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LABLAB PURPUREUS (L.) SWEET GENOTYPES OF ASSAM – A POTENTIAL LEGUME CROP

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ABSTRACT

Lablab purpureus (L.) Sweet is an important and widely cultivated legume because of their acceptability as a nutrition rich vegetable crop and their ease of cultivation with minimum requirements for their maintenance. Large number of genotypes *of Lablab purpureus* (L.) Sweet are available in Assam, India which are very rich source of gene pool. Understanding of those genotypes towards their genetic improvement, commercialization, conservation and their further utilization is needed. The present investigation was carried out during 2019-2021. In the study, germplasm of 16 (sixteen) genotypes of *Lablab purpureus* (L.) Sweet of Assam, were reported which showed morphological divergence. These genotypes have great potential and can be efficiently employed in selecting the suitable genotypes for further crop improvement programmes.
***Keyword*:** *Lablab purpureus* (L.) Sweet, divergence, potential crop.

Introduction

The family Leguminosae has played a very important role in fulfilling the nutritional requirements of mankind. Legume vegetables are unique component of human diet, serving primarily as an easy source of protein with the added benefits of the green vegetables. The nutritive value of legume vegetables has been reported in various studies (Sarma *et al.,* 2010; Omondi, 2011; Al-Snafi, 2017). Several genera of the family Leguminosae provide the source of proteins, amino acids and other minerals. One such genera is *Lablab* which belongs to the sub-family Papilionoideae and tribe Phaseoleae. The genera *Lablab* possess various morphotypes and bear close resemblances with the genera *Dolichos* and *Macrotyloma*. Initially *Lablab* was referred to as *Dolichos lablab* L., but now it is bifurcated from *Dolichos* due to some marked differences and regarded as monotypic genera. This genus is well-acquainted, widely distributed in the different parts of the world with about 3000 accessions of the germplasm worldwide and is an essential component in the cropping system both as single crop and as mix crop; substantially also receiving an inevitable corner in the homestead gardens (Maass, 2010). The genus *Lablab* is widespread in the Indian subcontinent including the North eastern states of India and Assam in particular. They have diverse usage ranging from their use as vegetables to forage crop for the livestock and as a good cover crop which can address problems like surface runoff, decreased soil fertility, rill erosion and also helps in the reduction of weeds (Humphreys, 1995; Afsan N. and Roy A. 2020).The pod and seeds are the most important parts of the plant from the economical perspective. The pods have been reported to contain vital dietary components which include minerals like Magnesium, Calcium and others besides the major proportion of protein and fibre (Deka and Sarkar, 1990). Medicinal properties like anti-diabetic, antioxidant, anti-hepatotoxic and other activity such as in the treatment of anaemia have also been reported for the genera (Somulung *et al*., 2012). The genera also find its mention in different Ayurvedic preparations.

Lablab is a monotypic genera and its single species is *Lablab purpureus* (L.) Sweet. Northeast India is diverse in the *Lablab purpureus* (L.) Sweet. genotypes. Asati B.S. and Yadav D.S. (2004) reported twelve (12) cultivars along with 02 (two) wild related cultivars from entire North East India. *Lablab purpureus* (L.) Sweet has been a common crop among the farmers of Assam, basically for their nutritive, fodder and some therapeutics value. Many genotypes are in practice among the farmers of Assam which are very rich source of gene pool. In spite of having great diversity, their importance and wide acceptability, no proper documentation of the *Lablab purpureus* (L.) Sweet of Assam is a matter of concern. Also the diversity of these genotypes of Assam has

not found its acquaintance in any of the breeding programmes. Very limited number of works has been done on *Lablab purpureus* (L.) Sweet. genotypes of Assam and no detail studies on the qualitative traits have been reported except for the amateur characterisation on pod colour and shape familiar among the masses and agriculturists (Sarma *et al.,* 2010). As no proper understanding of these genotypes are available, they are often been haphazardly grouped together despite their marked differences and are not even properly maintained. Proper understanding of the qualitative traits might help in identifying the desirable genotypes and suitable morphological traits can be used as selection markers in plant improvement program. Germplasm evaluation is an important practice in any crop improvement program. Identification of superior genotypes by considering qualitative and quantitative characters makes plant improvement program effective. Physio-morphological features and their characterisation can be useful for selection of suitable traits in plants (Islam *et al.,* 2011).

Prominence of the genera *Lablab* on the international arena:

The *Lablab purpureus* is a versatile subtropical and tropical nitrogen-fixing legume (Beckett, 2004).This multipurpose use of the crop has been reported by many workers. Many agricultural and nutritional use of the species has reported. Maass *et al*. (2010) reported that *Lablab* is one of the most diverse domesticated legume species which has multiple uses. Based on the morphological characters, Alam and Newaz (2004) has worked on the combining ability for pod and flower characters of the bean. The study was carried out using a 6x6 diallele cross and showed that the expression of the various traits were controlled by both additive and non-additive genes. In the study the parents DSN26 was found to be a suitable combiners for most of the characters studied while the parents KBS2 and KBS 3 were considered as good combiners for early flowering and pod development. In case of specific combining ability the F_2 progeny of DS52 x DS161, DS30 x DSN26 and DS30 x DS52 were considered as ideal specific combiners particularly for early flowering inflorescence formation and pod yield. Islam *et al.* (2011) has reported on the genetic variability, heritability and correlation study in hyacinth bean. In the study forty four genotypes were screened and the study has reported high genotypic coefficient of variation was obtained for 100-green seed weight, pod yield per plant, number of pods per plant and harvesting duration. Similar study by Afsan and Roy (2020) has considered four parameters viz number of flowers per plant (NFP), pods per plant (NPP), average number of seed per pod (ANSP) and average pod weight (APW). Based on these characters the variability and heritability were studied. Studies on variations in growth and yield of indigenous Dolichos bean of Sitakundu of Chittagong, Bangladesh have been carried out by Barua *et al.* (2014). A total of 3 (three) genotypes were considered in the study, which was out in the Bangladesh Agricultural Research Institute (BARI), Pahartali, Chittagong. The study also considered the standard phenological traits adopted in most of the available literature.

Prominence of the genera *Lablab* on the national arena

The development of an appropriate plant type is possible only when we there is a planned utilisation of the diversity and so study of the diversity is very important. The exploration of variability has become very important in Agronomy as the environmental conditions are abruptly changing. A study on the variability and heritability of 12 (twelve) pole type Dolichos from the gangetic plains was done by Chattopadhyay and Dutta (2010). In the study both qualitative (five, 05) and quantitative (nine, 09) characters were considered, which includes type of the plant, colour of the flower, pod and seeds and curvature of the pod. The quantitative parameters such as days to 50% flowering, length and weight of the pod, number of seeds per pod and other such standard descriptors were considered in the study. The study reported significant variation in the various descriptors; flower coloured varied between purple or violet and white, pod colour green and black or brown seed colour. The variability and heritability assessment of the study revealed less differences in the magnitude between the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), PCV being slightly higher for most of the characters studied; highest of which has been reported in the protein content, pod weight and breadth and the yield per plant. Durga, (2012) has conducted a study on the nature and magnitude of variability in 23 cultivars of *D. uniflorus* L. and reported that the highest GCV was observed for pods per plant and least GCV estimates were observed for germination rate and seedling length. These features suggest narrow variability and further decrease their scope of improvement and utilisation. In the study highest heritability was observed for seed yield per plant and least heritability was seen in number of primary branches per plant. Das *et al.* (2015) on the genetic analysis and interrelationships among yield attributing traits in the types of *Dolichos* i.e. pole and bush type Dolichos bean, where 20 (twenty) varieties were and correlation analysis were carried out for variance and co variance components and the co efficient of variance was divided into direct and indirect effects. The beans were analysed based on morphological parameters and early maturing was considered as one of the most favourable traits. In the same line of assessing variability, Verma *et al.* 2014 has studied in 12 (twelve) genotypes of *Lablab*. In the study a total of 12 genotypes, all of which have been collections from Indian Institute of Pulses Research (IIPR), Kanpur and All India Coordinated Research Project (AICRP) on pigeon pea, Bangalore. A total of 18 (eighteen) quantitative characters were studied viz. plant height (cm), days to first flowering, days to 50 percent flowering, days to first pod harvest and other such standardised parameters. The ideal lines reported in the study includes Culture-47, GL-243 and GL-671. The results of variability, heritability and genetic advance suggests that PCV were on the higher values as compared to the GCV which clearly indicates the lesser influence of the environment on the traits. High PCV and GCV were observed for traits like plant height, no. of secondary branches per plant, 100 seed per plant, pod yield, number of inflorescences and pods and per hectare yield. For

days to first flowering and pod width, there was report of comparatively low mean of genetic advance which suggests that the traits are being controlled by additive genes and least influenced by environment. The study also reported non-additive gene action for traits such as pod width.

In the improvement of beans and allied legumes, several parameters play a significant role, these parameters as highlighted by Gupta *et al.*, 2017 includes extent, nature and magnitude of genetic variability and its components (genotypic and phenotypic component of variation). Following this view, they studied on the co-relationship of floral traits, yield and nutritional parameters in dolichos bean (*Lablab purpureus* (L.) Sweet from the Allahabad agro-climatic zone. In the study carried out in the research farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, total of 38 (thirty eight) genotypes were studied. Various phenological traits were considered and ANOVA was carried out. The ANOVA revealed differences among the genotypes. The study reported that there was no-significant positive correlation between green pod yield per plant and number of seeds per pod, pod-length, width and weight, weight per 100 seeds, number of flowers and pods formed per inflorescence. It also shows the same correlation with that of biochemical parameters like chlorophyll-a, chlorophyll-b, total chlorophyll, carotenoids moisture content and protein content. On the other hand the study showed significant positive correlation between green pod yield per plant and quantitative traits of the plants such as pod-length, width weight, vine length, weight of 100 seeds, protein content and number of pods formed per inflorescence. Positive non- significant correlation was shown in characters like carotenoids and moisture content, number of flowers formed per inflorescence, chlorophyll- a and total chlorophyll. The study also showed non-significant negative co-relation in regard to length of the inflorescence, days to 50% flowering, days to initiation of flowering and chlorophyll-b. The use of different qualitative traits for determining the genetic diversity has been reported. Qualitative traits are simply inherited and are usually contributed by one or more genes. Their importance in a crop can be highlighted by the fact that the presence of such traits greatly enhances their commercial value and acceptability. In the genera Lablab also the market value of the germplasm that have characteristic colour, pungency or pod shape are very important and hence several studies have been done in this aspect. Mohan *et al.* 2009 has evaluated the various germplasm of *Lablab* based on pod and yield related traits, which reported wide range of variability for the traits studied, which were also in line with the previous studies (Bendale *et al.,* 2004). Further Deb Nath *et al.* 2019, while working on the variability and yield attributing traits have also reported variations in both qualitative and quantitative characters. The study considered four genotypes of *Lablab* viz. SB003, SB010-1, SB011and BP003 in the Sylhet Agricultural University (SAU). The qualitative characters that were considered in the study includes seed, flower and pod- shape and colour, colour of the cotyledon, colour of the leaf and leaf veins, in addition standard qualitative of the entire plant. Reddy *et al*. 2018, however considered only qualitative traits where 35 (thirty five) genotypes of *Lablab* was carried out at the Vegetable Research Station, Agriculture Research Institute, Rajendranagar, Hyderabad. A total of 13 (Thirteen) traits have been studied and most of the traits that have been considered showed variation except in regard to traits like colour of the leaf colour and pod suture and beak colour. The traits that were reported to show extensive variability includes colour of stem, leaf vein, flower and pod colour, shape of pod and seed characters such as colour and shape. The study considered more qualitative traits than those reported in the study of Chattopadhyay and Dutta (2010).

Prominence of the genera on the regional arena

Assam and its adjoining areas owing to the food habit, familiarity of the genera and the climatic conditions has harbour rich diversity of *Lablab* species. Considerable diversity of *Dolichos* species of North Eastern India have been reported, 12 (twelve) cultivars (Asati and Yadav, 2004). Their study have also reported the occurrence of 02 (two) wild relatives of *Dolichos lablab (L)* Sweet *viz.* The study also has reported the genera a component of the mixed cropping system and the usage of maize stubble as a common plant for their support. A very important study was done by Sarma *et al.* 2010 in regard to the nutritional properties of the various landraces from the different parts of the North-eastern region of India. In the study nutritive values and seed protein profiling were done. In the study the crude protein of the young pod ranges between 16.44 to 21.47%. The carbohydrate, lipid, crude fiber and ash content of the same were reported to be 14.53 to 19.61%, 0.43 to 0.96%, 13.53 to 21.47% and 6.23 to 9.17% respectively. In the study the protein, carbohydrate and crude fibre content were found to be comparatively higher in mature seeds than in the young pods viz. 23.99 to 35.51%, 28.18 to 48.41% and 10.52 to 16.77%. There was less difference in regard to ash content of the immature pods. The SDS-PAGE of the study has significantly revealed the presence of 30 bands which has been segregated into 2 clusters. The most common bands were observed in the size range 28.0 to 54.0 Kd. 6 (six) bands were universally present in all the studied germplasms. viz. 31.5, 32.2, 33.6, 40.0, 54.0 and 61.3 Kd which implicates their potential as a marker for this group of legumes. Under the present investigation sixteen (16) genotypes (Fig. 1) of the species *Lablab* has been focused from different agro-climatic zones of Assam which are widely cultivated among the farmers of Assam because of their acceptability and adaptability in diverse climatic regions. These genotypes (Table 1, Fig.1) may have great potential toward their utilization in future plant improvement programme.

Table 1: Co-ordinates of germplasm collection site and the corresponding agricultural zones

BankIt codes	Latitude	Longitude	Name of the Agro climatic zone
CUCYT22001	24.78852°N	93.02961°E	Barak Valley Zone
CUCYT22002	24.78852°N	93.02961°E	Barak Valley Zone
CUCYT22003	26.63563°N	90.38114°E	Lower Brahmaputra valley Zone
CUCYT22004	26.63563°N	90.38114°E	Lower Brahmaputra valley Zone
CUCYT22005	25.29430°N	93.11121°E	Hills Zone
CUCYT22006	25.29430°N	93.11121°E	Hills Zone
CUCYT22007	25.29430°N	93.11121°E	Hills Zone
CUCYT22008	25.29430°N	93.11121°E	Hills Zone
CUCYT22009	25.29430°N	93.11121°E	Hills Zone
CUCYT22010	25.29430°N	93.11121°E	Hills Zone
CUCYT22011	25.97996°N	91.23510°E	Lower Brahmaputra valley Zone
CUCYT22012	26.12102°N	92.69759°E	Upper Brahmaputra Valley zone
CUCYT22013	27.51477°N	95.34160°E	Upper Brahmaputra Valley zone
CUCYT22014	27.51477°N	95.34160°E	Central Brahmaputra Valley
CUCYT22015	26.658312	92.742131	North Bank Plain zone
CUCYT22016	25.74648°N	93.24242°E	Hills Zone

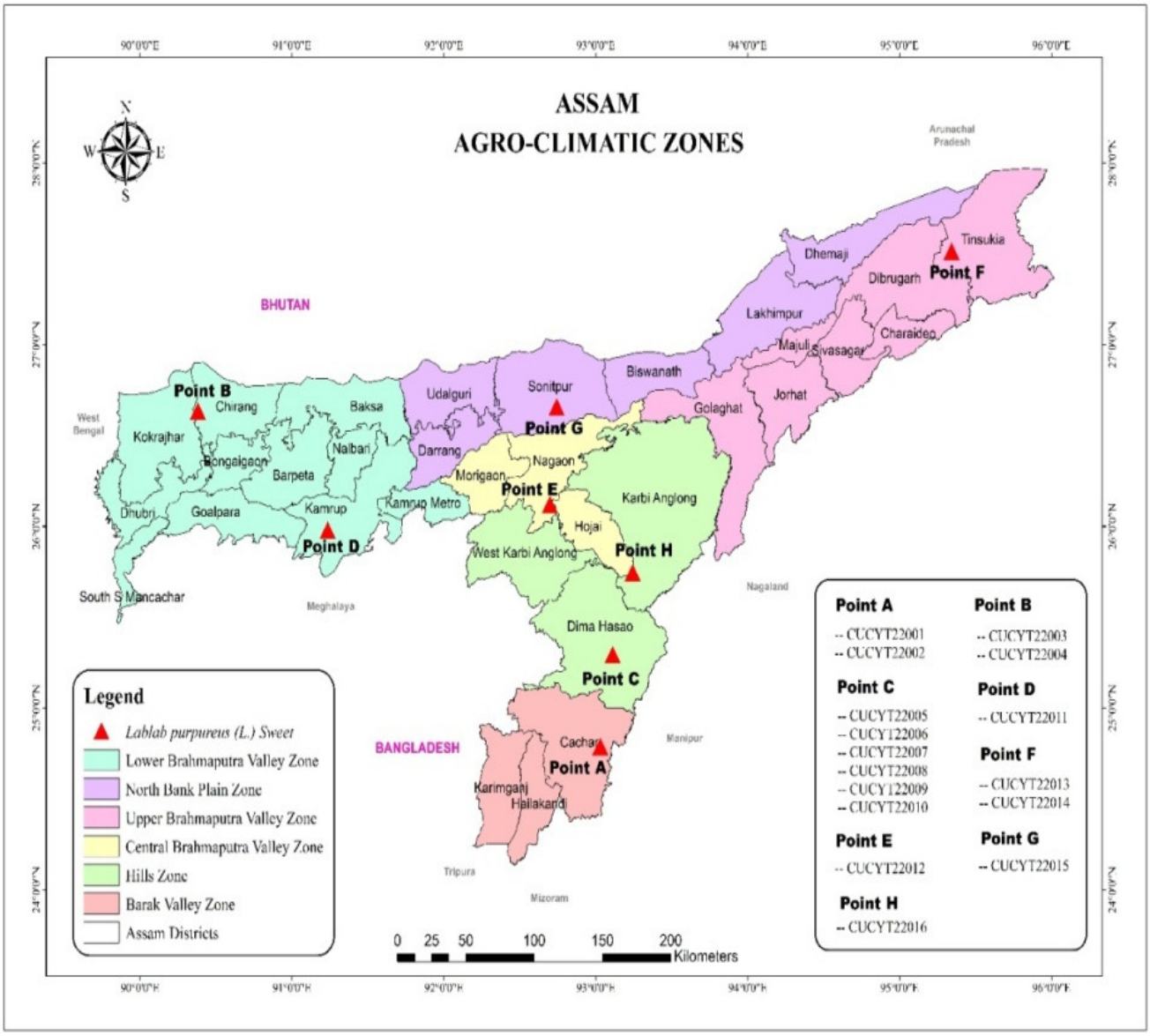

Fig. 1 : Map showing the agro climatic zones of Assam

Origin and Distribution of the Genera

The origin has been quite unclear in the earlier years with archaeological data supporting its Indian origin and the distribution of the wild relatives supporting its African origin. The genera is distributed throughout the different continents of the world, tracing its origin in the eastern and southern parts of Africa, with Ethiopia (Maass *et al.,* 2017) as the most likely centre of origin (Verdcourt, 1970). They are believed to have originated in the Indian sub-continent and then distributed to the different parts of the world (Purseglove, 1977). The Indian sub-continent despite having large diversity, has not been considered as centre of origin but the diversity found here are the results of escapes from domestication, but undoubtedly constituting the secondary centre of diversity with North America, also being one of them. The results from molecular diversity studies also extend its support towards African origin (Robotham and Chapman, 2017). The results from most of studies were based on only few accessions from the Asian continent (Wang *et al.,* 2007) and this factor can also contribute to the non-consensus towards the origin of the crop.

Habit and morphology

They are cultivated in different parts of the world and in India also. The plants are annuals but they also show perennial nature with luxuriant growth in vegetative parts, once the fruit set gets over. Generally on the basis of their growth habit 2 (two), types of habits are observed, these are the pole type and the bushy type. The pole type generally has indeterminate growth and the bushy type has determinate growth. The genus is often confused with *Dolichos* which can be distinguished from *Dolichos* on characters like blade-like style, non-penicillate stigma and verrucose margins of the pod (Verdcourt, 1980). They may have climbing or prostrate stems with leaves in the form of 3 (three) leaflets. The genera also show different coloration of the flowers which are white, purple and sometimes yellow, borne solitarily or in racemes, showing vexillary aestivation. The pods are of different colour, shapes and sizes characterised by the presence of a prominent beak. The genera is also known for their characteristic pungency, which is one the most important organoleptic character. The plants are photoperiodic existing as both long day and short day plants, also with some recent reports on day neutral plants (Dewangan *et al.,* 2017). They are often reported to be drought tolerant which is aided by the presence of prominent tap root system, also the development of nodules is also seen in the roots of older plants.

Future prospect

The utilization of plant genetic resources for mankind is one of the common practices since the pre-historic era. Variability in genetic resources is an essential tool for evaluating genetic resources. Morphological ad molecular characterization is one of the foremost initiatives to access genetic variability in crop improvement programs and facilitates the identification of distinct phenotypes. Under the present investigation all the genotypes exhibit pole type growth which has advantage of increased usable space, more exposure to sunlight and advantage of mixed cropping. Pigmentation on pod and seeds not only provide advantage for commercial acceptability but also possess antioxidant property. *Lablab purpureus* (L.) Sweet of Assam is a morphologically diverse crop grows luxuriantly in diverse agro-climatic zones of Assam. Sixteen (16) genotypes considered in the present investigation showed differences in their morphological characters which indicate the presence of divergence. Divergence and variability present in gemplasm is an essential tool for evaluation of genetic resources and are the key determinants for efficient breeding program. The adaptability of genotypes in different agro-climatic zones can be considered as suitable criteria. Genotypes with promising phenotypic expression may contain certain alleles or allelic combinations which can be utilized in developing improved varieties.

Conclusion

There is a constant surge in the demand for complete and fortified food and the biggest challenge in this pursuit has always been the disproportion in demand and productivity. The basic tool in overcoming this obstacle lies in the success of various crop improvement programmes. Hence it becomes inevitable even in regard of *Lablab* to seek for the diversity in the genotypes and use them appropriately. Morphological parameters serve as the easiest tool in this regard. Hence understanding the morphological peculiarities or markers are very significant in any plant with no exception in *Lablab* for establishment of distinctiveness. Morphological markers are inexpensive and direct and require little expertise however they have a major drawback of being influenced by the environment. Other drawbacks includes subjective characterisation and lethality of certain morphological variants (Bhandari *et al.,* 2017). But despite these facts they are widely used in understanding the differences among the different plants. Genetic diversity is not only significant for crop improvement but also for the maintenance of the biodiversity, which have been heavily impacted by different anthropogenic activities, making it indispensable for the survivability for the different species. Various international agencies have already been involved in the conservation of genetic diversity, which includes International Treaty on Plant Genetic Resources (ITPGR) and United Nations (UN) which supports the Convention on Biological Diversity (CBD), (Govindaraj *et al.*, 2014). There is a need for harnessing the existing diversity for development of different or resistant species to cope up with the changing environment the disease cycle and the evolution of newer diseases. Moreover it may also be mentioned here that the diseases that were not a concern in the past have now become more serious and in such situations it is of utmost importance to explore genetic diversity for the creation of complementary species that can complement the changing environment.

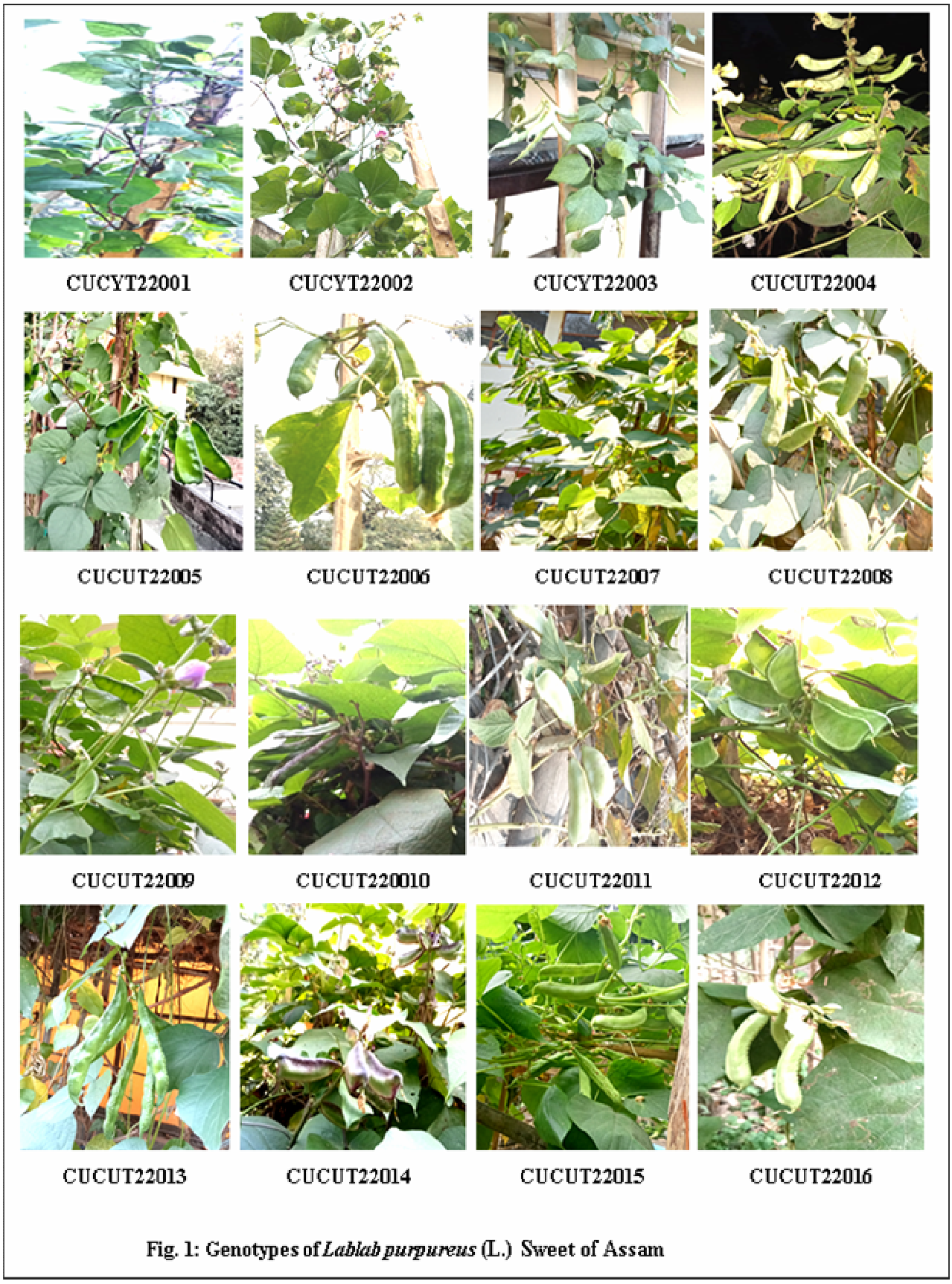

Fig. 1: Genotypes of *Lablab purpureus* (L.) Sweet of Assam

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