a}	114.9^{b}	187.8	15.7	13.3	***
NBPP	6.0^{a}	5.7^{a}	4.9^{b}	5.5	19.3	0.5	**
LSR	1.4^{b}	1.7^{a}	1.3^{b}	1.5	15.0	0.1	
DI	7.6^{a}	7.2^{ab}	6.7^{b}	7.2	24.0	0.8	***
DSH	157.2^{a}	122.5^{c}	138.9^{b}	139.5	10.6	6.7	***
NPPP	23.0^{c}	27.2^{b}	30.7^{a}	27.0	13.6	1.7	***
HSW	19.0^{c}	21.2^{b}	23.4^{a}	21.2	7.2	0.7	***
SY	684.1^{a}	550.7^{c}	635.0^{b}	623.2	15.9	45.0	***

Means followed by different letters within a row are significantly different ($p \leq 0.05$). ** and *** are significant level at 1% and 0.1%, respectively. GP = germination percentage after a month of sowing date, PH = plant height at forage harvest, NBPP=number of branches per plant, LSR = leaf-to-stem ratio, DI = disease incidence (%), DSH = days to seed harvest, NPPP=number of pod per plant, HSW=hundred seed weight (g), SY=seed yield (kg ha^{-1}).

3.8. Combined Mean Performance of Lablab purpureus. Highly significant (p<0.001) differences were observed for the most agronomic traits, while branch number per plant and leaf-to-stem ratio showed significant variation at ($p < 0.01$) across the three locations (Table 11). Lablab accessions differed significantly in the agronomic characteristics across location [14].

The mean value of germination percentage (GP) across location scored 80.3, 82.9, and 85.2 at Tepi, Bechi, and Kite sites, respectively, with the overall mean value of 82.6. This showed that at Kite location recorded higher value of GP followed by Bechi location (Table 9). These showed higher

Table 12: Mean values of agronomic traits of lablab accessions combined over locations.

Lablab accessions	Agronomic traits								
	GP (%)	PH (cm)	NBPP	LSR	DI (%)	DSH	NPPP	HSW(g)	SY (Kg ha^{-1})
11615	81.1^{bc}	195.7^{ab}	5.6^{ab}	1.4^{cd}	2.8^{d}	129.7^{c}	23.9^{ef}	22.1^{c}	522.8^{e}
14459	81.8^{bc}	203.1^{ab}	5.2^{b}	1.5^{bc}	8.2^{c}	141.4^{bc}	26.1^{de}	21.5^{cd}	569.3^{cde}
6528	91.5^{a}	214.5^{a}	6.2^{a}	1.4^{cd}	2.1^{d}	144.6^{bc}	26.0^{def}	22.3^{abc}	504.5^{e}
11612	78.1^{c}	183.1^{b}	5.2^{ab}	1.4^{cd}	2.6^{d}	129.2^{c}	22.6^{fg}	20.1^{de}	593.9^{cde}
14417	86.8^{ab}	197.1^{ab}	5.2^{b}	1.7^{a}	8.8^{c}	128.6^{c}	32.1^{ab}	22.3^{abc}	768.3^{b}
11613	81.5^{bc}	193.7^{ab}	6.0^{ab}	1.7^{a}	2.2^{d}	137.2^{bc}	32.3^{a}	23.5^{ab}	871.6^{a}
14425	78.7^{c}	183.4^{b}	6.1^{ab}	1.5^{bc}	2.1^{d}	130.8^{bc}	28.2^{cd}	19.2^{ef}	534.4^{de}
10953	80.7^{bc}	210.1^{ab}	5.9^{ab}	1.4^{cd}	2.7^{d}	136.4^{bc}	30.7^{abc}	23.6^{a}	856.1^{ab}
14435	64.9^{d}	191.2^{ab}	5.5^{ab}	1.4^{cd}	2.1^{d}	156.8^{a}	19.9^{g}	18.2^{f}	500.7^{e}
11619	83.4^{bc}	190.2^{ab}	5.2^{b}	1.5^{c}	15.9^{a}	139.8^{bc}	28.5^{cd}	19.6^{e}	620.5^{cd}
14445	86.4^{ab}	206.2^{ab}	5.8^{ab}	1.5^{abc}	14.4^{ab}	157.2^{a}	24.6^{ef}	22.0^{c}	652.9^{c}
11614	91.7^{a}	121.7^{d}	4.1^{c}	1.2^{d}	15.9^{a}	140.7^{bc}	26.9^{de}	19.2^{ef}	534.3^{de}
Gebisa	87.4^{ab}	151.0^{c}	5.7^{ab}	1.4^{cd}	13.1^{b}	141.2^{bc}	28.6^{bcd}	22.1^{bc}	572.6^{cde}
Mean	82.6	187.8	5.5	1.5	7.15	139.5	26.9	21.2	623.2
LSD	7.2	27.8	1	0.2	1.6	13.9	3.5	1.4	93.6
R^2	0.68	0.87	0.62	0.67	0.96	0.73	0.81	0.86	0.84

Means followed by different letters within a column are significantly different ($p \leq 0.05$); GP = germination percentage, PH = plant height at forage harvest (cm), NBPP= number of branches per plant, LSR = leaf-to-stem ratio, DI = disease incidence, DSH = days to seed harvest, NPPP=number of pod per plant, HSW=hundred seed weight (g), SY=seed yield (kg ha^{-1}).

value of germination percentage than the previous study where the average germination percentage is 71.6, 73.2, and 70.5 in the first-, second-, and third-year records for the same varieties, respectively [14]

The plant height recorded higher value for Tepi and Bechi but lower value for Kite location (Table 9). This might be the difference in soil chemical composition that showed lower value of P, Ca, Mg, and pH (5.1) at Kite location and might be sandy and silt texture class of the soil at Kite location. It showed slightly acidic soil at Kite than the remaining two locations (Table 12) and other weather conditions might be causing to effect variations in plant height. Plant growth and height varied greatly with weather, agreeing that under wet and cool weather conditions, the plants normally gain high vegetative parts producing more leaves through increasing plant height [14]. This study obtained the mean value of plant height that ranged in the previous study recorded by [18], and the longest plant height of lablab accessions at fifty percent flowering date was 206.60 cm, whereas the shortest plant height recorded 17.90 cm. The study also recorded higher value for plant height than data ranged from 38.0 to 86.3 cm with the mean value of 63.81 cm in lablab genotype [38], however lower than reported by [35] that ranged 169.0–565.9 with the mean value of 355.6 cm on selected lablab bean.

High seed or grain yield (684.1 kg/ha^{-1}) was obtained at Tepi location followed by Kite (635.0 kg/ha^{-1}). Unlike the dry matter yield, seed yield at Kite was relatively good, but seed yield at Bechi is the lowest. However, Kebede *et al.* [39] reported the highest lablab grain yields as high as 1271 kg/ha^{-1}. Most forage crops are selected for their forage yield rather than their grain or seed yields. However, higher seed productivity could be an additional advantage for easy access of planting materials, and in many cases, grains could provide dual purposes and serve as food for human beings and animals too. The main product of forage crop is the herbage and not given priority for seed yield.

The average number of branches per plant for the different lablab accessions at Tepi and Bechi was 6 and 5.7, respectively (Table 11). The lowest value of 1.7 was reported by [38]. However, higher number of primary branches per plant was reported by [35] ranging from 4.2 to 21.2 with a mean value of 11.1 cm for selected lablab varieties. This might be due to the effect of differences in geographical location, date of sowing, soil type, and performances of lablab varieties.

The highest average leaf-to-stem ratio of the tested lablab accessions of 1.7 was obtained at Kite, which allows increasing forage quality. The present finding is in line with values liberated in [40], which are 1.4 with a range of 0.76–2.55. Leaf-to-stem ratios are important in evaluating legumes that leaf fraction of legumes has a better nutritional quality in comparison with the more fibrous stems. This is coupled with the fact that cattle select for the highly nutritious leaf fraction [41]. Therefore, leaf-to-stem ratio is a simple indicator of good quality forage. Generally, higher leaf-to-stem ratio indicates the better the quality of forage.

Leaf rust (Cercospora dolichi) of *Lablab purpureus* was the major disease observed in the tested locations (Figure 3). The disease incidence percentage was relatively pronounced at Tepi followed by Bechi, and this may be the favorable conditions for infestation of disease such as environmental conditions and soil properties. Even though several diseases have been associated with lablab, only a few cause serious losses. Naturally, in several areas of the world, lablab is virtually free of diseases [42].

Days to seed harvest for the different accessions of lablab at the different locations followed the trend of days to fifty percent flowering. Long days to seed harvest were recorded at Tepi (157.2 days) followed by Kite (138.9 days). In this study, the accessions were early maturing compared with the report of [35], which ranged between 154 and 270 days with the mean value of 199 days in Tanzania on selected lablab varieties.

Figure 4: Lablab grain photograph during data collection.

Table 13: Pearson's correlation coefficient between agronomic traits of *Lablab purpureus* in Tepi, Bechi, and Kite testing sites.

Traits	GP	FD	PH	NBPP	NLPP	LA	LSR	DMY	NPPP	NSPP	DSH	HSW
FD	-0.18^{*}											
PH	-0.14^{ns}	0.26^{**}										
NBPP	-0.11^{ns}	0.18^{*}	0.32^{***}									
NLPP	-0.22^{*}	0.08^{ns}	0.39^{***}	0.14^{ns}								
LA	-0.10^{ns}	0.12^{ns}	0.79^{***}	0.27^{**}	0.32^{***}							
LSR	-0.02^{ns}	-0.25^{**}	0.30^{***}	0.01ns	0.22^{*}	0.37^{***}						
DMY	-0.18^{*}	0.24^{**}	0.74^{***}	0.39^{***}	0.32^{***}	0.71^{***}	0.27^{**}					
NPPP	0.15^{ns}	-0.16^{ns}	-0.32^{***}	-0.14^{ns}	-0.08^{ns}	-0.22^{*}	0.02^{ns}	-0.29^{*}				
NSPP	0.08^{ns}	-0.35^{***}	-0.46^{***}	-0.21^{*}	-0.26^{**}	-0.35^{***}	0.02^{ns}	-0.40^{***}	0.36^{***}			
DSH	-0.18^{ns}	0.87^{***}	0.14^{ns}	0.17^{ns}	-0.02^{ns}	0.05^{ns}	-0.33^{***}	0.13^{ns}	-0.08^{ns}	-0.26^{**}		
HSW	0.18^{*}	-0.23^{*}	-0.39^{***}	-0.09^{ns}	-0.04^{ns}	-0.38^{***}	0.02^{ns}	-0.29^{**}	0.35^{***}	0.28^{**}	-0.27^{**}	
SY	0.04^{ns}	0.16^{ns}	-0.02^{ns}	0.08^{ns}	-0.09^{ns}	0.09^{ns}	-0.09^{ns}	0.33^{***}	0.09^{ns}	0.06^{ns}	0.17^{ns}	0.28^{**}

*, **, ***, and ^{ns} are significant levels at 5%, 1%, 0.1%, and nonsignificant, respectively. GP = germination percentage after a month of sowing date, FD = days to 50% flowering date, PH=plant height, NLPP=number of leaves per plant, NBPP=number of branches per plant, LA = leaf area, LSR = leaf-to-steam ratio, DMY = dry matter yield, DSH = days to seed harvest, NPPP=number of pods per plant, NSPP= number of seeds per pod, SY= seed yield.

Number of pods per plant and hundred seed weight obtained were higher at Kite location followed by Bechi and lower at Tepi (Table 11). Hundred seed weight (Figure 4 and Table 11) in this study was comparable with the weights reported by Patil [43], which ranges from 16.1 to 37.9 gram with a mean value of 24.8. However, [35] reported higher value of hundred seed weight, which ranges from 21.2to 50 with the mean value of 36 g for selected lablab varieties.

3.9. Combined Mean Performance of Agronomic Traits of Lablab Genotypes. Agronomic and morphological performance of the tested lablab accessions combined over the locations is presented in Table 12. Average field germination percentage on the 30th day after planting of the accessions was significantly different (P<0.05), where the highest percentage was observed from T12 (91.7%) and T3 (91.5%) and the mean value was 82.6% (Table 12). These accessions, T12 (221 cm) and T3 (214 cm), were also the highest in terms of average plant height at forage harvesting stage across the locations. This study recorded slightly lower value of plant height than previous report by [25] with the mean value of 216 cm for *lablab purpureus*.

Accessions are significantly different in their branching characteristics in which T3 (6.2), T7 (6.1), and T6 (6.0) showed the highest average number of primary branches per plant over the locations. On the other hand, leaf-to-stem ratio of accessions over the location was higher for T6, T5, and T11 (Table 12). Those varieties with high leaf-to-stem ratio are normally preferred characters to use as a forage crop.

In the assessment of disease incidence of the different accessions, during the experimental period leaf rust (Cercospora dolichi) was the only disease observed and incidence was highest for T10, T12, and T11 across all the locations (Figure 4).

Lablab seed could sometimes use as grain for human consumption in other countries, but the use of the grain as livestock feed is not common. Therefore, threats related to seed productivity such as number of pods per plant, hundred seed weight, and seed productivity should be considered from this perspective. In this study, seed-related traits of accessions are significantly different (Table 12).

Similar studies in Uganda by [14] reported variations of accessions and the number of pods per plant was higher than that in this study. In this study, average seed yield over the locations was highest for T6 (871.6 k/ha^{-1}) followed by T8 (856.1 kg/ha^{-1}).

3.10. Relationship between Agronomic Traits. The linear correlation coefficients between recorded agronomic characters are shown in Table 13. Seed yield was weak and positively correlated with forage dry matter yield at 0.33 and hundred seed weight (0.28). The present finding was in line with [44] in which seed yield was positively correlated with hundred seed weight, number of branches per plant, and number of seeds per pod in *Lablab purpureus* genotypes.

Plant height at harvest was strongly and positively associated with forage dry matter yield (0.74) and leaf area (0.79) but weakly correlated with number of branches per plant (0.32), leaf-to-stem ratio (0.30), number of leaves per plant (0.39), and days to forage harvesting (0.26), however negatively and significantly associated with number of pod per plant (−0.32), number of seeds per pod (−0.46), and hundred seed weight (−0.39). Plant height was negatively and nonsignificantly associated with germination percentage (−0.14) and seed yield (−0.02). This is in agreement with Kebede *et al.* [23] where plant height at forage harvest showed strong positive significant correlation with dry matter yield, whereas that showed negative and significant correlation with thousand seed weight and seed yield in vetch species and their accessions. Feyissa *et al.* [45] also reported that days to maturity of forage correlated positively with plant height and herbage yield but negatively correlated with seed yield and thousand seed weight in oat varieties. Dry matter yield was weak and positively associated with days to forage harvest (0.24) and leaf-to-stem ratio (0.27).

4. Conclusion and Recommendation

This study revealed that all lablab genotypes were adapted and performed well for all the three low land locations, without adverse effect for growth and disease problems. Stockholders in the area could produce lablab genotypes by considering the location and genotype for the dry matter and seed yield production. The better lablab genotypes were identified in this study that would improve the livestock feed problems in the area. The study concludes that lablab showed average forage dry matter yield of genotypes, which were highest for accession 11613, acc.10953,acc.14417, and acc.11612 with 90.4%, 61.1%, 25.9%, and 37.0% yield advantage over the control Gebisa, respectively, and in terms of seed yield, these accessions, respectively, scored 52.2%, 49.5%, 34.2%, and 3.7% higher when compared to the control Gebisa.

This in the final analysis leads to recommending one or two best lablab accessions to be recommended or registered for the Tepi area and other similar agro-ecologies. In the wider use of the lablab, further evaluation of the recommended one or two varieties in terms of animal performance, refining the main agronomic practice like the right time of sowing, the right application rate of fertilizer, harvesting time, identifying best food crop-lablab integration methods, conservation practices, and feeding strategies are vital to address in the future.

Data Availability

The datasets used during this study are available from the author on reasonable request.

Conflicts of Interest

The authors declare there are no conflicts of interest.

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