



Potentials Distribution and Origin of Lablab [*Lablab purpureus* (L.) Sweet]: A Review

Melkam Aleme

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ABSTRACT

The review summarizes the potential, distribution and origin of *Lablab purpureus*. Forage legume has potentials for the production and productivities of arable land by supplying nitrogen for the living organisms in the soil those allowed to obtain their own feed in the symbiotic relationships. Further the soil become fertile for the next cropping season even at the time of intercropping the yield would be improved than mono-cropping systems. It also supplies the protein requirement of livestock and human consumption as vegetable or as seed sources. It is summer growing annual trifoliate forage legume. The origin of lablab is considered to be in Africa because in large parts of tropical Africa wild type cultivated lablab exists. Then it is heavily distributed to the corner side of the continent and Southeast Asia for seed and vegetable production. Even though the origin and distribution of lablab initiated in the African continent the applicability and degree of uses of the species were not well recognized across countries in the continent. Therefore further conservation and evaluation of this dual purpose species give priority by governmental and non-governmental bodies.

Key words: Distribution, Origin, *Lablab purpureus*.

Lablab (*Lablab purpureus* (L.) is predominantly self-fertilizing herbaceous forage crop among cultivated plants belonging to family leguminosae with chromosome number - $2n=22$ (Kshirsagar *et al.*, 2018). Adebisi and Bosch (2004) concluded that lablab has great potential as a crop species because its grain yields is higher than cowpea and its ability of adaptability in the different agro-ecological areas which makes it different from other leguminous plants.

Lablab helps to improve and balance the nutritional requirement of livestock when fed together with fibrous roughages. Studies have shown that when ruminant animals fed with fibrous crop residues and forage materials such as maize stover supplemented with lablab forage, their performance were improved. Its foliage also could be conserved as hay, silage for livestock feed and could also be used for green manuring (Kabirizi *et al.*, 2007).

Wide range of diversity of lablab accessions exists worldwide including the African indigenous materials. These accessions have not been evaluated under the different agro ecologies of Ethiopia and hence not much information on their adaptation and performance (Taye *et al.*, 2007).

Lablab is very productive forage crop that has a very good wide adaptation of environments and soil types. It is most well adapted in warmer environments with high moisture availability. Moreover as a legume crop it is rich in protein, therefore it could be very good source of protein source forage in the study area where feed is one of the major constraints limiting livestock production. These species are also well adapted to moisture stress area which makes it ideal for drought prevalent areas in Ethiopia. They are promising due to their high productivity, palatability and quality feeding value (Davies and Onwuka, 1993). Their production and productivity and utilization under arid conditions to provide low cost fodder to animals particularly

Ethiopian Institute of Agricultural Research, Tepi Agricultural Research Center, P.O. Box: 34, Tepi, Ethiopia.

Corresponding Author: Melkam Aleme, Ethiopian Institute of Agricultural Research, Tepi Agricultural Research Center, P.O. Box: 34, Tepi, Ethiopia. Email: melekamaleme@gmail.com

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during the dry season and quality for exploitation and the potential ease of agronomic practices to produce these forage species make them of higher choice and priority. However, suitable varieties for the different areas are lacking and hence identification of varieties for the different environmental conditions and specifically for the targeted study locations is very essential. Characterizing there agronomic features will help to minimize biomass productivity, forage quality, improve soil fertility and helps compatible multiple cropping production systems with others crops (Mark and Paul, 2007). The review finalizes the potential, distribution and origin of *Lablab purpureus*.

Literature review

Potential of forage legume as feed for livestock

Forage legumes contribute great potentials for livestock as protein sources in their feed compositions. Legumes allowed fastening the digestibility and consumption of forages (Mengistu, 2002). Forage legumes are significant because they improve the soil nitrogen content and have a high nutritive value for feed grown. Legumes allowed to be fully-fledged in mixed with grasses forages (Mark and Paul, 2007).

Legumes supply associated grasses with nitrogen and thereby contribute to the conservation of energy by reducing the need for Nitrogen fertilization. By the introduction of legumes in the system of fodder production, the quantity as well as quality of herbage production can be substantially increased (Mark and Paul, 2007). The herbage yield and nutritive value of the hay from grass-legume mixtures are better than the hay of mono species. The pest reduction and nitrogen fixation from legumes could be better important in organic production, where no synthetic pesticides or fertilizers can be used (Wang and Noite, 2010).

Currently, alfalfa is a commercially grown source of forage in many countries as animal feed. Though, cowpea also has the significance important to produce quality forage and fodder for animal use. The production of forage legumes is under thought due to changing climatic conditions, indicating the need for breeding cultivars that can sustain and adaptable to the negative effects of climate change. Current research work in genetic and genomic implements has facilitated the identification of quantitative trait loci and genes/alleles that can aid in improved forage cultivars complete genomics-assisted breeding systems (Kulkarni *et al.*, 2018). In other way, to supply nitrogen to the soil and to serve as a break in cereal-dominated rotations, forage legumes contribute admirable uses to livestock production in crop livestock systems. Little worth crop residues needs protein supplementation. That can be provided by forage legumes to become productive diets. In the Ethiopian high lands, for example, *Vicia faba* is not fed to livestock except in combination with cereal straw (Anderson, 1985).

Due to their high dry matter production, cereal crops have been used over many centuries as a feed for ruminant animals. However, they are poor in protein content and hence often considered low-quality forage sources. Forage legume crops provide high-quality fodder and feed for livestock. When cereal crops grown together with legume crops which can improve yield as well as protein content and other quality parameters (Zhou *et al.*, 2015). Forages legumes are mostly used as cut fodder or grazed pasture. Fodder may be fed directly to livestock or used after conservation as fermented green matter (silage) or dried for products like hay, pellets or cube concentrates. Pastures may be grazed directly or cut and used in feed rations for livestock. Legume crop residues and by-products are an important source of feed for livestock, allowing the grain to be used for human consumption as food-feed crops. Forages also have an important role in marginal areas in maintaining the natural resource base through soil stabilization, preventing soil erosion and contribute to soil fertility through microbial nitrogen fixation and organic matter. Some forage legumes are also used to control leaching of nutrients in soils, as well as rotational crops to control pests and diseases of other crops. Forage legumes have the possibility to provide high quality and quantity of feed, to increase soil nitrogen, to maximize income to farmers and help to reduce soil erosion when they are intercropped with cereals;

therefore intercropping legumes for small-scale, resource-poor farmers in developing countries like Ethiopia (Kassie, 2011).

Better-quality forages primarily legumes, can advance the efficiency of these pastures by enhancing the fertility status of the soil. They can also recover the feed value of the native pastures since they have more protein content than naturally occurring grass. To advance the efficiency, vegetation structure and value of degraded usual pastures, above planting of enhanced legumes and grasses have been tried in the mid-altitude areas. Results designated that *Stylosanthes guianensis* presented higher formation of seed ordinary meadows while *Desmodium uncinatum* is likely species for this resolution. Rhodes grass failed to form with smallest soil ruckus. Substantial methods of pasture launch claim high investment cost and labor, low cost establishment methods such as intercropping forages with food crops are carefully practicable for source meagre agriculturalists. Research results show that some better-quality feeds such as *Chloris gayana* and *Desmodium uncinatum* can effectively launch when under sown to maize after final weeding of crop without moving maize grain return. The forage persevered glowing for three to four years next launch (Alemu, 1998).

Potential of *Lablab purpureus* L. sweet

Lablab (*Lablab purpureus*) is a very excellent nitrogen fixer used for human consumption, cover crop and for animal feeding (Awad *et al.*, 2011). A potential measure of lablab is; used as a livestock supplementary feed. The leaves are highly digestible and have very high protein. 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%. Feed protein content is often considered a good determinant of quality (Milford and Minson 1968). In conclusion, 35% lablab leaf meal and 63% wheat bran were found to be a very promising supplement in sheep fed low-quality crop residues under the condition of the experiment (Hidosa *et al.*, 2018). Soil fertility includes leaf/stem and C/N ratio, among others. It is assumed that rapid senescence and abscission of leaves in legumes is a reaction to the reallocation of carbon (C) and nitrogen (N) from senescing leaves to sustain yield under water deficit conditions, which is expressed via the leaf/stem ratio (Turner *et al.*, 2001). The leaf/stem ratio in legumes is usually reduced towards the end of the life cycle (Tesfaye *et al.*, 2006). Leafy biomass generally exhibits greater palatability and digestibility, the remaining share of leaves at the end of a plant's life cycle is an important indicator in estimating its value for livestock nutrition (Aganga and Tshwenyane, 2003).

In other hand, the C/N ratio is an important value to evaluate the quality as a soil amendment. Here, the mineralization of N is an important factor in determining the rate of mineralization, immobilization and nitrification during decomposition in the soil (Bengtsson *et al.*, 2003). In general,

the smaller the C/N ratio, the higher the N content in relation to the C content and the faster it may be decomposed by soil microorganisms (Hadas *et al.*, 2004). However, general, the smaller the C/N ratio, the higher the N content in relation to the C content and the faster it may be decomposed by soil microorganisms. Though, the break down is not only a function of the C/N ratio, but a complex interaction of N content, lignin content, water soluble N and cellulose content (Hadas *et al.*, 2004).

The prevalent environmental conditions have a great impact on decomposition rate as well. The C/N ratio among accessions at maturity was greatest in stems and generally lowest in seeds, followed by leaf parts. The ratio among accessions was in general higher in the rain fed water treatment compared to the fully irrigated water treatment. This may indicate a relatively greater stem utilization of mobile compounds such as N for grain filling processes, a phenomenon commonly found in stressed plants, like under drought stress (Blum, 2005). It is widely known that cereals such as maize or wheat have greater C/N ratios compared to legumes. For maize, a C/N ratio of 32.4 is reported and for wheat a ratio of 136 (Hadas *et al.*, 2004). This indicates lablab residues may have a high decomposition rate leading to fast benefits in terms of N supply for subsequent crops. However, more research is needed in this area to prove the quality of lablab accessions as a soil amendment.

Lablab (*Lablab purpureus*) species description

Lablab (*Lablab purpureus*) is a summer-growing annual or occasionally short-lived perennial forage legume. It is a twining, climbing, trailing or upright herbaceous plant that can grow to a length of 3-6 m. It has a deep taproot and vigorous, glabrous or pubescent trailing stems. Lablab leaves are alternate and trifoliate. The leaflets are rhomboid in shape, 7.5-15 cm long and 8-14 cm broad, acute at the

apex. The upper surface is smooth while the underside has short hairs. Inflorescences are many-flowered racemes borne on elongated peduncles. The flowers are white to blue or purple in color, about 1.5 cm long, typically papilionaceous in shape. Lablab fruits are linear, 4-15 cm long and 1-4 cm broad, smooth and beaked pods that contain between 1 and 7 seeds. Lablab seeds (beans) are ovoid, laterally compressed with a conspicuous linear hilum. Lablab beans are variable in color, depending on variety or cultivar, usually white to dark brown and some are black (Table 1). Wild varieties and some cultivated varieties tend to have mottled seeds (Mengistu, 2002; Hector and Jody, 2002; Murphy *et al.*, 1999; Islam, 2008).

It can be planted alone in large plots or mixed with other warm season forages. Lablabs' quality forage with high protein (15-30 %) with high levels of lysine and about 55% digestibility makes it excellent for hay and silage (Hector and Jody, 2002). It is normally established to the same areas as cowpeas. It tolerates acidic (pH 4.5-6.5), drought and low fertility soils well than most other legumes. Lablab is intolerant of waterlogged/flooded conditions and it is adapted to annual rainfall ranging from less dry 750 mm to 2500 mm dry to highly wet condition (Mullen *et al.*, 2003). Once established, it can be grown in rain-fed conditions in minimal irrigation. It serves as an excellent to suppress weeds and provides soil erosion control and is a very good N-fixer and green manure crop to increase soil carbon-based material which recovers soil construction and quality. It is used in alternation with yearly harvests including vegetables, herbs, cut flowers, annual ornamentals and root crops such as dry land that can be foraged/hay/ silage (Hector and Jody, 2002). Lablab has recovering root disease confrontation than cowpea and is more tolerant of defoliation than cowpea or soybean. It is more palatable to cattle compared to cowpea which is not found immediately palatable by cattle (Smith *et al.*, 2008).

Table 1: Description in *Lablab purpureus* (L.) sweet.

Parameters	Quantification	References
Seed		
1000 seed weight (g)	200-1000	Islam, 2008; Maass and Usongo, 2007
Seed color	Very diverse: white, cream,	Maass and Usongo, 2007
Tannin contents (%)	0-8	
Trypsin inhibitor units in FM (mg ⁻¹)	14-41	Guretzki and Papenbrock, 2014
Cyanogenic potential in FM (μ mol ⁻¹)	1-7	
Pods		
Fresh pod length (cm)	4-17	Islam, 2008; Pengelly and Maass (2001)
Fresh pod width (mm)	15-43	Islam, 2008; Pengelly and Maass (2001)
Number of seeds per pod	1-7	Islam, 2008; Pengelly and Maass (2001)
Plant		
Flower color	Purple, violet, white	Islam, 2008; Pengelly and Maass (2001)
Growth habit	Indeterminate/climber, determinate/bushy	
Maturity type (number of days to flowering)	Early to very late (54-220)	
Dry matter (ton/ha)	0.8-12.9	Mihailovic <i>et al.</i> , 2016
Seed yield (kg/ha)	0-2524	

FM= Fresh matter.

The lablab bean is an old well-known irrigated crop in the Sudan. Commercial crop *Lablab purpureus* is grown as a pulse crop in Africa, Asia and the Caribbean. It is also expended as a green vegetable (green bean, pod, leaf). Maass *et al.* (2010) observe that *L. purpureus* may suffer from low yields when grown as a main cash crop and suggest that it is more popular in home-grown and mixed-cropping systems. Protein separate from the bean can be used as a food additive for successful cake quality. It is used as forage, hay and silage. As forage, it is often sown through sorghum/millet. The leaf is highly edible but not stem and the seeds are moderately tasty. So that it is highly obsessive legumes for livestock feed (Maass *et al.*, 2010).

Lablab [*Lablab purpureus* (L.) Sweet] is the most popular leguminous forage species in the world (Pengelly and Maass, 2001; Murungweni *et al.*, 2004). It supplies protein for both as feed and human consumption. The cultivation season of lablab has been found in early dry (November to February) in northern Nigeria. It is a legume which produces high quality conserved feed (4 t DM/ha and 120 g CP/kg DM) (Amodu *et al.*, 2004).

Many findings have based on strategies to develop animal nutrition at a time of dry periods (Mapiye *et al.*, 2007). Improved pasture grasses attains enough metabolizable energy (ME), scored between 8 ME MJ/kg dry matter (DM) and 12 ME MJ/kg DM (McDonald *et al.*, 2011). However, there is a shortage of protein source feed, mainly in the dry winter season. Generally, forage legumes supply protein up to 12% to as high as 25% (McDonald *et al.*, 2011) for maintenance and production, depending on the species. The use of legumes has also been limited by the availability of fermentable fiber (Mupangwa, 2000).

Taxonomy, diversity and origin of lablab

Lablab purpureus (L.) is grouped in the family of Fabaceae and is also known as Hyacinth bean, Egyptian kidney bean or Dolichos Lablab (Verdcourt, 1979). The species is highly diverse and taxonomically three subspecies are recognizing, based on differing characteristics of pods and seeds (Maass *et al.*, 2005 and Tolera, 2006). The first subspecies is the wild species *un-ciantus* that is distributed in East Africa and includes the variety *rhomboideus*. The remaining two cultivars, species *purpureus* and species *bengalensis* are known. The lablab species is known for being highly range of diversity with over 200 genotypes were recognized (NRC, 2001).

Genotypes are distinguishes based on differences in size, shape and colors of pods, seeds, flowers and leaves (Hendrikson and Minson, 1985). Lablab is early adopted cultivated, heavily distributed in Africa, the Indian sub-continent and Southeast Asia (Maass, 2006), that has been used as seed production and vegetable over 3500 years (Maass *et al.*, 2005). Lablab is currently highly distributed throughout the tropics and subtropics (Kimani *et al.*, 2012), where it has become naturalized in some areas (Tolera, 2006).

Even though, it has large morphological diversity in South-Asia, however, the origin is considered to be in Africa because in large parts of tropical Africa wild and cultivated lablab coexists. In Africa it was dispersed by man probably as early as 800 B.C. and it is now found throughout the continent, which is the only continent where wild plants recorded to occur naturally (Maass *et al.*, 2010). In the late, 1970s, lablab is listed as a minor and neglected crop in most areas, however it has long tradition, great diversity and adoption to a diverse range of agro-ecological areas (Maass *et al.* 2010; Kimani *et al.*, 2012). This has led to the thought of genetic erosion of naturally occurring and semi-domesticated lablab varieties in Africa (Maass *et al.*, 2010). One of the reasons is limited interest in research area and the decreasing production and demand in Africa due to the uses instead by other leguminous species like common bean and cowpea (Tolera, 2006). So far, low test of flavor attributes and low cooking qualities of some lablab genotypes may led to minimum consumption by users. Therefore, it favored other legume species, especially for human consumption (Maass *et al.*, 2010).

Chemical composition of *Lablab purpureus* L. sweet

The development period can vary from around 75 to 300 days. Under suitable conditions, it will produce maximum vegetative progress 130 days post germination, with additional growth possible subject to temperature. Lablab is highly drought tolerant staying green during the dry season if it is once established before the wetness situation is sustained (Mayer *et al.*, 1986).

The amount in crude protein recorded for total plant, leaf, stem and seed sections of lablab are summarized in Table 2. The mean crude protein contented of lablab herbage was 17% with a range of 10% to 22% on a dry matter basis. Leaf crude protein various from 14.3% to 38.5%, while the stem crude protein gratified reached from 7.0% to 20.1%. Lablab follows a familiar development design as protein pleased descents with development (Milford and Minson, 1968). The National Research Council (2001) indicates that the least necessities for growth and lactation of a 400-kg cow are 119 g crude protein/kg DM and 124 g crude protein/kg DM correspondingly. Norton and Poppi (1995) have recommended that a regime comprising 210 g crude protein/kg digested organic matter (DOM) will deliver the lowest condition for rumen degradable nitrogen. Any decipherable nutritional protein in surplus of this necessity will be despoiled to ammonia in the rumen and the ammonia defecated as urea in the urine.

The crude fiber contented of the entire plant is 27.8% with the average of NDF, ADF and ADL being 43 %, 38.6% and 7.1% in dry matter basis respectively. One of the encounters of rising forage in tropical surroundings is the result of the environment on the nourishing physiognomies of plants. High temperatures decrease the soluble carbohydrate content of plants, causing in amplified fiber content and reduced digestibility (Norton and Poppi, 1995).

Table 2: Dry mater yield, chemical composition and digestibility of *Lablab purpureus* (L.) sweet.

Lablab composition		Sample fractions	Amount	Reference
Dry mater yield (kg/ha)		Whole plant	3136-5040	Milford and minson (1968)
		Leaf	940-1562	
		Stem	2996-3478	
Crude protein (% in DM)		Whole plant	17.73	Washaya <i>et al.</i> (2018); Murphy (1998)
			10-22	
		Leaf	14.3-38.5	
		Stem	7.0-20.1	
		Seed	23.0-28.0	
Crude fiber (% in DM)		Whole plant	30.49	Dougall and Bogdan (1966)
		Leaf	12.16	
		Stem	31.5	
		Seed	4.4	
Neutral detergent fiber (% in DM)		Whole plant	45.5(42.6-50.5)	Bhardwaj and Hamama (2019); Washaya <i>et al.</i> (2018); Murphy (1998)
			46.51	
			44.0	
		Leaf	37.3	
		Stem	61.9	
		Seed	NA	
Acid detergent fiber (% in DM)		Whole plant	60.1(57.4-67.1)	Bhardwaj and Hamama (2019)
			33.65	
			32.3	
		Leaf	23.42	
		Stem	49.4	
		Seed	NA	
Acid detergent lignin (% in DM)		Whole plant	15.1(10.9-26.4)	Bhardwaj and Hamama (2019)
			5.8	
		Leaf	4.4	
		Stem	9.1	
		Seed	NA	
Digestibility	% in DM	<i>In vitro</i>	56.7	Solomon <i>et al.</i> (2003)
	g/kg	<i>In situ</i> (cattle)	626.2	
	% in DM	Sheep	52.7	

NA= Not available.

Table 2 summarizes dry matter digestibility of lablab. The average dry matter digestibility of the readings existing is 56%. Irrespective of the method used to limit digestibility (*in vitro*, *in situ* or *in vivo*) or the classes (cattle or sheep); the values of dry matter digestibility are all fairly comparable. Most legumes, the gasping stock digestibility of lablab drops with ripeness (Milford and Minson, 1968).

CONCLUSION AND RECOMMENDATION

The dual purpose forage legume are play indispensable role for the community as well as in the sector livestock production during deprivation of other non-substituting environmental friendly cropping martial. The unique characteristic of lablab purpureus is relatively acidic tolerate than other legume crops. Even the crop residue of this legume used as protein sources for animal consumption because of the higher protein content of its biomass which obtained up to 24 CP per cent of DM base during the forage

harvesting time. However, this legume species is originated in Africa in early before 800 BC the uses and distribution to stock holders is negligible this id due to the availability and access of seed technologies.

Data availability

The dataset that supports the review in the summarization is available from the corresponding author upon request.

Conflict of interest

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