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Genetic resources of Bay Islands of mungbean, urdbean and wild *Vigna* relatives: a potential donor for enhancing pulse productivity in the Islands Agriculture

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Abstract

The Andaman and Nicobar Islands even though possess an apparently uniform tropical humid warm climate, shows considerable variation in the species diversity and vegetation pattern. The occurrence of over 2500 indigenous and 500 non-indigenous angiosperm species in these Islands makes it unique to Indian flora. Orchids and medicinal plants etc.), wild relatives of crop plants having agricultural, medicinal and industrial value have an impressive array of diversity. The genetic resources of pulses especially mungbean - urdbean in the Andaman and Nicobar Islands provide an ample scope for the sustainable food and nutritional security of the Islander, biological support to production system and agro-ecosystem of the islands. It is the basis of farming; it also forms a large part of terrestrial biodiversity. It results from the interaction between the environment, genetic resources and the management systems. Conservation and access to these resources are important, especially in disaster-prone areas, as farmers of these regions often lose most or all of their seed stocks during disasters, which also cause erosion of genetic diversity. Furthermore, in order to ensure food security in these regions, effective strategies and policies are needed to implement the programmes that protect the local crop diversity. These strategies can only achieve their goal in a collaborative effort in terms of conservation and utilization of plant genetic resources. Mungbean and urdbean is a very important Rabi crop in Andaman & Nicobar Islands covers about 7.31 per cent of the total area under field crops. The available genetic resources in the mungbean and urdbean (*Vigna radiata* L. Wilczek and *Vigna mungo* L. Hepper) provide an excellent platform for trait specific development of tropical and warm season legume crop adapted to a variety of soil in the islands. A considerable level of variability was observed for quantitative traits, hence, these can be used for genotypic relationship and it indicated that improvement in mungbean and urdbean could be successful utilizing the potential landraces which may be use as the potential donors for physiologically efficient cultivars with high yield potential. The classification of germplasm gave rise to some elite lines for specific characters and the accessions for various characters and it was observed that some of these accessions possessed desirable gene for more than one character and hence these could be utilized for selection and/or directly or indirectly in hybridization programme for varietal development.

Keywords: *Genetic resources, mungbean, urdbean, landraces, potential donors*

Introduction

Andaman and Nicobar Islands are a unique insular habitat in Bay of Bengal with warm and humid climatologically features and ideal tropical ecological conditions. The Andaman-Nicobar Islands and the Western Ghats of the Peninsular India have similarities in their features and floristic composition, even though these geographical regions are widely separated by the Bay of Bengal (Balakrishnan and Ellis, 1996). There are several regions in Western Ghats which have ideal ecological niches for *ex- situ* conservation of insular species of the Andaman and Nicobar Islands. The tropical rain forests occurring in these islands are remarkable with unique insular endemics and the last stronghold of several Malaysian floristic elements within the Indian territory. The insular floristic species are very much intriguing and innovating with several interspecific variants and potentially useful plant genetic resources for agri-horticulture, phytopharmacology etc. However, some of the insular floristic features like relatively small gene pool and reduced out breeding owing to geographical isolation, fragile ecological equilibrium owing to the competition of maximum taxa within limited geographical space etc, are naturally pushing off several insular species into endangered status and to further extinction. The diversity of plant forms in these islands had been documented from the British days (Parkinson, 1923) and more recently by

the Botanical Survey of India (Hajra *et al*., 1999; Hajra and Rao, 1999).

Pulses also known as grain legumes are valued for their protein rich grains and soil fertility restoration and soil amelioration properties. Pulses are indispensible for sustainable cropping systems in these islands are because of their distinctive characteristics like short duration and ability to fix atmospheric nitrogen and thrive well under adverse conditions. Pulses are an efficient source of plant-derived protein that which require minimal inputs and act as an effective rotational break. These crops are generally under-represented species in region specific research and development programmes. Moreover, in the context of Andaman and Nicobar Islands pulse crops have orphan status despite of abundance of wild species and landraces in this region. Understanding the genetic relativeness between related species is one of the important criteria for effective utilization of germplasm in the crop breeding programme. This can be revealed by the analysis of intraspecific genetic relativeness in individual accessions of related taxa. The underutilized legume *Vigna marina* and promising landraces of mungbean and urdbean collected from the different parts of the Andaman and Nicobar Islands were characterized to obtain genetic relationships between these taxonomic entities.

Evaluation and Characterization of mungbean and urdbean

The local landraces of mungbean were evaluated for different morphological and quantitative traits *viz.*, days to 50% flowering, days to maturity, plant height (cm), primary branches per plant, number of pods per plant, length of pods (cm), number of seeds per pod, 100-seed weight (g) and seed yield per plant (g) and range of variability for important quantitative traits for further characterization and selection of the best entries. The details of the morphological traits are given in Table 1.

Table. 1. Range of variability for quantitative characters in mungbean germplasm lines

Character	Characteristics	Potential donors for further utilization
Days to 50 % Flowering	Earliness	ANM-11-46, ANM-11-44
Days to Maturity (earliness)	Earliness	ANM-11-46, ANM-11-44, ANM-11-12
Plant height (cm)	Medium	ANM-11-11, ANM-11-08, ANM-11-07-2
Primary branches plant^{-1}	Profuse branching	ANM-11-08, ANM-11-12, ANM-11-15
Number of Pods plant^{-1}	More pods/ plant	ANM-11-08, ANM-11-12 , ANM-12-02, ANM-11-07-2
Length of Pods (cm)	Long pods	ANM-12-02, ANM-12-01, ANM-11-08
Number of Seeds pod^{-1}	Max. Seeds per pod	ANM-12-02, ANM-12-01, ANM-11-12, ANM-11-15, ANM-11-08
100 seed weight (g)	Bold seeds	ANM-12-02, ANM-12-01, ANM-11-12, ANM-11-08
Seed yield plant^{-1} (g)	Highest seed yield per plant	ANM-12-02, ANM-12-01, ANM-11-12, ANM-11-15, ANM-11-08, ANM-11-05, ANM-11-44

The listed germplasm lines selected from local landraces / farmers' varieties has maximum seed yield per plant as against for different morphological and quantitative traits and range of variability for important quantitative traits for further characterization and selection of the best entries. The details of the morphological traits are given in Table 2.

Table. 2. Range of variability for quantitative characters in urdbean germplasm lines

Character	Characteristics	Potential donors for further utilization
Days to 50 % Flowering	Earliness	ANU-11-22 , ANU-11-09
Days to Maturity (earliness)	Earliness	ANU-11-22, ANU-11-09
Plant height (cm)	Medium	ANU-11-34 , ANU-12-01, ANU-12-02, ANU-11-11
Primary branches plant^{-1}	Profuse branching	ANU-11-10, ANU-12-01, ANU-12-02, ANU-11-11
Number of Pods plant^{-1}	More pods/ plant	ANU-11-29, ANU-11-09, ANU-11-19,
Length of Pods (cm)	Long pods	ANU-11-29, ANU-11-09, ANU -11-19, ANU -11-34
Number of Seeds pod^{-1}	Max. Seeds per pod	ANU-11-10, ANU 11-30, ANU 11-34
100 seed weight (g)	Bold seeds	ANU-11-19, ANU-11-29, ANU-11-09
Seed yield plant^{-1} (g)	Highest seed yield per plant	ANU- 11-29, ANU - 11-34

Identification of promising genotypes / donors and wild relatives

Some promising accessions from the existing collections of local land races were identified as a potential genotypes/ donors for incorporating desirable attributes in high yielding varieties for the genetic improvement of pulses under Bay conditions (Table 3). On the basis of screening of the local landraces/ cultivars comparing with the standard check one accession in mungbean shows early maturing while 9 accessions shows high seed yield per plant in case of mungbean. The germplasm lines was found best accessions having brown pods with seed yield per plant, maximum number of primary branches per plant, pods per plant and shows highly resistance against MYMV and Charcoal rot disease of mungbean with seed yield per plant, number of pods per plant and shows highly resistance against MYMV and Charcoal rot.

On the basis of screening of the local landraces/ cultivars comparing with the standard check one accession in urdbean shows early maturing while 02 accessions shows high seed yield per plant. The germplasm lines was found best local accessions in terms of yield and yield attributing traits over other having high seed yield, pods per plant and shows highly resistance against powdery mildew and leaf crinkle disease of urdbean. Yield per plant, number of pods per plant and shows highly resistance against MYMV and Charcoal rot.

Table. 3. Potential donors identified for different characters

Crop	Specific trait	Promising accession
Mungbean	Early maturity	ANM-11-14
	Primary branches plant^{-1}	ANM-11-08, ANM-11-12, ANM-11-17
	Pods plant^{-1}	ANM-11-01, ANM-11-08, ANM-11-09, ANM-11-11, ANM-11-12, ANM-11-44, ANM-11-46, ANM-12-01, ANM-12-02
	Yield plant^{-1}	ANM-12-02, ANM-12-01, ANM-11-12, ANM-11-05, ANM-11-07-2, ANM-11-08, ANM-11-15, ANM-11-44 & ANM-11-46
	MYMV resistance	ANM-12-02, ANM-12-01, ANM-11-12, ANM-11-05, ANM-11-07-2, ANM-11-08, ANM-11-15, ANM-11-44 & ANM-11-46
	Resistance to Charcoal Rot	ANM-12-02, ANM-12-01, ANM-11-12, ANM-11-05, ANM-11-07-2, ANM-11-08, ANM-11-15, ANM-11-44 & ANM-11-46
Urdbean	Early maturity	ANU-11-24, ANU-11-09, ANU-11-29
	Primary branches plant^{-1}	ANU-11-19, ANU-11-09, ANU-11-29
	Pods plant^{-1}	ANU-11-09, ANU-11-19, ANU-11-29
	Yield plant^{-1}	ANU-11-19, ANU-11-09, ANU-11-29
	MYMV resistance	ANU-11-19, ANU-11-09, ANU-11-29, ANU-11-10
	Resistance to powdery mildew	ANU-11-19, ANU-11-09, ANU-11-29, ANU-11-10
	Resistance to leaf crinckle	ANU-11-19, ANU-11-09, ANU-11-29, ANU-11-10, ANU-11-13, ANU-11-22

On the basis of screening of the local landraces/ cultivars comparing with the standard check one accession in urdbean shows early maturing while 02 accessions shows high seed yield per plant. The germplasm lines was found best local accessions in terms of yield and yield attributing traits over other having high seed yield, pods per plant and shows highly resistance against powdery mildew and leaf crinkle disease of urdbean. Yield per plant, number of pods per plant and shows highly resistance against MYMV and Charcoal rot.

Beachpea (*Vigna marina* (Burm.) Merr.)

Beachpea (*Vigna marina* Burm., Merr.), is a wild relative of cultivated *Vigna* species distributed throughout the tropics and shows a great similarity in floral structure of mungbean and urdbean as the main distinctive characters being some vegetative traits. In particular, beachpea (*Vigna marina*) possess succulent stems and leaflets, the later being ovate, its legume-grain are broader, more glaborous and the seeds are oval in shape, brown and radish brown in colour and larger than those of cultivated mungbean and urdbean. These all three legumes, namely mungbean, urdbean and beachpea differ in their habitats, as mungbean and urdbean grows along fresh water and are cultivated for their economic use. The habitat of *Vigna marina* are associated with seashore, where it may occur from immediately above watermark to low coastal dunes and scrub, particularly over sandstone and sandy soils. This is underutilized potential crops having protein content varies from 19.8 –30.26 per cent with good source iron, calcium, magnesium and zinc in the fresh and dry seeds. This crop grows well sandy beaches in tropical and sub tropical regions (Singh *et al*., 2014) and is generally found on tropical beaches of Andaman & Nicobar Islands and other parts of the world (Abraham *et al*., 2008, Elanchezhian *et al*., 2009 and Singh *et al*., 2015). *Vigna marina* is determinate type, dune creeper having salt tolerant capacity. It is prostrate, creeping vine; perennial underutilized pulse crop belongs to the family Fabaceae. This vine is great for open, sunny areas as a ground cover and especially good for beach front properties. The local holding of mungbean, urdbean landraces germplasm at the ICAR-Central Island Agricultural Research Institute, Port Blair also includes

wild relative's accessions beachpea (*Vigna marina*) for their agro-morphological characterization and utilization in pulse improvement programme. While, the analysis of genetic relationship with cultivated species is equally important for further enhancement of collection. Since, a very few studies on the analysis of the genetic relationship among *Vigna* cultivated species and their wild relatives has been done. In the present study genetic relationship of mungbean (*Vigna radiata*), urdbean (*Vigna mungo*) with *Vigna marina* agree with those records. Grouping patterns generated by cluster analysis based on molecular analysis showed the genetic diversity between genetically related mungbean, urdbean and beachpea (Singh *et al.*, 2014 & 2015). The present study reveals that, the inclusion of genotypes bred for specific objectives like salinity tolerance (Elanchezhian *et al.,* 2009 and Sanjeewani *et al.*, 2012) resulting in narrowing of genetic base and the marker system used could be the reason for clustering most of the cultivars in one cluster. The relationships between the landraces are not necessarily reflecting the agronomic traits. Molecular markers are scattered throughout the genome and their association with various agronomic traits is influenced by the cultivator under selection pressure induced by domestication.

Table. 4. Potential donors of *Vigna marina* identified for different characters

Crop	Specific trait	Promising accession
Mungbean	Early maturity	ANBp-14-01, ANBp-14-03
	Primary branches plant^{-1}	ANBp-14-02, ANBp-14-03
	Pods plant^{-1}	ANBp-14-03, ANBp-14-04, ANBp-14-02
	Yield plant^{-1}	ANBp-14-03, ANBp-14-04, ANBp-14-01
	Quality parameters (Protein and mineral contents)	ANBp-14-03, ANBp-14-04, ANBp-14-02

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