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VEGETABLE TYPE PIGEONPEA GERMPLASM IDENTIFIED AND EXPLORED FROM VAISHALI DISTRICT OF BIHAR

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ABSTRACT: Genetic resources are the basic material for any crop improvement programme, obviously because they contain some unique traits/gene. Exploration for collection of germplasm is the quickest and simplest method for acquiring the desired one. Indian is world's biggest home of vegetarian inhabitants and legumes are main source of protein in their diet, pods are consumed fresh, or processed as vegetable either dried seed are used as *dal* or variety of preparation. A vegetable type pigeon pea of perennial nature has been identified and explored from Vaishali district of Bihar. Such promising and unique germplasm could be utilized by pigeon pea workers in their respective crop improvement programme to reinforcement food and nutritional security of country by efficient utilization.

Keywords: *Exploration, germplasm, pigeon pea, perennial, vegetable.*

India is world's largest homeland of vegetarian population and world leader in pulses production and impart to provide protein supplements. Indian pulse production has been struck in between 14 and 15 Mt since mid-nineties, resulting in poor consumption (33 g/capita/day) during 2010 (Ali and Gupta, 1). Pigeonpea (*Cajanus cajan* (L.) Millspaugh) is a leguminous shrub that can attain heights of 5 m. It is an ephemeral perennial (short lived) and is invariably cultivated as annual crop, except in backyard for vegetable purpose. The centre of its origin is the eastern part of peninsular India, including the state of Orissa, where the closest wild relatives (*Cajanus cajanifolia*) occur in tropical deciduous woodlands. The crop is known to be grown in 22 countries but it is cultivated in large areas only in a few countries (Saxena *et al.*, 5). Pigeonpea cultivars are grown for vegetable purpose, in the same way as a normal pigeonpea crop, however pods are harvested at the milking to dough stage of its development. The main stream accepted vegetable pigeon pea varieties should have long pods with large sweet seeds, which can easily be separate from the pod shell. In India, most of consumers prefer green podded pigeonpea for vegetable purpose. These usually charge a higher price than stripped ones, or pods of other colours (Saxena *et al.,* 7; and Singh *et al.,* 8).

Considerable diversity exists also in case of vegetable pigeonpea. Important growth and development traits (determinate/non-determinate), along with the nature of branching play an imperative role in determining its plant type. Few genotypes are erect and compact with narrow branching while in others the angle of branches open giving the appearance of semi-spread or spreading plants. Substantial variation is observed for plant height. In conventional germplasm these two characters have a considerable range with a strong environmental effect, depending on the planting time (Wallis *et al.*, 11; and Saxena *et al.,* 6). In vegetable type genotype of pigeonpea normal sugar levels are around 5.0%; but researchers at ICRISAT have identified varieties, such as ICP 7035, with a sugar content as high as 8.8% (Saxena *et al.,* 3; and Saxena *et al.,* 4). Pigeonpea grown for domestic use in backyards are maintained up to 3-4 years and attain a plant height of well over 3 m. The plants start flowering at the onset of short days and immature pods. However, optimum plant population of 250,000 – 325,000 plants /ha is quite good for early maturing vegetable type varieties whereas in contrast to long duration non-determinate types, which require 45,000–52,000 plants/ ha for optimum yields, since pigeonpea is known to be highly sensitive to environmental factors (Saxena *et al.*, 4). Keeping view the above facts this work was taken on priority. As Singh and Bhatt (9) explained exploration for collection of

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Fig. 1: Perennial and vegetable pigeon pea at pre-flowering stage and along with bunch of pods during first year.

germplasm is one of the best, simplest and quickest methods of enriching of gene pool of any crop commodity.

MATERIALS AND METHODS

One unique accession was identified and marked for regular visit. This germplasm was marked while author was on visit to review the progress of an ongoing research project. This unique pigeon pea was spotted and marked by me in the month of July 2010, I enquired to the farmers about the plant and other related information. He was unable to satisfy me, he simply told me, that since this is rice field, I never grown pigeon pea.

Table 1: Diversity in vegetable type pigeonpea germplasm of different regions.

Region	No. of accessions	Days to		Plant height (cm)	Seeds pod^{-1}	Pods plant^{-1}	Pod length (cm)
		flower	mature				
Eastern Africa	106	117 – 229	166 – 270	130 – 270	5.4 – 6.7	26 – 406	5 – 12
Southern Africa	17	131 – 194	163 – 260	185 – 260	5.4 – 6.1	33 – 154	5 – 11
Central Africa	4	141 – 166	215 – 232	200 – 230	5.4 – 5.6	74 – 130	7 –9
Western Africa	13	142 – 156	194 – 218	170 – 250	5.4 – 5.6	67 – 246	7 – 10
Central America	26	106 – 151	167 – 202	85 – 240	5.4 – 7.2	19 – 160	7 – 11
South America	16	132 – 158	182 – 230	100 – 285	5.4 – 6.1	27 – 420	5 – 11
South Asia	39	80 – 175	133 – 235	85 – 230	5.4 – 7.2	55 – 830	3 – 9
South-east Asia	8	134 – 201	190 – 264	140 – 210	5.4 – 5.9	24 – 119	5 – 9
Europe	2	156 – 174	222 – 237	210 – 260	5.4 – 5.8	137	9
Total	231	80 – 229	133 – 270	85 – 285	5.4 – 7.2	19 – 830	3 – 11

Source: Adopted from Saxena *et al.* (4).

Fig. 2 : Perennial and vegetable piegeon pea along with bunch of pods during subsequent year.

He told one interested thing , that due to creation of pond some cow dung is used and this pigeon pea seeds may me brought along with cow dung to this place, and get germinated before time on the bank of the pond, an at 4-5- feet elevation (Fig.1 and 2). I requested him to kindly protect this plant and have some watch and ward. I was in touch with farmer to know the growth and development and phenology of this unique plant type. Every time during our visit to the project site, I discussed with concerned farmers about the progress of the pigeon pea plant. Being legume, gifted with the unique ability of indeterminate growth habit, vegetative and reproductive growth was taken place simult-aneously after initial thrust. June germinated plants, comes in to reproductive phase in second week of November. Anthesis, first flowerings starts in the second week of November and behaves like perennial and continued to month of March next year. Data were recorded for growth and development. Since the size of pod and seed was amazing and was easy to peal with sweet in nature, encourage to further study for its suitability towards vegetable type. Accordingly, observations were taken and simultaneously data were recorded on growth and development yield attributes and pod yield.

RESULTS AND DISCUSSION

Taxonomy and classification of explored pigeonpea

The great botanist Linnaeus (1753) gave pigeonpea its first binomial nomenclature – Cytisus cajan. Van der Maesen (10) reported that the first scientific name of pigeonpea was given by Bauhin and Cherler during 1650- 1651 and they called it *Arbor trifolia indica* (Thora Paerou), which means ‘common dal’ in the Malayalam language of India. Van der Maesen (10) has written an excellent monograph on this aspect and at present the following taxonomical classification is globally accepted. Based on various morphological, cytological, chemical and hybridization data, Van der Maesen (10) merged genus *Atylosia*, the nearest wild relative of pigeon pea, with genus *Cajanus*. Consequently, genus *Cajanus* now has 32 species and pigeon pea (*Cajanus cajan*) is the lone cultivated species of the Cajaninae sub-tribe.

Order: Fabales

Tribe: Phaseoleae

Sub-tribe: Cajaninae

Family: Leguminosae

Genus: *Cajanus*

Species: *cajan*

Fig. 3: Seeds of vegetable pigeonpea—ready to be use as vegetable purpose.

In situ performance of explored pigeonpea

Regular watch and wards and upkeeps were taken place to provide congenial environment to prove its potential. Being ephemeral perennial shrub commonly cultivated as annual crop for human and livestock consumption. The crop phenology is basically governed by photo-period, because flowering in this species is induced by long periods of darkness. This phenomenon (photo-period sensitive reaction) has been found to be positively linked to its time to flower and biomass production. The genotype is true to type of perennial as it was evident by days to anthesis/ flowering which was 151days; similarly maturity was recorded (222 days). Generally, traditional pigeonpea cultivars and most landraces are of medium (160 -180 days) to long (>250 days) maturity durations (Saxena *et al.,* 4). It was notices by Wallis *et al.* (12) that early maturing pigeonpea genotypes are relatively less sensitive and the long duration types are most sensitive to photoperiod response. Plant height was recorded (140 cm), when after the first flush is over. Yield attributes like seeds per pod, pod per plant and pod length were recorded within the range, being a genetic characters and not much influenced with the environmental conditions prevailed (Table 2).

Table 2: Year wise performance of perennial pigeonpea.

Years	Days to		Plant height (cm)	Seeds/ pod	Pods/ plant	Pod length (cm)
	flower	mature				
First Year	151	222	140	5.4	137	8.2
Subsequent years	-	-	330	5.2	145	7.9
Average			285	5.3	141	8.1

Table 3: Classification of pigeon pea genotypes.

Point of difference	Determinate types	Indeterminate types
Photo-period sensitivity	Sensitive	Insensitive
Biomass production	produce more biomass	produce compatibly less biomass
Adopted to cropping system	Intercrop or as perennial hedges	Sole cropping
Flowers / podding pattern	flowers / pods in clusters at the top of the canopy	terminal buds are vegetative and the flowers/ pods are borne in axillary clusters
Growth pattern	Plant growth ceases after the induction of flowering and pod maturity is more or less uniform, i.e. synchronize growth habit prevailed	After some time vegetative and reproductive phase goes on simultaneously of flowering and pod maturity is not uniform i.e. non synchronize growth habit prevailed
Stresses tolerate	Less tolerate biotic and abiotic stresses than indeterminate types	Tolerate biotic and abiotic stresses better than determinate types

Table 4: Soil and nutrient dynamics of pigeonpea site.

Value	Sand (%)	Silt (%)	Clay (%)	Soil pH	Organic carbon (%)	Bulk Density (m m^3)	Electrical Conductivity (dSm^{-1})	NO_3 (ppm)	Available Phosphorus (ppm)	Exchangeable Potassium (ppm)	Sulphur (ppm)	Zinc (ppm)
Initial	26.5	42.3	31.2	7.5	0.65	1.42	0.21	121.2	12.9	91.3	4.0	0.36
Final	25.4	42.1	32.5	7.4	0.71	1.40	0.20	151.3	14.6	103.1	4.3	0.38

Inherited capability to rejuvenate, and some approximate built in stress compensation device help the pigeonpea to conquer such stresses and encourage regeneration of vital plant parts as soon as the micro-environment becomes conducive (Wallis *et al.*, 12). General growth and development traits associated with determinate and indeterminate type of pigeonpea is summarized in the Table 3.

Soil and Nutrient Dynamics

Soil samples were taken during first visit (June, 2010) and was treated as initial soil fertility status and at the end (April, 12) to know the nutrient dynamic (Table 4) in the perennial pigeon pea field after two years (Ryan *et al.,* 2). Since pigeonpea is endowed with strong and deep root system, encourage more rhizosphere microbial activities. Considerable build-up of major fertility indicators was recorded at the end of three of cycle. Physical parameters viz., sand, silt and clay composition was not much influenced by the pigeonpea. Bulk density also did not change. However other parameters related to soil fertility got influenced. N, P, K, S and Zn was improved significantly (Table 4).

CONCLUSION

Exploration for collection of desired germplasm to strengthen the gene pool of particular crop is quickest though simplest instrument. It should be an integral part of any plant germplasm augmentation programme. Perennial pigeonpea is often having traits qualify for vegetable type apart from grain purpose, though vegetable type annual pigeonpea has been developed and are in the process of wide adaptation, under rainfed condition. This unique germplasm can be utilized in the ongoing research programme as donor for high rain fall area like Bihar and other Eastern States to strengthen vegetable protein right from podding stage.

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