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Adaptability Evaluation of Cowpea (*Vigna unguiculata*) and Lablab (*Lablab purpureus*) Forage Crops at Farmers Conditions in Dire Dawa and Harari, Eastern Ethiopia

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Abstract: The experiment were conducted at Fedis Agricultural Research Center by supported to AGP-II program in 2017 and 2018 consecutive years on-farm in Harari regional state (Qile PA) and Dire Dawa (Adada PA) with three cowpea [V. unguiculata (Local. check), (9334) and (9333)] and three lablab (Gebis-17, Beresa-55 and Local check) selected varieties that introduced from Bako Agricultural Research Center and obtained from farmers as local checks which were laid out in a randomized complete block design with three replications based on the objective of selected and recommended high quantity yielding and adaptable varieties to the area and the same agro-ecologies. The analyzed result showed in Table 1 aboveground dry biomass and grain yields of cowpea were a significant different ($p < 0.05$) over locations among varieties. The highest aboveground dry biomass of cowpea-9334 (4.67 t ha^{-1}) followed by cowpea-9333 (4.00 t ha^{-1}) at Harari (kile PA) and the minimum was obtained from Local check (2.52 t ha^{-1}) at Dire Dawa (Adada PA) and statistically significant difference ($p < 0.05$) among varieties of lablab dry matter yield at Harari (Qile PA) and at Dire Dawa (Adada PA) over locations. The highest dry matter of 15.44 t ha^{-1}, 9.74 t ha^{-1} which was obtained from variety lablab Beresa-55 at Harari and Dire Dawa respectively. It was concluded that the cowpea-9334 and lablab Beresa-55 were found promising to be demonstrated under in the study areas and same agro-climatic conditions with the study area.

Keywords: Cowpea, *Dolichos lablab*, Forage Crops, Forage Legumes

1. Introduction

In many developing countries, livestock play an important role in most small-scale farming systems. They provide traction to cultivate fields, manure to maintain crop productivity, and nutritious food products for human consumption and income-generation [9]. For instance, livestock production is an important component of the Ethiopian economy with an overall contribution of about 20% to the gross domestic product (GDP) and 40% to the gross value of annual agricultural output.

Agriculture dominates the economies of developing countries and in these countries; the livestock sector is the fastest growing agricultural sector (3.77% for livestock *vs.* 2.71% for crops in last decade). By 2020, consumers in developing countries will eat 87% more meat and 75% more milk than they do today making livestock production the largest share of the value of global agricultural output [4] Animal feeding systems in Ethiopia are mainly based on grazed native pastures, which are deteriorating in production and quality, which vary seasonally resulting in poor animal performance. Despite the importance of livestock, inadequate livestock nutrition is a common problem in the developing world, and a major factor affecting the development of viable livestock industries in poor countries [9].

Ethiopian has a large livestock population and diverse agro-ecological zones suitable for livestock production and for growing diverse types of food and fodder crops. However, livestock production has mostly been subsistence-oriented and characterized by very low reproductive and production performance due to primarily shortages of quality and quantity of animal feed [8], due to land degradation, land shortage and poor soil fertility [13] and due to rapidly increasing human population pressure, cropping is expanding and grazing areas are shrinking [1].

Legumes are the most important forage plants that substantially improve the feed available for livestock as they can provide the essential protein for animals, improving soil fertility food crop production and household nutrition through a more reliable supply of milk and meat [2].

Grain legumes provide food, feed, and facilitate soil nutrient management. Herbaceous and tree legumes can restore soil fertility and prevent land degradation while improving crop and livestock productivity on a more sustainable basis. Thus the adoption of such dual-purpose legumes, which enhance agricultural productivity while conserving the natural resource base, may be instrumental for achieving income and food security, and for reversing land degradation. In particular the integration of legumes into cereal-based systems can provide services such as high quantity and quality fodder production, soil erosion prevention, and soil fertility restoration. Enhanced availability of livestock feed can reduce degradation of grazing lands. The demand for forage and the opportunities for diffusion of forage technology may be high where livestock response to improved feed technology and profitability from livestock enterprise is high. Farmers are responsive to the amounts of economic incentives provided by the new technology [10].

Cowpea (*Vigna unguiculata*) is a leguminous forage crop. This could be grown in relatively infertile sandy soils. It is a fast growing, drought resistant crop, which also improves soil fertility by fixing atmospheric nitrogen. Cowpea forage is usually superior to other forage legumes in terms of both quantity and quality. Cowpea crop is grown as a green manure and a cover crop to increase soil fertility, retain moisture and reduce soil erosion [6]. Cowpea (*Vigna unguiculata*) is among the most widely used legumes in the tropical world. They can incorporate into cereal cropping system to address soil fertility decline and cereals to provision of better legume/Stover to cereal [3], and there is a big market for the sale of cowpea grain and fodder in West Africa. A farmer who cut and store cowpea fodder for sale at the peak of the dry season Cowpea can be grown under rain fed conditions as well as by using irrigation or residual moisture along river or lake flood plains during the dry season, provided that the range of minimum and maximum temperatures is between 28 and 30°C (night and day) during the growing season. Cowpea performs well in agro ecological zones where the rainfall range is between 500 and 1200 mm/year [7]. Percentage dry matter, crude protein, neutral detergent fiber, in vitro dry organic matter digestibility of cowpea were in the range of 89.2- 89.9%, 14.7 - 15.6%, 56.3 - 60.7% and 55.1 - 60.2%, on a dry weight basis respectively [11].

Lablab (*Lablab purpureus*) is an herbaceous, climbing, and warm season annual or short-lived perennial with a vigorous taproot. It has a thick, herbaceous stem that can grow up to 3 feet, and the climbing vines stretching up to 25 ft from plant [14].

Objective: To select and recommend high quality and quantity yielding and adaptable legumes (cowpea & lablab) varieties.

2. Materials and Methods

2.1. Description of the Study Area

The study were done on farm at Harari Regional state and Dire Dawa administration town which are far from 518 km and 510 km Addis Ababa respectively which is 1500 m.a.s.l and annual rainfall 650- 900 mm.

Layout system is randomized complete block design (RCBD) three replication. The plot size is 3x2 m^2 was used three (3) varieties of cowpea and three (3) varieties of lablab.

A seed rate of 30 kg/ha was used by keeping 40 cm row-to-row spacing and 20 cm between plants. Fertilizer NPS (19% N, 38% P_2O_5 and 7% S) and Urea (46% N) each at the rate of 100 kg ha^{-1}. NPS during planting and Urea after plants emerged 2-3 leaves were used.

2.2. Data Collection and Measurement

Days of emergency, it was recorded as the number of days from the date of Sown to when 50% of plants in a plot to emerged.

Days of 50% flowering, it was recorded as the number of days from the date of emergence to when 50% of plants in a plot produced a flower.

Plant Height, was measured from the middle rows on five randomly taken plants at the flowering stage from the ground to the tip of the plant using 5 m tape.

Pod per plant, five randomly taken plants from the sampling area was used for the determination of a number of pods per plant.

Seed per pod, was counted from ten randomly taken pods per plant from ten plants per plot at harvesting.

Green fodder yield, it was measured from one row randomly selected from net rows of the plot at 50% flowering stage as soon cutting, then converted to per hectare based; by using the sensitive balance.

Dry biomass yield, dry matter production (t ha^{-1}) was calculated as: - (10 x TotFWx (DWss/ HA x FWss)) [12]. Where: TotFW = total fresh weight from a plot in kg, DWss = dry weight of the sample in grams, FWss = fresh weight of the sample in grams, HA = Harvest area meter square and, 10 = is a constant for conversion of yields in kg m^2 to t ha^{-1}.

Grain yield per hectare (kg): it was determined after threshing the seeds harvested from each net plot. The seed yield was adjusted to 10% moisture level and was converted to kg ha^{-1}.

2.3. Statistical Analysis

Data were analyzed using the Statistical Analysis Software to perform ANOVA (SAS 9.1) in a randomized complete block design. Means of all treatments were calculated and the difference was tested for significance using the least significant difference (LSD) test at $p < 0.05$ [5].

3. Results and Discussions

3.1. Agronomic Data, Yield and Yield Components of Cowpea

Days to Flowering, the result indicated that in table 1; days to flowering obtained from the cowpea varieties sown during the consecutive two years were significant deference ($p < 0.05$) in different location. The late Days to flowering obtained under cowpea-9334 at Harari (Qile PA) (86 days) followed by cowpea 9333 (80.5 days) and the minimum days to flowering obtained by local check (60.67 days) at Dire Dawa (Adada PA).

Days to Maturity, the result showed that a significant deference among tested varieties of cowpea at 5% level of significant. The late matured was obtained under cowpea-9334 (131.5 days) at Harari (Qile PA) followed by cowpea-9333 (125.78 and 125.5 days) at Dire Dawa and Harari respectively whereas the early matured obtained under local check (105.33 days) at Dire Dawa (Adada PA).

Plant heights, the result showed that a significant deference ($p < 0.05$) level of significant among the tasted varieties of cowpea in over location. The maximum plant height recorded under cowpea (9334) 85.95 cm at Harari (Qile PA) and 63.89 cm at Dire Dawa whereas the minimum plant heights obtained by cowpea (9333) 76.72 cm and local check 78.31 cm at Harari, and cowpea (9333) 54.37 cm in Dire Dawa location. Thus, result lined with the latest finding of [15] the plant heights ranges (66.07- 80.13) under intercropping and sole of cowpea with sorghum.

Table 1. *Mean of fresh biomass yield, plant height, dry grain yields obtained from the cowpea varieties sown during the consecutive two years at Harari (Qile PA) and Dire Dawa (Adada PA) in 2017 and 2018.*

Harari (Qile PA)							
Treatments	**PHt (cm)**	**Df 50%**	**Dm**	**FBMY (t/ha)**	**DBMY (t/ha)**	**P/P**	**Gy (Qt/ha)**
L. check	78.31^{b}	75.63^{b}	123.48^{b}	31.95^{b}	3.73^{ab}	22.2^{b}	9.08
Cowpea-9334	85.95^{a}	86^{a}	131.5^{a}	39.48^{a}	4.67^{a}	31.6^{a}	8.83
Cowpea-9333	76.72^{b}	80.5^{ab}	125.5^{ab}	34.62^{b}	4.00^{ab}	26.1^{b}	9.00
Mean	80.32	80.54	126.83	35.35	4.14	26.64	8.97
CV (%)	31.25	9.51	3.18	38.9	32.6	23.74	17.72
LSD (0.05)	6.56	3.78	1.78	4.25	0.65	2.5	NS
Dire Dawa (Adada PA)							
L. check	54.37^{b}	60.67^{b}	105.33^{b}	22.49	2.52^{b}	16.79	8.22
Cowpea-9334	63.89^{a}	66.67^{ab}	114.17^{b}	21.63	3.2^{a}	16.73	8.38
Cowpea 9333	58.36^{ab}	80.33^{a}	125.78^{a}	26.9	3.55^{a}	18.21	9.53
Mean	58.87	74.56	118.43	23.67	3.09	17.24	8.71
CV (%)	22.43	9.51	21.99	23.06	21.45	21.14	20.37
LSD (0.05)	4.23	7.88	13.66	NS	0.31	NS	NS

Means with the same letter in the same column are not significantly ($p<0.05$) different. Df= days to 50% flowering PHt (cm)= plant height, Dm=days to maturity FBMY (t/ha)=fresh biomass yield P/P=no of seed per pod, DBMY (t/ha)= dry biomass yield, s/p=seed per pod, Gy Qt/ha = grain yield Quntal per hectare

Fresh biomass yield, the aboveground fresh biomass yield of cowpea was a significant different ($p < 0.05$) among tasted varieties. The result in Table 1 showed the maximum fresh biomass yield recorded of cowpea-9334 (39.48 t ha^{-1}). The minimum were obtained from cowpea local check (31.95 t ha^{-1}) and cowpea-9333 (34.62 t ha^{-1}). However, at Dire Dawa location had not significant difference ($p > 0.05$) among varieties of cowpea.

The dry biomass yield of cowpea was significantly different ($P < 0.05$) in both locations among cowpea varieties. The highest dry matter yield of 4.67 t ha^{-1}, 4.00 t ha^{-1} which were obtained from varieties cowpea-9334 and cowpea-9333 at Harari (Qile PA) respectively where in Dire Dawa location the maximum biomass yield recorded (3.55 and 3.2) t ha^{-1} from cowpea-9333 and cowpea-9334 respectively.

The grain yield across all the experimental years varied between 6.67 and 12.79 Quintal ha^{-1} with a mean of 8.6 Quintal ha^{-1}, but were not Significant differences ($p > 0.05$) among varieties of cowpea and location.

3.2. Days to Flowering, Maturity and Dry Biomass Yield of Lablab

Days to flowering and days to maturity obtained from the lablab varieties sown during the consecutive two years were presented in Table 2 were found significant ($p < 0.05$) deference in different location at Dire Dawa (Adada PA) for Df 50% and at Harari (Qile PA) but non-significant among planting years for days to maturity and flowering. The late Days flowering obtained under lablab Beresa-55 at Harari (Qile PA) (105 days) flowering and days to maturity (185 days) were lablab Beresa-55 at Harari, at Dire Dawa lablab Beresa-55 (109 days) flowering and days to maturity (171.83 days). The early flowering (85.67 days) and maturity (15583 days) local check) at Adada PA of Dire Dawa location.

Table 2. *Mean of fresh biomass yield, plant height, dry biomass yields obtained from the lablab varieties over location and over years.*

Harari (kile PA)					
Treatments	**Pht (cm)**	**Df (50%)**	**Dm**	**FBY t/ha**	**DBMY (t/ha)**
L. check	181.67[b]	105	185.00[a]	84.38[b]	10.19[c]
Gebis-17	186.67[ab]	102.25	176.67[c]	106.6[a]	12.22[b]
Beresa-55	203.33[a]	105.33	178.33[b]	116.31[a]	15.44[a]
CV (%)	12.56	2.24	0.93	13.82	15.04
LSD (0.05)	20.16	Ns	0.69	10.7	2.04
Dire Dawa (Adada PA)					
L. check	64.06[b]	85.67[b]	155.83[b]	28.25[b]	5.95[b]
Gebis-17	92.10[a]	107.50[a]	170.17[a]	43.34[a]	9.07[ab]
Beresa-55	92.49[a]	109.00[a]	171.83[a]	48.63[a]	9.74[a]
CV (%)	19	3.95	5.35	25.16	26.67
LSD (0.05)	13.11	16.74	6.49	17.74	3.76

Means with the same letter in the same column are not significantly ($p < 0.05$) different FBY=fresh weight biomass yield ton per hectare, DRY=dry biomass yield.

Plant height of lablab was significant ($p < 0.05$) different across location and during cropping consecutive years. The maximum plant heights were recorded from lablab (Beresa-55) (T3) 203.33 cm at Harari region, Qile PA and Gebis-17 (92.10 cm), Beresa-55 92.49 cm at Dire Dawa. The minimum was recorded from Lablab (Local check (181.67 cm) and 64.06 cm at Harari and Dire Dawa locations respectively.

The dry matter herbage yield of lablab was significantly different ($P<0.05$) at Harari (Qile PA) and at Dire Dawa (Adada PA). During the first and second growing years, highest dry matter herbage yield of 15.44 t ha^{-1}, 9.74 t ha^{-1} which was obtained from variety lablab Beresa-55 at Harari (Qile PA) and Dire Dawa respectively. Lowest dry matter herbage yield of 10.19 t ha^{-1} and 5.95 t ha^{-1} which was obtained from variety lablab local check at Harari (Qile PA) and Dire Dawa respectively.

4. Conclusion

The performance of cowpea and Lablab were tested in the Harari regional state and Dire Dawa funded with AGP-II program. The result showed that significant ($P < 0.05$) variations among the tested of cowpea and lablab, among the parameters of; Dry biomass yield in over locations over the years. Among the tested cowpea (cowpea-9334 and Cowpea-9333) lablab (Gebis-17 and Beresa-55) have greater performances in terms of their high dry Biomass yield, plant height and fresh biomass yield. Therefore it was concluded that the variety cowpea-9334 and lablab Gebis-17 and Beresa-55 promising to be demonstrated in the study area and under the same agro-climatic conditions and better to popularize for their livestock mix with poor quality as feed resources to enhance animal products.

Appendix

Table 3. *ANOVA of Cowpea varieties that show the mean squares of factorials'.*

Source of Variation				**Mean squares**			
	DF	**Pht (cm)**	**Df (50%)**	**Dm**	**FBY (t/ha)**	**P/P**	**DBMY (t/ha)**
Year	1	38.12ns	125.0ns	294.69ns	55752.96**	54.67ns	94.12ns
Loc	1	11685**	11165.44**	5064**	1729.59**	440.72*	22.67**
Trt	2	1085.1ns	248.86**	200.03*	43.48*	659.98**	0.678
Rep	2	1116.18ns	13.36ns	10.03ns	166.06ns	40.47ns	2.13ns

Table 4. *ANOVA of lablab varieties that show the mean squares of factorials'.*

Source of Variation			**Mean squares**			
	DF	**Pht (cm)**	**Df (50%)**	**Dm**	**FBY (t/ha)**	**DBMY wt (t/ha)**
Year	1	17147.47**	4761.00**	3.36ns	534.09ns	8.12ns
Loc	1	64219.16**	10138.78**	3461.36**	12385.83**	250.80*
Trt	2	634.95ns	2070.58**	41.58ns	1518.5*	55.21*
Rep	2	324.16ns	52.00ns	158.33ns	1470.55ns	51.67ns

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