Agro-morphological characterization of Bay Islands Pigeonpea (*Cajanus cajan*) landraces and advanced lines under Islands conditions

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Outline:

- Sustainable aspects of pulse crops in general
- Pulse crops of the Andaman & Nicobar Islands
- Importance of pigeonpea crops for Island agriculture
- Agro-morphological variation of pigeonpea landraces
- Utilization of landraces
- The way forward

Pulses and their sustainable aspects

- Pulses are essential for the regeneration of nutrient-deficient soils and for providing needed protein, minerals, and vitamins to humans and livestock.
- Pulses can be a means of improving the livelihoods of smallholder farmers.
- Pulses for the nutritional and food security of human beings;
  - *As a source of protein.*
  - *As a source of important vitamins and minerals*
  - *As a way of reducing cholesterol and blood sugar.*
- Pulses are more resilient to the rainfed/ dryland tropics.
- Pulses are the source of soil health improvement and environmental degradation
- Pulses for animal nutrition
- Pulses for crop and soil improvement

Major Pulse crops of Islands

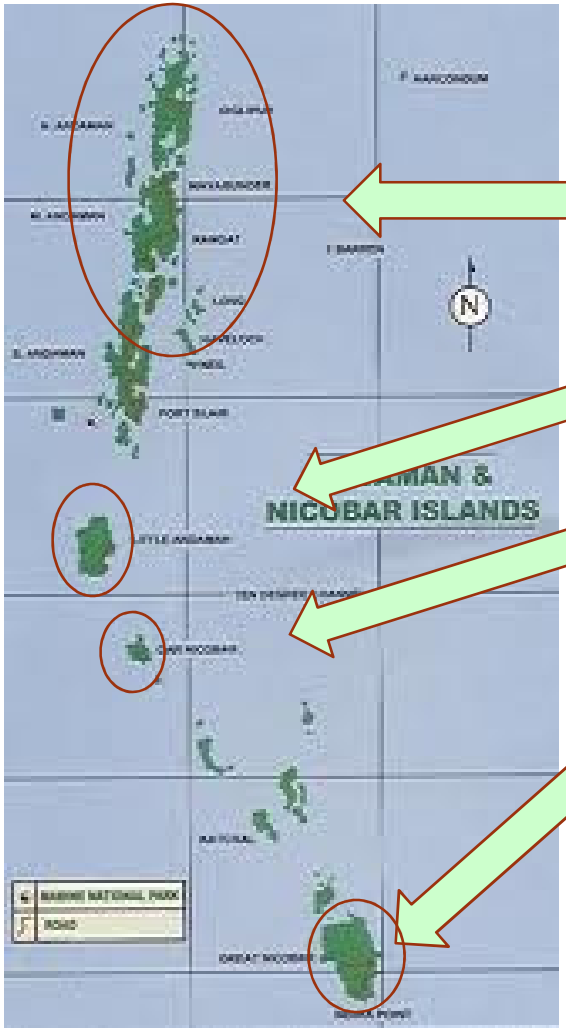
Mungbean (*Vigna radiata*)	**Cultivated / landraces**
Urdbean (*Vigna mungo*)	**Cultivated / landraces**
Pigeonpea (*Cajanus cajan*)	**Cultivated / landraces**
Cowpea *(Vigna unguiculata)*	**Cultivated / landraces**
Beachpea (*Vigna marina*)	**Endemic and endangered wild relative of *Vigna***

Land utilization pattern of the Islands

- Total cultivated land pre tsunami (approx.) = 50,000.00 ha
- Permanently submerged land = 4,206.00 ha
- Total cultivated land post tsunami = 45,794.00 ha
- Total cropped area (2012-13) = 16,535.22 ha
- Fallow land = 3281.60 ha
- Net area sown = 14710.07 ha

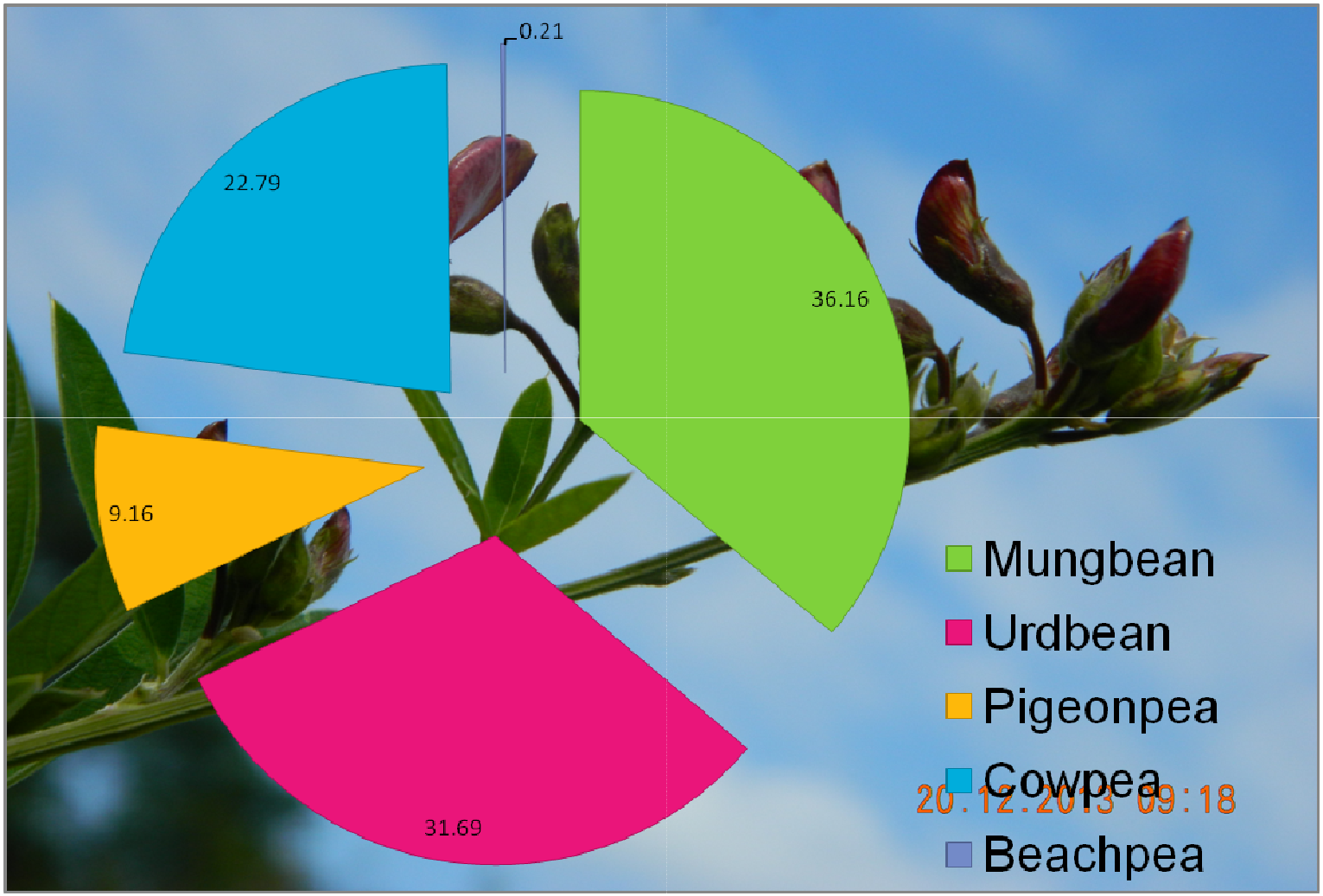
Crops	Area (ha)	Area (%)
Paddy	8,390.00	18.32
Maize	163.54	0.36
Pulses	2910.00	5.82
Oilseeds	46.10	0.10
Condiments & Spices	1610.80	12.69
Vegetables	5150.00	11.25
Coconut and Arecanut	25920.00	56.60

Area and Distribution of Pigeonpea in Andaman & Nicobar Islands



Scenario of pulse cultivation in the Island

Share of different pulse crops in Island Agriculture



Pigeonpea

- **Pigeonpea (*Cajanus cajan* (L.) Millsp.) is an important grain legume that originated in the Indian sub-continent.**
- **The crop is grown for its multiple benefits mainly by smallholder growers and is useful in providing household food security in the region.**
- **The crop provides highly nutritious food for human consumption and fixes considerable amounts of atmospheric nitrogen, thus improving soil fertility. D**
- **The crop is also relatively tolerant to drought (Kumar et al., 2011) thus making it suitable for cultivation in the semi-arid agro-ecological conditions prevalent in the region.**

Pigeonpea

- Crop of marginal area
- Improve the soil fertility
- Suitable for varying cropping system
- Improve organic matter content
- Suitable for degraded land
- Grain, fodder, fire wood and medicinal use
- Adoption to varied agro-ecological conditions of the Island

Importance of pigeonpea for Island agriculture

- Declining factors productivity
- Depletion of soil fertility
- Imbalance use of nutrients
- Declining in organic matter content
- Problems of soil salinity and alkalinity
- Increasing disease and insect-pest pressure
- Menace of weeds
- Environmental pollution

Pigeonpea improvement and conservation programs depend on the presence of genetic variability and the accurate characterization of that variability.

The distribution of genetic diversity between and within pigeonpea landraces of Island regions is largely unknown. An understanding of the genetic diversity is essential for both utilisation and conservation strategies.

Determination of genetic diversity of any given crop species is a suitable precursor for improvement of the crop because it generates baseline data to guide selection of parental lines and design of a breeding scheme.

Objective of the study:

The early systematic studies of the genus Cajanus were based on phonological or morphological characters, which have been shown to have limited genetic resolution especially at species levels, as is required for pigeonpea.

- **To determine the genetic diversity and relationships within and among pigeonpea landrace accessions**
- **Morphological characterization of pigeonpea accessions/ landraces**
- **Genetic differentiation among populations**

Collection and characterization of pigeonpea landraces



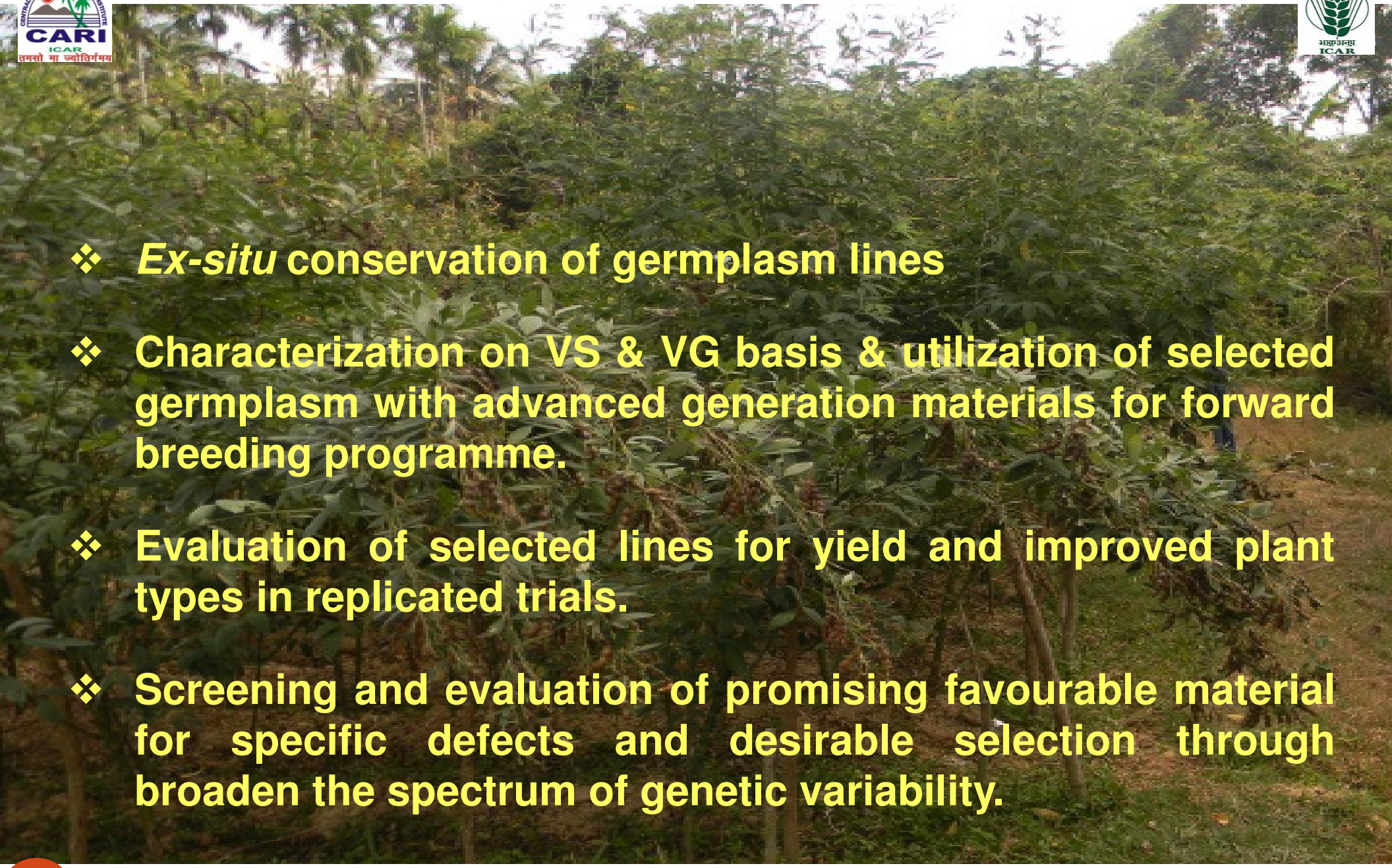
Pigeonpea (*Cajanus cajan* L.)

Crop: Pigeonpea (*Cajanus cajan* L.)	Year of Collection & ex-situ conservation of germplasm			
	2011-12	2012-13	2013-14	Total
Local landraces	26	17	08	51
Procurement of germplasm from others sources (IIPR & SAU's etc.)	18	05	19	42
Total	44	22	27	93

Agro-morphological studies of Pigeonpea landraces and advanced breeding lines

SN	Experiment	No. of Accession	Replication	Year
1.	PGET	78	Augmented	2011-12 2012-13
2.	Mother Trial	52	RBD	2012-13
3	Observation Nursery (IVT)	32	RBD	2013-14

Characterization & utilization of selected germplasm of pigeonpea for Yield Evaluation trials



- *Ex-situ* conservation of germplasm lines
- Characterization on VS & VG basis & utilization of selected germplasm with advanced generation materials for forward breeding programme.
- Evaluation of selected lines for yield and improved plant types in replicated trials.
- Screening and evaluation of promising favourable material for specific defects and desirable selection through broaden the spectrum of genetic variability.

Morphological variations for plant growth and flower types

Morphological variations for plant types, seed colour and seed size

Agronomic performance of landraces and advanced breeding lines based on morphological markers

Genotypes	Days to 50% Flowering	Days to maturity	Plant height at maturity	Number of Branches/ plant	Length of Pods (cm)	100-seed weight (g)	Seed yield per plant (g)	Seed yield per Plot (g)
NA-1	111.22	216.63	203.68	10.46	3.98	11.95	38.62	170
CO-6	143.62	221.88	190.92	11.35	4.37	16.67	46.05	237
Bahar	199.76	227.04	192.37	8.27	3.91	13.40	26.45	132
IPAC-68	146.00	192.00	243.00	23.40	6.68	23.11	106.78	800
IPAC-493	128.00	200.00	260.40	15.40	5.92	18.15	58.55	250
IPA-203	166.00	238.00	303.20	20.40	4.62	21.59	53.96	370
IPA-7-2	168.00	261.00	217.40	16.60	4.96	19.57	38.26	300
IPAC-452	175.00	261.00	242.60	18.00	4.94	20.44	82.22	550
IPA-9F	175.00	261.00	288.20	14.20	5.04	20.44	51.24	475
IPAC-66	176.00	261.00	183.40	9.60	5.22	14.51	32.49	125
IPAC-142	180.00	261.00	225.00	11.40	4.66	15.95	26.39	175
KPBR-80-2-1	166.00	261.00	254.80	15.20	4.28	18.12	30.84	250
IPA-7F	180.00	261.00	236.20	12.80	4.96	19.57	38.26	300
IPAC-451	197.00	261.00	235.80	13.40	5.72	21.12	42.18	375
IPA-8F	177.00	261.00	231.00	11.00	4.44	14.44	41.09	195
IPAC-165	180.00	261.00	248.80	17.20	5.62	13.79	55.73	225
ANP-12-03	128.00	261.00	261.00	16.40	4.26	19.57	33.81	300
BSMP-736	126.00	261.00	257.80	16.40	6.24	13.79	26.98	185
IPAC-12	110.00	261.00	267.00	12.80	4.96	21.00	36.77	350
BSMP-853	177.00	261.00	232.60	12.40	5.88	16.68	31.83	200
ANP-12-05	193.00	261.00	240.40	15.60	6.60	21.66	26.39	175
IPAC-8	96.00	261.00	229.80	14.20	5.76	21.11	26.18	375
IPAC-79	189.00	261.00	238.60	17.00	4.72	21.66	36.77	175
ANP-13-01	152.00	258.00	193.60	10.00	6.58	18.78	74.35	650
ANP-11-13	167.00	258.00	206.20	18.20	4.54	18.77	67.44	650
ANP-11-14	167.00	258.00	207.00	16.40	4.54	21.75	61.09	450

Agronomic performance of landraces and advanced breeding lines based on morphological markers

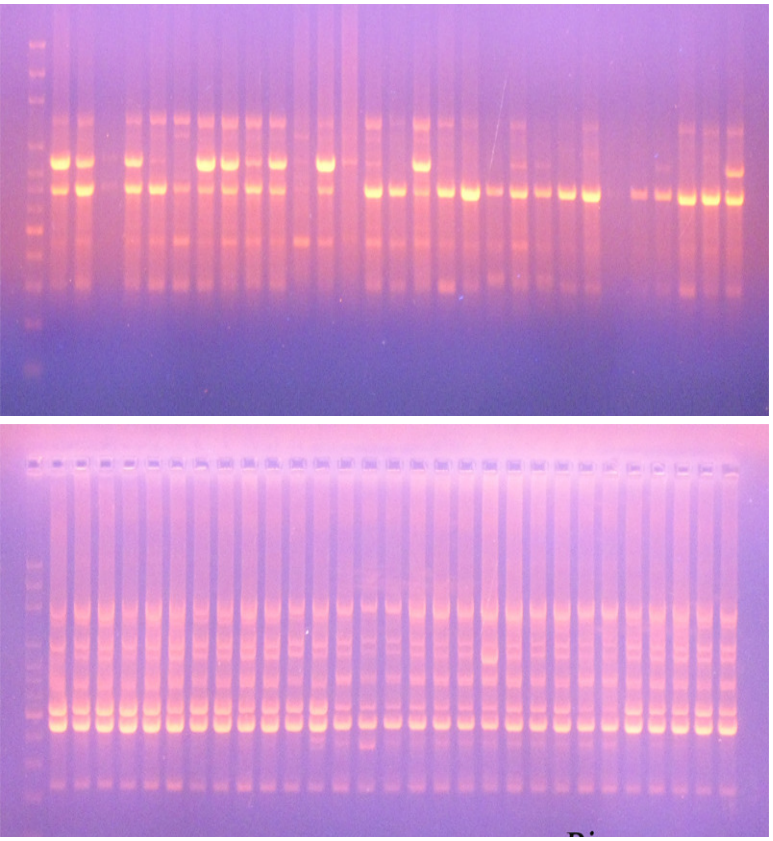
Genotypes	Days to 50% Flowering	Days to maturity	Plant height at maturity	Number of Branches/ plant	Length of Pods (cm)	100-seed weight (g)	Seed yield per plant (g)	Seed yield per Plot (g)
ANP-11-18	182.00	258.00	170.00	12.20	4.68	15.95	31.98	175
ANP-11-19	149.00	258.00	231.80	15.80	4.94	13.00	38.26	375
ANP-12-02	167.00	258.00	212.60	13.40	6.84	17.30	84.59	475
ANP-11-23	179.00	258.00	213.20	12.40	6.76	11.91	47.96	350
ANP-12-09	167.00	258.00	206.40	13.40	6.60	15.95	31.98	175
ANP-13-02	167.00	258.00	229.00	11.00	6.28	21.32	53.61	600
ANP-13-03	152.00	258.00	230.80	11.00	6.20	23.09	56.65	685
ANP-13-04	172.00	258.00	199.60	8.60	6.44	16.02	32.44	180
ANP-11-12	169.00	258.00	171.20	8.60	6.90	18.84	36.32	275
ANP-11-12-1	167.00	260.00	183.20	9.20	6.48	17.40	38.54	225
ANP-11-12-2	152.00	260.00	225.20	11.20	6.26	20.98	62.71	450
ANP-11-24	152.00	260.00	199.40	13.80	4.80	18.12	38.83	250
ANP-12-03	152.00	260.00	219.40	18.20	4.18	14.13	49.08	325
ANP-12-05	175.00	260.00	198.00	13.40	6.58	14.31	27.41	125
ANP-11-32	169.00	260.00	185.80	11.40	4.98	16.68	28.49	200
ANP-11-33	169.00	260.00	167.60	13.60	5.16	13.79	29.13	100
ANP-13-26	156.00	260.00	214.40	16.40	4.30	25.21	34.55	125
ANP-11-27	159.00	260.00	233.00	16.80	3.88	14.44	64.86	150
ANP-11-28	146.00	260.00	196.20	15.60	4.12	19.57	47.45	300
ANP-11-29	155.00	260.00	232.25	15.25	4.14	13.79	32.13	126
ANP-13-30	154.00	260.00	230.67	18.00	4.18	16.68	79.13	376
ANP-13-31	129.00	260.00	213.20	15.60	4.20	16.76	39.57	230
ANP-13-32	146.00	260.00	270.50	12.50	4.30	15.99	51.93	175
ANP-11-36	156.00	260.00	253.00	18.00	4.20	18.13	250.00	250
ANP-11-37	144.00	260.00	251.60	16.60	4.24	18.41	60.09	260
ANP-13-33	192.00	260.00	238.33	17.33	4.20	14.39	65.46	125

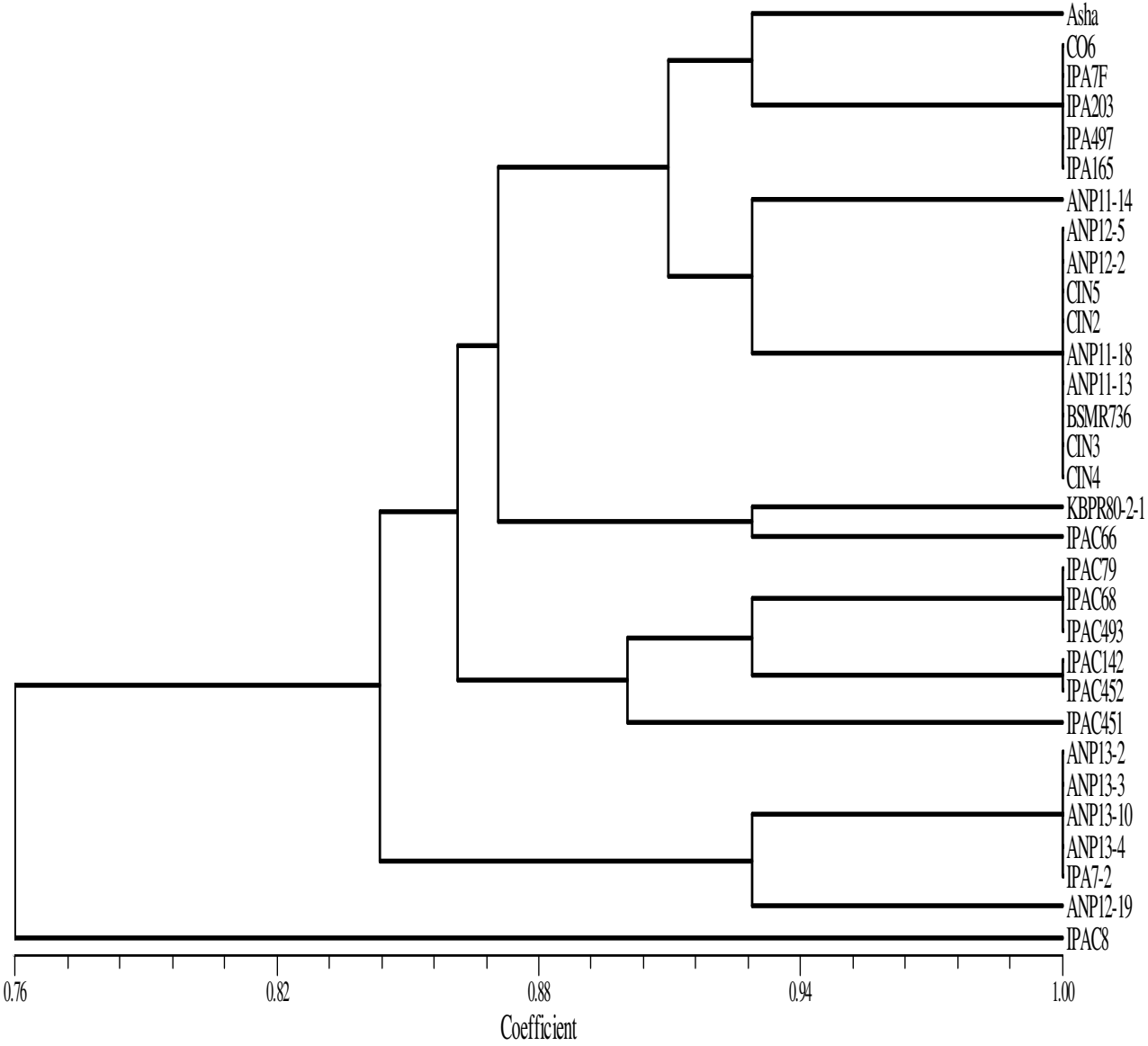
Molecular characterization landraces and advanced breeding lines based on RAPD markers

List of RAPD primers used for RAPD profiling

S.N.	Primer name	Primer sequence	No. samples/ No. samples amplified	Total No. bands	Range of marker(kb)	% polymorphism	PIC
1.	OPG03	GAGCCCTCCA	48/48	253	0.2-1.4	3.16	0.223
2.	OPG04	AGCGTGTCTG	48/42	112	0.3-1.4	10.70	0.494
3.	OPG05	CTGAGACGGA	48/46	124	0.35-1.4	10.40	0.497
4.	OPG06	GTGCCTAACC	48/22	75	0.2-1.4	25.33	0.313
5.	OPG07	GAACCTGCGG	48/19	65	0.2-0.8	23.07	0.265
6.	OPG08	TCACGTCCAC	48/47	163	0.35-0.7	5.52	0.430
7.	OPG10	AGGGCCGTCT	48/16	79	0.2-1.4	18.98	0.235
8.	OPG11	TGCCCGTCGT	48/24	92	0.3-1.2	20.65	0.365
9.	OPG14	GGATGAGACC	48/36	144	0.4-1.2	8.72	0.499
10.	**OPG15**	**ACTGGGACTC**	**48/23**	**96**	**0.3-1.2**	**14.58**	**0.453**

Molecular characterization landraces and advanced breeding lines based on RAPD markers





Identification of Promising pigeonpea lines for YET under Initial varietal trial

Genotypes	Days to 50% flowering	Plant height (cm) at maturity	Days to maturity	Number of branches/ plant	Length of Pods (cm)	100-seed weight (g)	Seed yield per plant (g)
ANP-13-01	152	193.60	228	10.00	6.58	18.78	74.35
ANP-11-13	167	206.20	239	18.20	4.54	18.77	71.44
ANP-12-02	167	212.60	247	13.40	6.84	17.30	84.59
ANP-11-12-2	152	225.20	260	11.20	6.26	20.98	69.71
ANP-11-27	159	233.00	246	16.80	3.88	14.44	66.86
ANP-13-30	154	230.67	263	18.00	4.18	16.68	79.13
ANP-11-36	156	253.00	239	18.00	4.20	18.13	250.00
IPAC-68	146	243.00	192	23.40	6.68	23.11	106.78
IPAC-452	175	242.60	245	18.00	4.94	20.44	82.22
Mean	162.8	226.76	232.69	14.13	4.29	17.74	55.69
CD (Geno. x Control)	61.13	70.31	19.06	17.79	0.95	1.94	9.47
CV (%)	17.82	5.53	6.10	12.65	6.61	12.41	22.17






Thanks
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